Interannual Carbon Stocks in Eelgrass Areas Around Mt. Desert Island: Implications for Eelgrass Protection and Restoration in Maine

Holmes, D.[1], Hooper, M.[2], Schnorr, M.F.[2], Johnson, B.[3], Farrell, A.[4], Disney, J.E.[4]

[1]Mercyhurst University, Erie, PA, [2]University of Maine, Orono, ME, [3]Bates College, Lewiston, ME, [4]MDI Biological laboratory, Salisbury, Cove, ME

Introduction

- *Zostera marina*, eelgrass, is an important part of marine ecosystems around the world.
- Eelgrass has experienced significant worldwide decline, including the area around Mt. Desert Island (MDI), Maine.
- Eelgrass sequesters carbon, removing it from the atmosphere during photosynthesis and storing it in ocean sediments.
- In 2015, we determined the percent total carbon and dry bulk density in above ground biomass, below ground biomass, and sediments in five remaining eelgrass areas.
- The majority of stored carbon was found in the sediment (Figure 1). Sediments from sites that had not recently lost eelgrass (Bar East, Wonderland, Ship Harbor) had significantly higher carbon compared to sites that had recently lost eelgrass (Bar West, Hadley Point).

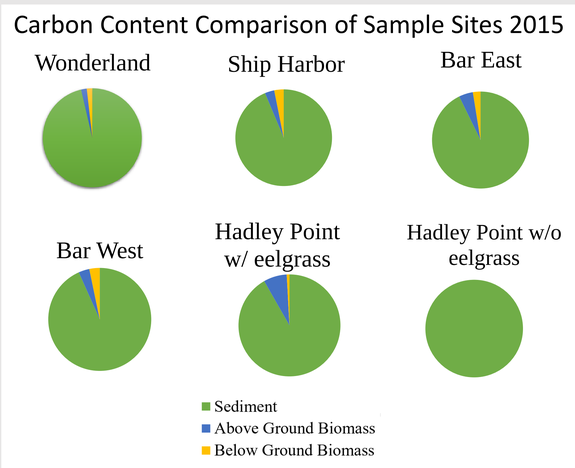

Figure 1. Each pie chart represents the average total carbon for each sampling site in Mg of Carbon/Hectare.

Objectives

- Resample sediment in the same five areas to find inter-annual variation in carbon stock.
- Assess correlation between plant density and carbon stock.

Methods

- Collected six 30 cm sediment cores at five sites around MDI.
- Measured plant density using 25 x 25 cm quadrats.
- Sent samples for Carbon Analysis to the University of Maine Analytical Soil Testing Lab.
- Mapped eelgrass bed area by using GPS units to collect coordinates and mapping in ArcGIS.
- Calculated 2016 carbon stock and inter-annual variation in carbon stock for 2015-2016.

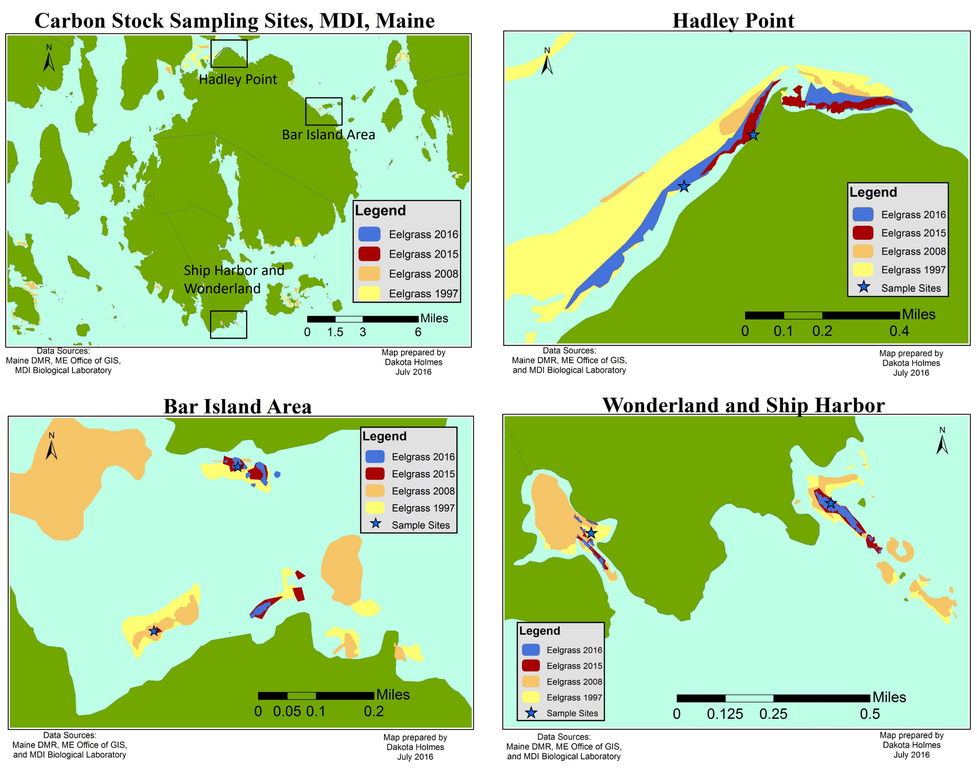

Figure 2. ArcGIS maps depicting past and present eelgrass extent, as well as carbon sampling sites around MDI, 2016. Eelgrass has declined significantly in all areas since 1997. From top left: carbon stock sampling sites around MDI are outlined by boxes. Eelgrass and carbon stock sampling sites at Hadley Point, Bar Island, and Wonderland and Ship Harbor.

