Frenchman Bay Eelgrass Meeting
9-3-2014
MDIBL Davis Classroom
3-5 pm

Present: Terry Towne, Jenn Fortier, Chris Petersen, Anna Farrell, Jirias Charabati, George Kidder, Jane Disney, Hamish Stevenson, James O'Donnell.

We started with introductions. Terry represents Maine Coast Heritage Trust, Chris Petersen, College of the Atlantic professor and vice-president, Frenchman Bay Partners, Anna Farrell and Jirias Charabati are both AmeriCorps Environmental Stewards at MDIBL, George Kidder and Jane Disney are staff scientists at MDIBL working in the Community Environmental Health Laboratory, and Hamish Stevenson and James O'Donnell are MDIHS students who are working with Billy Helprin at Maine Coast Heritage Trust and who are interested in doing independent study work in Environmental Science.

1. George Kidder presented his work on side scanning sonar. He presented background on how side scanning sonar works as well as recent results. The handouts are appended to these minutes.

The raw readout from the Lowrance system shows the result of 10,000 "pings" through the transducer. The computer program being used to analyze the scans is from the Army Corps of Engineers. It allows for the calculation of percent cover and canopy height. The program can correct for tide height. Then, coordinates can be exported to GIS and visualized on a map. Points are colored according to plant density. An example from near Stave Island shows that some eelgrass is present where it was mapped historically. The ultimate goal is to be able to map eelgrass around the bay each year using this system.

2. Jane presented an overview of the summer. Handouts are appended to these minutes.

Jane discussed the need to report out our progress in some way that is accessible to people. All of our work may not be publishable in peer reviewed journals but will still be important for partners to see.

She set the context of the work in summer 2014. Last summer (2013) eelgrass did not come up in the upper bay. The reasons are still unknown. It may have been a variety of stressors including green crabs. Then winter 2013-2014 was very cold and may have killed off a lot of green crabs.

Eelgrass was transplanted in 5 areas in upper Frenchman Bay. The first restoration project took place in Berry Cove. Four 8 ft. x 32 ft. crab exclusion fences were constructed in the water. Grids were placed inside and outside of the exclosures. We will be checking in on the status of plants this fall.

We did some incidental trapping, and since crab numbers seemed low, we did not construct fences at other sites during the summer.

Funding from Army Corps of Engineers has not been released. State partnership in the eelgrass restoration work is being required; the state must co-sign a cooperative agreement or Army Corps will withdraw the grant. While trying to sort this out, MDIBL moved forward with project partners.

We tried using two different wooden biodegradable grids this year. One had a wooden frame with strings with ties for securing eelgrass. The other had a wooden frame with burlap into which eelgrass was woven.

In addition to deploying wooden grids with eelgrass at Berry Cove, Hadley Point, Thomas Island, Jordan River, and Goose Cove, other methods were tested. “Restoration runners” made of burlap weighted with sandbags were deployed at Hadley Point and in Jordan River. Eelgrass was tied onto metal washers and dropped at Hadley Point and in Jordan River as well. We tried tying eelgrass onto rocks and dropping in Goose Cove in Trenton.

Anna presented “Restoration By the Numbers”, including how many volunteers, volunteer hours, grids, and plants were involved in restoration this summer.

Jane reviewed the work of two interns at the Community Environmental Health Laboratory.

Alden Dirks studied the eelgrass from sites around MDI and tried to find anything that would tell us why eelgrass is so abundant and doing so well in outer parts of Frenchman Bay but not in upper Frenchman Bay. He compared plant abundance, biomass, composition, and tensile strength. He found that these attributes varied among sites. He looked at the correlation between these attributes and water quality variables. The only significant correlation that he found was between plant biomass and nitrate levels in the water column.

Because silicate seemed to be lower in the upper bay in the last several years, it was hypothesized that there might be a relationship between plant abundance or plant biomass, or even tensile strength of plants and levels of silicate in the water column or in the plant tissue itself. But these correlations were not found. An abstract of Alden’s work is attached to these minutes.

In a tank experiment, where silicate (in the form of wollastonite) was added to three tanks with eelgrass and not to three control tanks, no difference was seen in plant strength, or biomass, or rhizome and root biomass. There was no difference in silicate levels in the water column either, despite additions of wollastonite. We are waiting to find out if there are differences in the amount of silicate in the plant tissue. This was a short term study that may require more time. Alden and Mary mapped eelgrass in all of their study sites. It was suggested that areas without eelgrass be mapped as well, or that we create a frame around the area in which mapping was done, so that in the future we know if the mapped area was the full extent of the eelgrass or just the area studied.

Jane mentioned that dried plant material will be sent off for analysis of cellulose and lignin, which are indicators of plant strength. We will see if levels correlate with tensile strength, or can in any other way explain the success of eelgrass in some areas but not others.

On a positive note, eelgrass seedlings are coming up around Hadley Point. This might mean that eelgrass can come back in an area even after being absent for a full year.

Mary Badger studied the genetics of green crabs from around MDI and found that both northern and southern varieties of green crabs could be found at all locations and that there was no correlation between the proportion of crabs with northern haplotypes and eelgrass abundance. An abstract of her work is attached to these minutes.

In order to assess whether differences in eelgrass abundance could be attributed to crab abundance, a crab survey was conducted in the last week in all of the eelgrass study sites around MDI. Preliminary results show that crab abundance does not seem to influence eelgrass abundance or biomass. Preliminary data are attached to these minutes.

3. Jane then presented Anecdata.org and encouraged everyone to use the website to initiate projects, add to existing projects, etc.