Results

- Eelgrass density and carbon stock are significantly and positively correlated (Figure 3).
- The carbon stock for both 2015 and 2016, in areas with thriving eelgrass, is significantly different from areas that have experienced eelgrass loss.
- There was no significant difference in carbon stock between 2015 and 2016 (Figure 4).

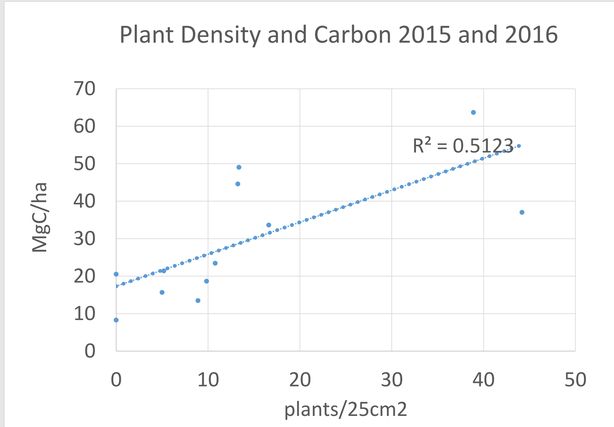

Figure 3. Plant density and carbon stock are positively correlated in 2015 and 2016. Pearson correlation coefficient is 0.715729 and p=0.009.

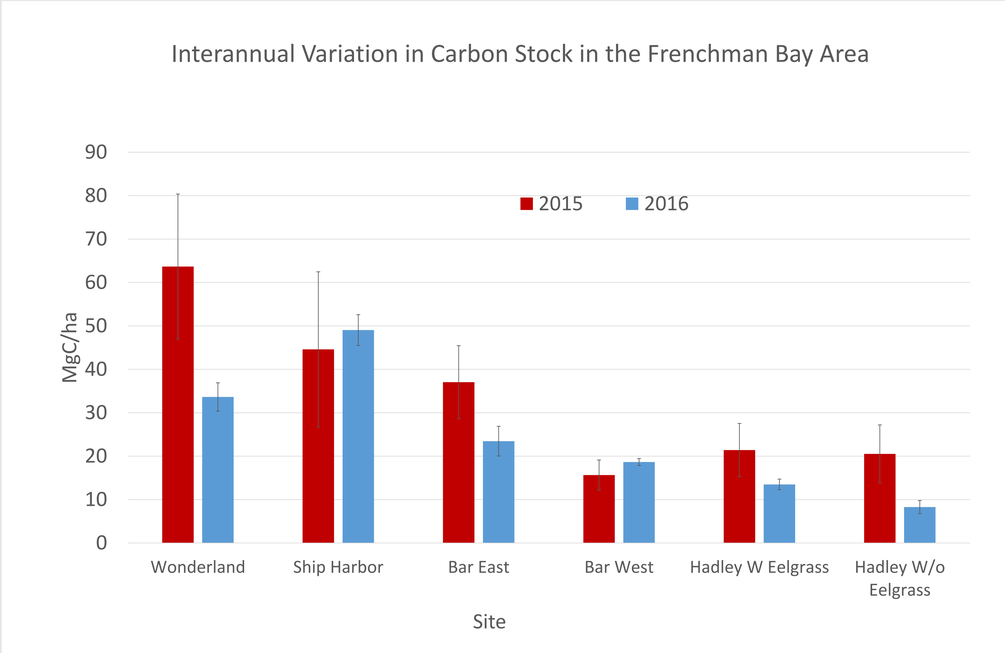

Figure 4. Carbon stock in areas around Frenchman Bay and MDI. There is no significant difference between 2015 and 2016 at any site. Wonderland, Ship Harbor, and Bar East have significantly higher carbon stocks than Bar West, and Hadley Point with and Hadley Point without eelgrass. Hadley Point has significantly higher carbon stock in areas with than without eelgrass in 2016.

Conclusions

- Healthier eelgrass beds store carbon in larger amounts than declining beds.
- Carbon stock is higher in restored eelgrass areas as compared to areas without eelgrass, indicating that carbon stocks are restored where eelgrass is restored.
- Eelgrass loss over a short period of time negatively impacts carbon stock. It is important to protect and restore eelgrass to prevent the loss of sequestered carbon.

Future Directions

- Analyze organic carbon in the cores to help determine specific sources of carbon.
- Date sediment carbon to determine a carbon sequestration rate for Frenchman Bay.
- Protect and restore eelgrass in Maine because of its role in carbon sequestration.

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