4. Next Steps:

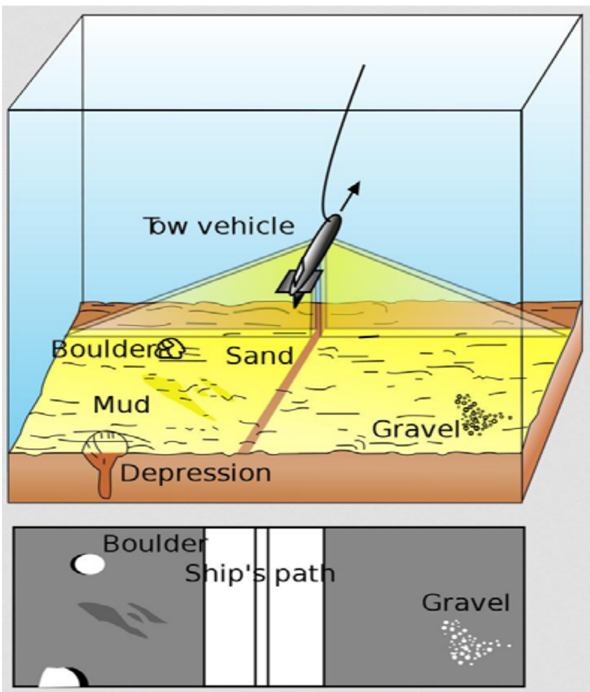
a. The fencing will be removed from the Berry Cove restoration site next week. The plants on several grids from inside and outside of fenced areas will be assessed. Chris P. suggested looking at crab numbers inside and outside of the fence before removing the fencing. If eelgrass looks good inside and outside of the fences, we will skip the crab trapping effort.
b. In order to assess whether seedlings at Hadley Point are truly seedlings and not coming up from rhizome remnants, we will take a closer look at the area. We plan to determine shoot density in the area as well. Chris suggested planting some seeds in a test plot and seeing if the seedlings look like the shoots we have at Hadley Point. This may help us determine the source of these shoots at Hadley Point.
c. We will communicate with mussel harvesters to appreciate their cooperation, let them know that shoots can come up even after a year with no growth, so that eelgrass areas without eelgrass also need to be protected.
d. We will frame in eelgrass areas on GIS maps so that we know the extent of our mapping efforts in 2014.
e. We may present findings at the Acadia Science Symposium in October.
f. Jane will follow up on the Army Corps Grant

Notes for Presentation

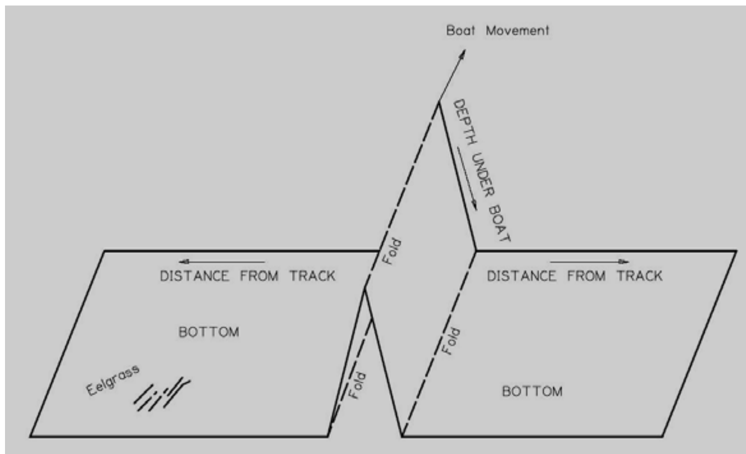
Side-Scan Sonar

George Kidder
Sept. 3, 2014

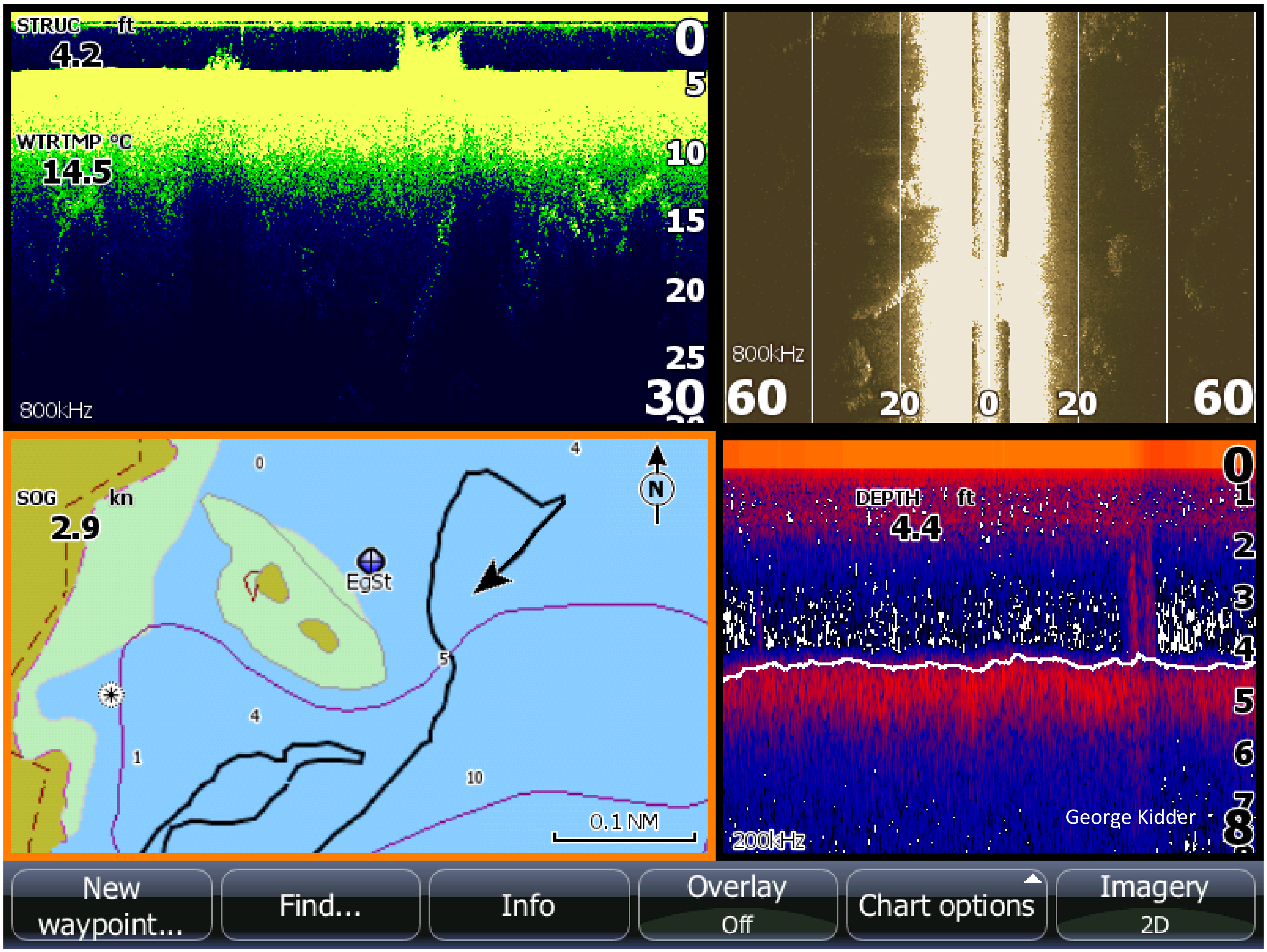
Cartoon

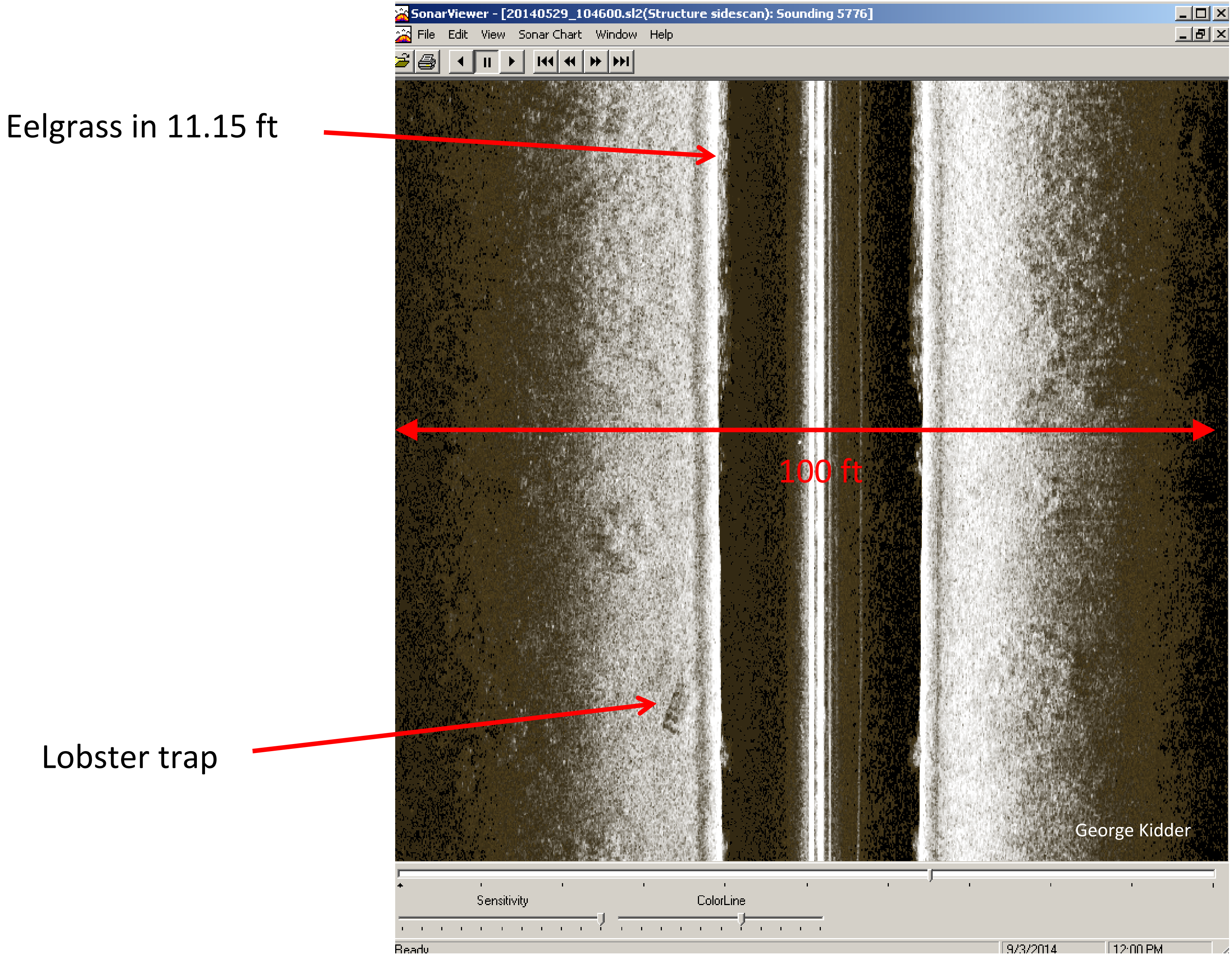


Visualizing image



Lowrance HDS 10 screenshot from back of Stave Island





Eelgrass in 11.15 ft
Lobster trap
SonarViewer - [20140529_104600.sl2(Structure sidescan): Sounding 5776]
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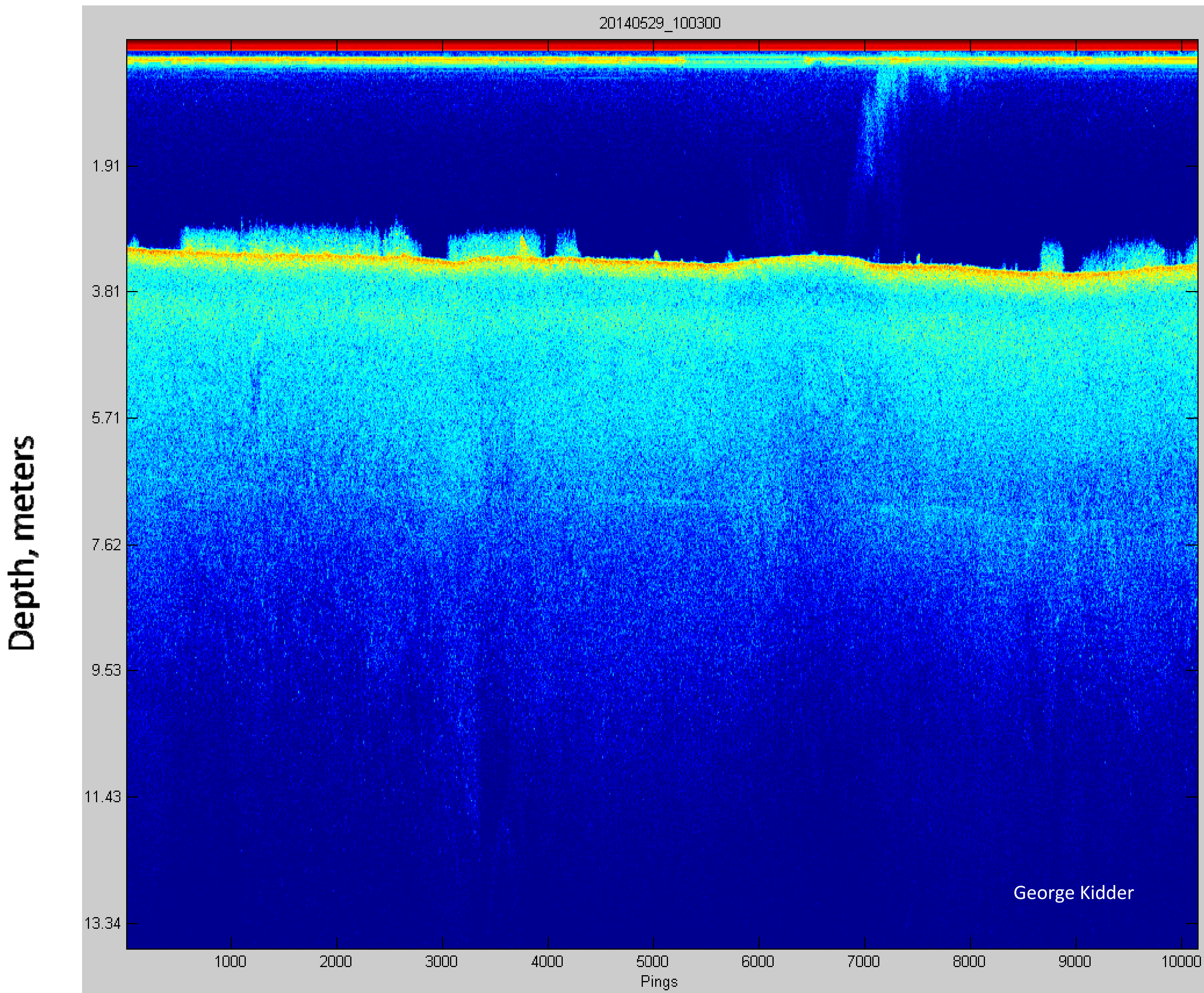
View
Sonar Chart
Window
Help
100 ft
George Kidder
Sensitivity
ColorLine
Ready
9/3/2014
12:00 PM


20140529_100300
Depth, meters
1.91
3.81
5.71
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9.53
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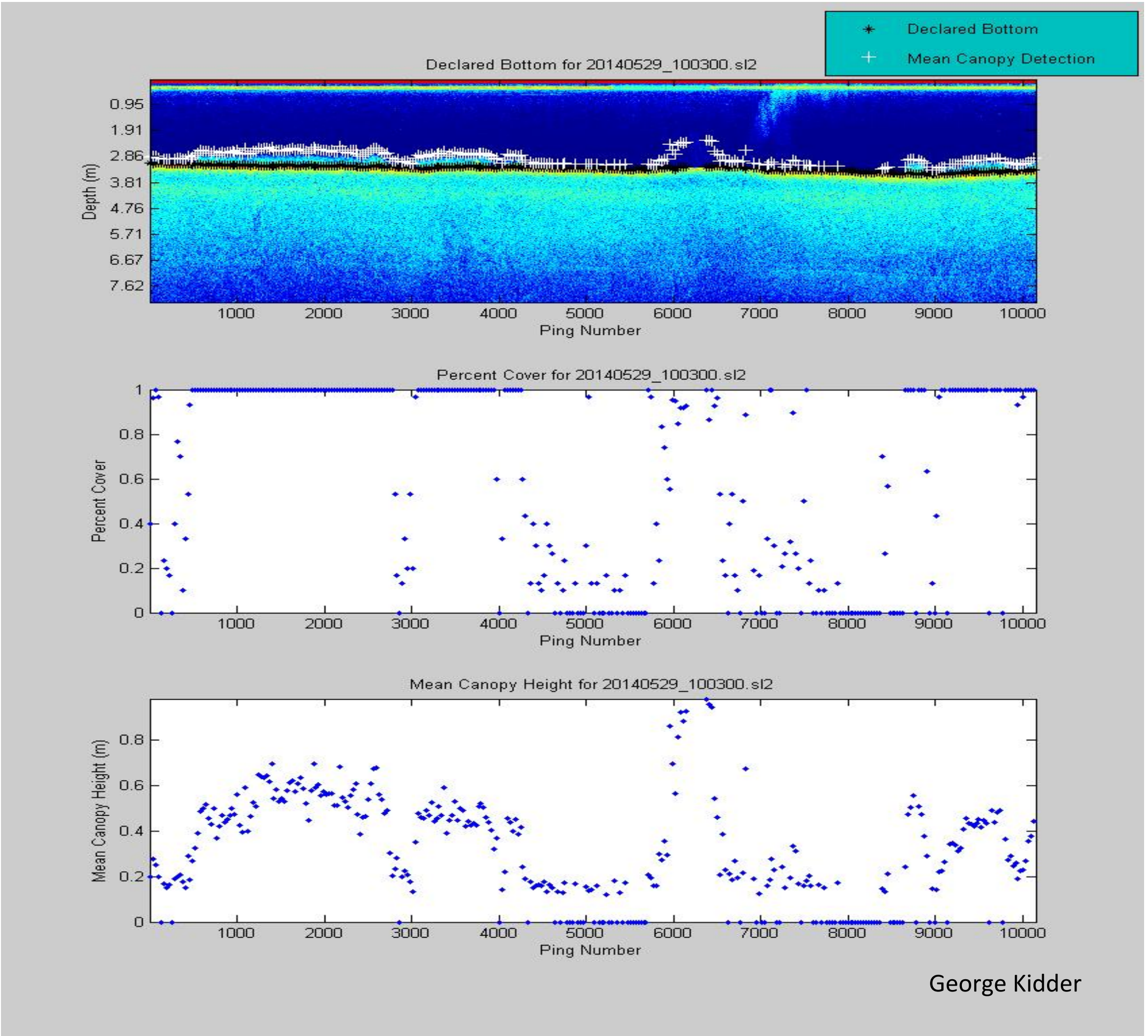
Pings
George Kidder

SAVEWS Jr. Output

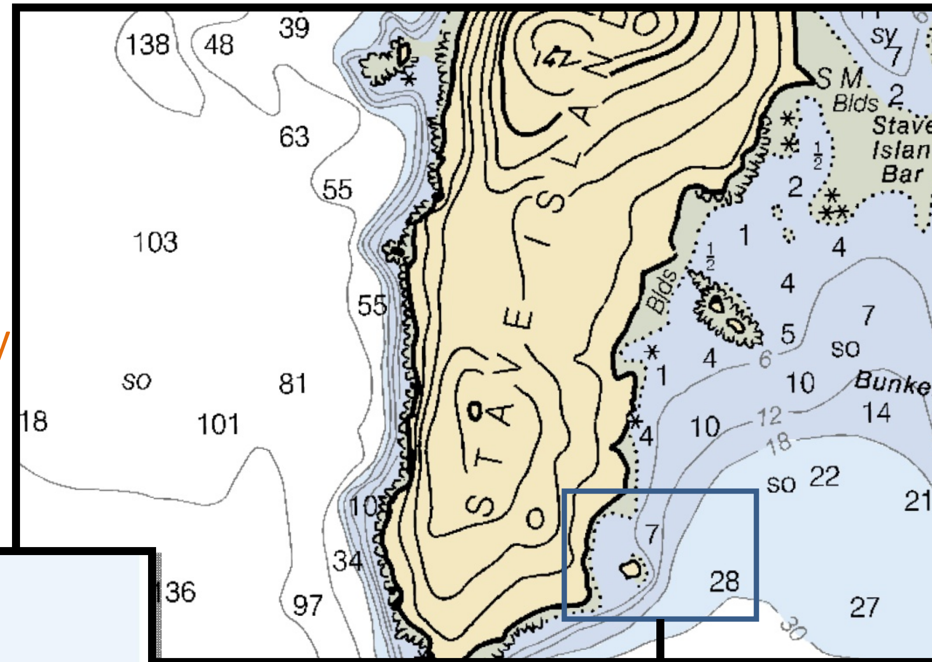


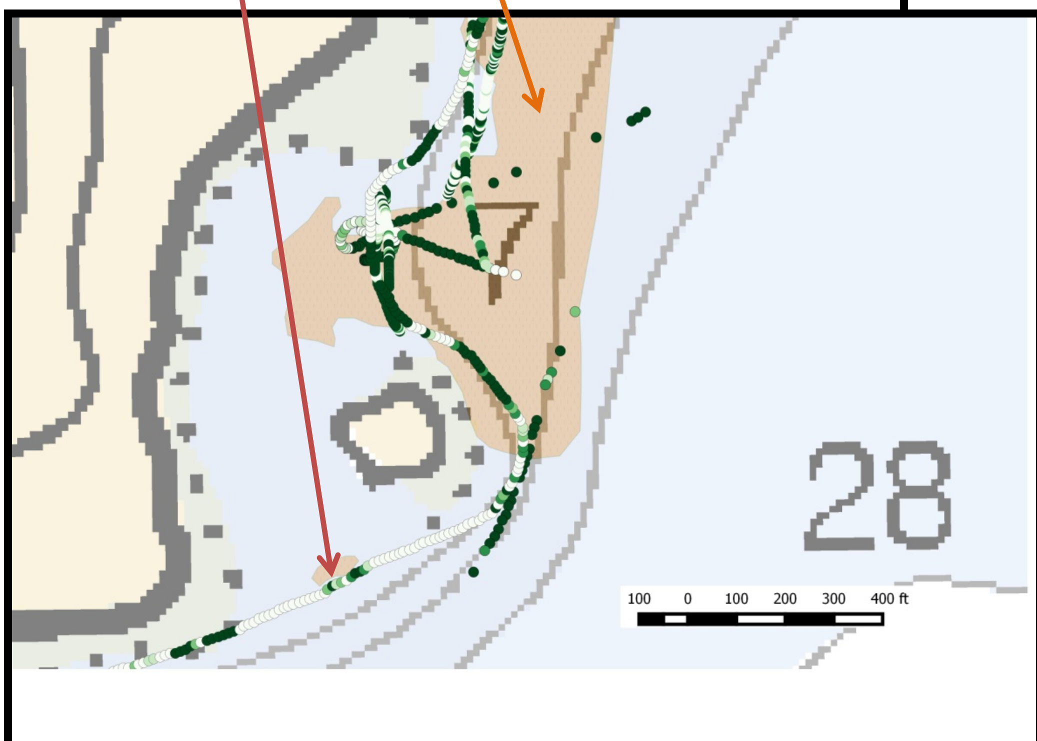
Percent cover

Canopy height

Stave Island (Gouldsboro) Harbor

Eelgrass coverage by aerial photography 2008





Shipyard Cove

George Kidder

Eelgrass Research and Restoration in Frenchman Bay 2014

Introduction

Eelgrass has been declining in Frenchman Bay since it was originally mapped by Maine DMR in 1996. A variety of community partners have been working together to restore eelgrass in the bay since 2007. At the end of 2012, all eelgrass died back in upper Frenchman Bay and did not re-emerge throughout the entire 2013 growing season. This included restored eelgrass as well as naturally occurring eelgrass. There was speculation that warming temperatures combined with expanding invasive green crab populations was responsible for the wholesale loss of eelgrass.

At the start of 2014, green crab populations seemed to be low in number. It was thought that an exceptionally cold winter might have decreased the numbers of green crabs.

Scientists, AmeriCorps Environmental Stewards and college interns at the MDIBL Community Environmental Health Laboratory worked with Maine Coast Heritage Trust and numerous community volunteers to restore eelgrass in upper Frenchman Bay throughout the summer of 2014. Eelgrass was harvested from the subtidal area of Stave Island, which hosts an expansive eelgrass bed. In all, 8,000 vegetative eelgrass plants were transplanted into five different areas of upper Frenchman Bay, including **Berry Cove, Hadley Point, Thomas Island, Jordan River, and Goose Cove in Trenton**, using a variety of old and new methods.

For the first restoration effort, which took place in May in Berry Cove, four crab fences were constructed in the subtidal area. Wooden frames with twine or burlap were used to transplant eelgrass both inside and outside of the fences. Eelgrass appeared to do well in both locations, so subsequent eelgrass restoration efforts did not include construction of crab fences.

Collecting Eelgrass at Stave Island

Why is eelgrass thriving at Stave Island and other locations around MDI and not in upper Frenchman Bay?

Eelgrass Here and There

Eelgrass continues to do well at outer island sites despite warming trends in the Gulf of Maine and high green crab numbers. We attempted to determine what is different at Stave Island, the east side of Bar Island, at Wonderland and Ship Harbor in Acadia National Park, as compared to upper Frenchman Bay. We looked at water quality, plant strength, plant abundance, density, biomass, and composition, and green crab type and abundance. We are looking at the relationship between variables in an attempt to understand eelgrass loss.

Eelgrass Restoration Methods: 4 new methods tried.

In order to transplant eelgrass into the subtidal area, plants were first tied onto wood frames with string or woven into wood frames with burlap. More time and effort were required up front to construct grids with string and make ties from floral tape. More time and effort was required to weave plants into burlap on the shore. We attempted to move away from grids altogether by trialing a burlap “restoration runner” weighted with sandbags approximately every 12 inches. Up to 84 plants were woven into runners that were 7 feet long. One runner was placed at Hadley Point and two runners were placed at Jordan River in July. Another method that was tried involved tying eelgrass to metal washers. These were dropped at Hadley Point and in Jordan River in July. In an attempt to move from the potential environmental impact of metal washers and decrease the cost of restoration, we tied eelgrass to small rocks and dropped them in Goose Cove in August.

2014 Methods:
To date, we have used frames with eelgrass tied to strings, frames with eelgrass woven into burlap, burlap without frames with eelgrass woven in, eelgrass tied to washers, and eelgrass tied to rocks. We are working on a seeding method. Seeding plants have been collected and are maturing in a flow-through seawater tank.

Eelgrass by the Numbers--Anna Farrell September 3rd, 2013

Volunteers

- Total numbers
  - Volunteers: 128
  - Hours: 678 hours

Grids

- Total built:
  - String: 355
  - Burlap: 220
- Total deployed in restoration efforts
  - String: 153
  - Burlap: 174

Eelgrass Plants

- Total transplanted: 8,060
- Transplant by site:
  - Berry Cove: 1860
  - Hadley Point (and Thomas Island): 2540 and 2220
  - Goose Cove: 600
  - Jordan River: 800
  - Some used in various experiments regarding methodology

Other Methods

- Runners:
  - 3 burlaps runners deployed during summer restoration, with about 88 plants/runner.
  - Deployment sites:
    - Hadley Point: 1
    - Jordan River: 2
- Washers:
  - 203 deployed during summer restoration
  - Deployment sites:
    - MDIBL Dock: 46
    - Hadley Point: 100
    - Jordan River: 57
- Rocks:
  - 250 rocks, 1-3 plants per rock. Generally, one plant was tied on per rock. We collected 600 plants for this restoration.

Eelgrass (*Zostera marina* L.) loss in Maine:
An investigation into possible causes

Alden Dirks, Swarthmore College

Abstract

Eelgrass (*Zostera marina* L.) supplies myriad ecosystem services that make it an indispensable cornerstone of coastal environments. The complete disappearance of eelgrass in upper Frenchman Bay, Mt. Desert Island (MDI), Maine, in 2013 matched a precipitous drop in the concentration of dissolved silica (DSi). Eelgrass in outer Frenchman Bay and other locations around MDI appeared to be intact; however there were no DSi data to compare with upper Frenchman Bay locations. To investigate the relationship between eelgrass health and DSi, we determined eelgrass abundance and biomass at six locations around MDI. Furthermore, we measured dissolved nutrient concentrations in the water column as well as tensile strength and nutrient composition of tissue samples. We found a positive relationship between eelgrass abundance and biomass, and a positive relationship between biomass and the concentration of nitrite and nitrate. In addition, tensile strength was significantly different across the six sample sites. However, neither abundance nor tensile strength was significantly correlated with nutrient composition of the plants or water quality. These results reveal a deeper complexity to the issue of eelgrass abundance and tensile strength that requires further nuanced investigation into other factors such as local geography, oceanographic currents, and sediment type as they relate to eelgrass viability.

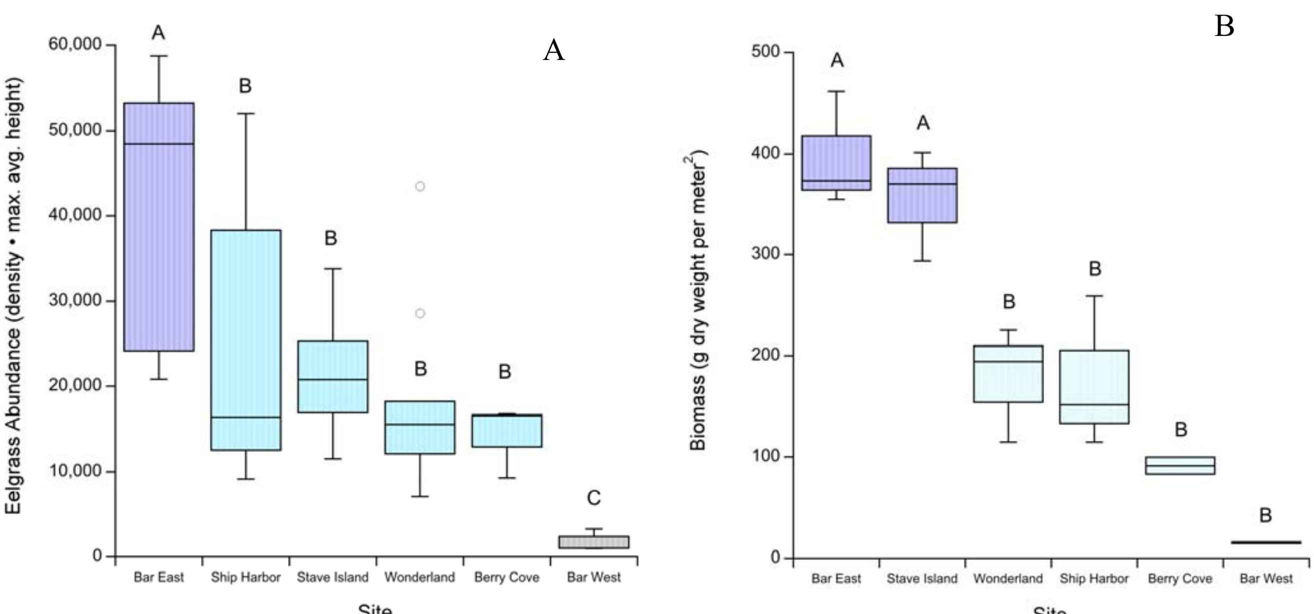


Figure 1. Eelgrass abundance (**A**) and biomass (**B**) differed significantly across sample sites. The boxplots show the median, the first and third quartiles, and the lower and upper extremes. Different letters indicate significant differences between means. Four data points from Bar East were excluded in the eelgrass abundance analysis; an outlier taken from the edge of a patch and the last three data points were removed to equalize sample sizes.

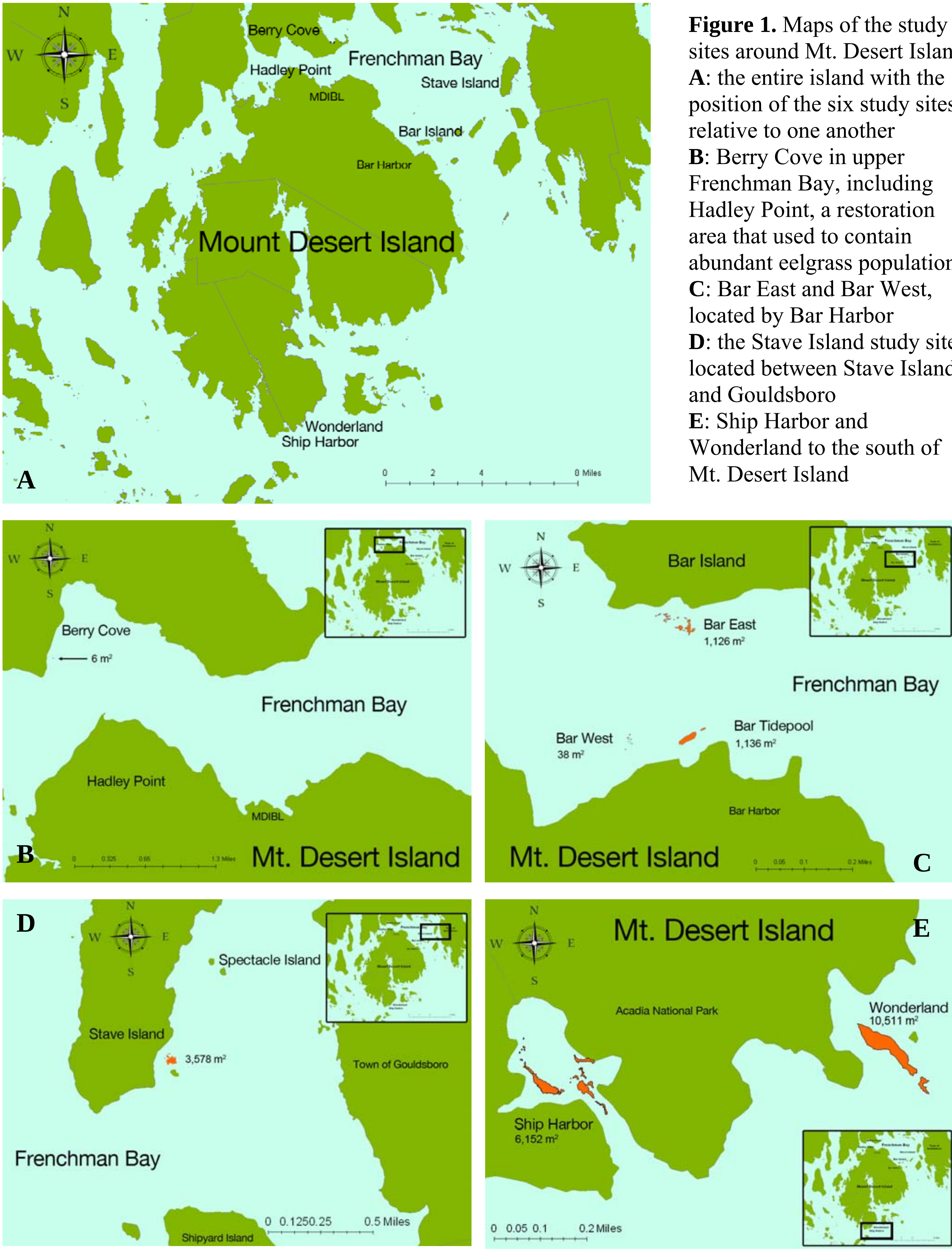


Figure 1. Maps of the study sites around Mt. Desert Island. **A**: the entire island with the position of the six study sites relative to one another **B**: Berry Cove in upper Frenchman Bay, including Hadley Point, a restoration area that used to contain abundant eelgrass populations **C**: Bar East and Bar West, located by Bar Harbor **D**: the Stave Island study site, located between Stave Island and Gouldsboro **E**: Ship Harbor and Wonderland to the south of Mt. Desert Island

Table 1. The relationships between variables, including eelgrass abundance, biomass, nutrient composition, water quality, and tensile strength were tested. Significant ($P \leq 0.05$) and weakly-significant ($P \leq 0.11$) relationships are listed below by ascending p-value.

Eelgrass biomass and abundance comparison		*Correlation*	*p-value*
Biomass	Abundance	0.8681	0.0249
Biomass	Nitrate + Nitrite	0.86	0.028
Log (abundance)	Ammonium	-0.8341	0.039
Log (abundance)	Total Inorganic Nitrogen	-0.7862	0.0637
Log (abundance)	Phosphate	0.7783	0.0683
Log (biomass)	Ammonium	-0.7529	0.084
Log (abundance)	DSi	0.7386	0.0936
Biomass	Tensile strength	0.7155	0.1099

Tensile strength comparison		*Correlation*	*p-value*
Tensile strength	Fe	-0.8076	0.052
Tensile strength	Ammonium	-0.7259	0.1024
Tensile strength	Biomass	0.7155	0.1099

Water quality and nutrient composition comparison		*Correlation*	*p-value*
Total Inorganic Nitrogen	N	0.8691	0.0246
Nitrate + Nitrite	Biomass	0.86	0.028
Total Inorganic Nitrogen	DSi	-0.8509	0.0317
Ammonium	N	0.8394	0.0366
Ammonium	Log (abundance)	-0.8341	0.039
Ammonium	DSi	-0.8303	0.0407
Total Inorganic Nitrogen	Log (abundance)	-0.7862	0.0637
Phosphate	Log (abundance)	0.7783	0.0683
Phosphate	Mn	-0.7773	0.0689
Ammonium	Log (biomass)	-0.7529	0.084
DSi	Log (abundance)	0.7386	0.0936

Population Genetics of the Invasive European Green Crab, *Carcinus maneas* and its Role in Eelgrass Loss in the Gulf of Maine

Mary Badger, Smith College

Abstract

In 2013, there was a devastating loss of eelgrass (*Zoestra marina*) in upper Frenchman Bay, Mount Desert Island, Maine. This study examined the relationship between the most recent invasion of novel haplotypes of the European Green Crab (*Carnicus maneas*) and the decline of eelgrass in upper Frenchman Bay. While *C. maneas* is an invasive species that has been present in the Gulf of Maine for over 100 years, a second invasion of *C. maneas* in Nova Scotia occurred during the 1980s and 1990s, bringing novel haplotypes of the species that have been cited to be more cold tolerant and voracious as compared to other haplotypes. The presence of these new haplotypes has been hypothesized to be a contributing factor to habitat destruction along the Maine coast. In 2013, northern haplotypes of green crab were documented in upper Frenchman Bay where the eelgrass had disappeared. In order to assess this relationship, the cytochrome oxidase I (COI) haplotype of the crabs at sites around Mount Desert Island was determined as well as the abundance of the eelgrass at corresponding study sites. The study did not find a significant correlation between the presence of northern green crab haplotypes and eelgrass abundance at the study sites. This indicates that the status of eelgrass health is not dependent on the genetic composition of green crabs that are present. It is more likely that factors such as green crab abundance or water quality are contributing to the declining health of Eelgrass beds along the Maine coast.

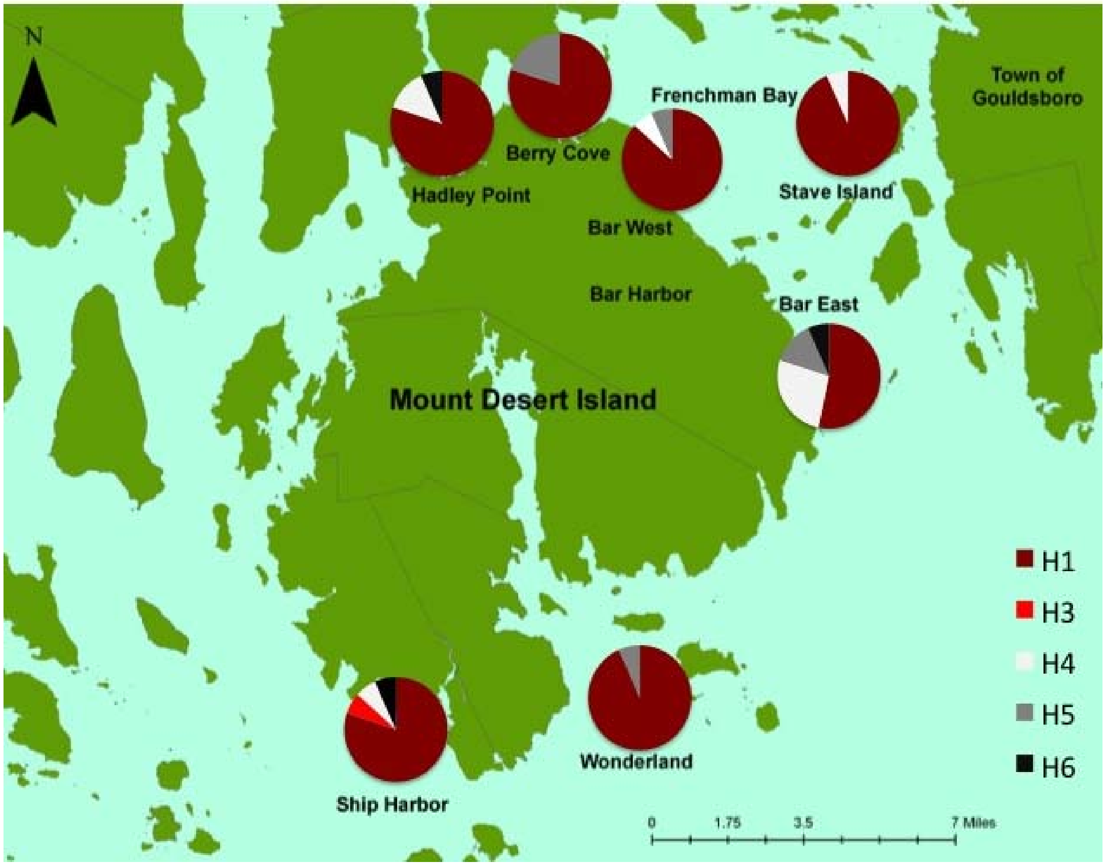


Figure 1. *C .maenas* haplotype frequencies of a 500 bp region of the cytochrome oxidase I gene (n=15 per site). Pie charts indicate proportion of haplotypes found from each population. Haplotypes in Dark red, red and Orange are of the southern variety; haplotypes in black grey and white are of the northern variety

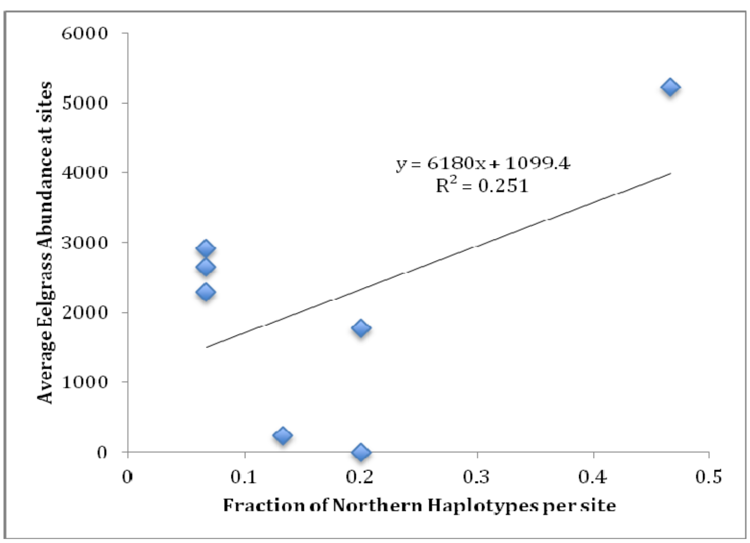
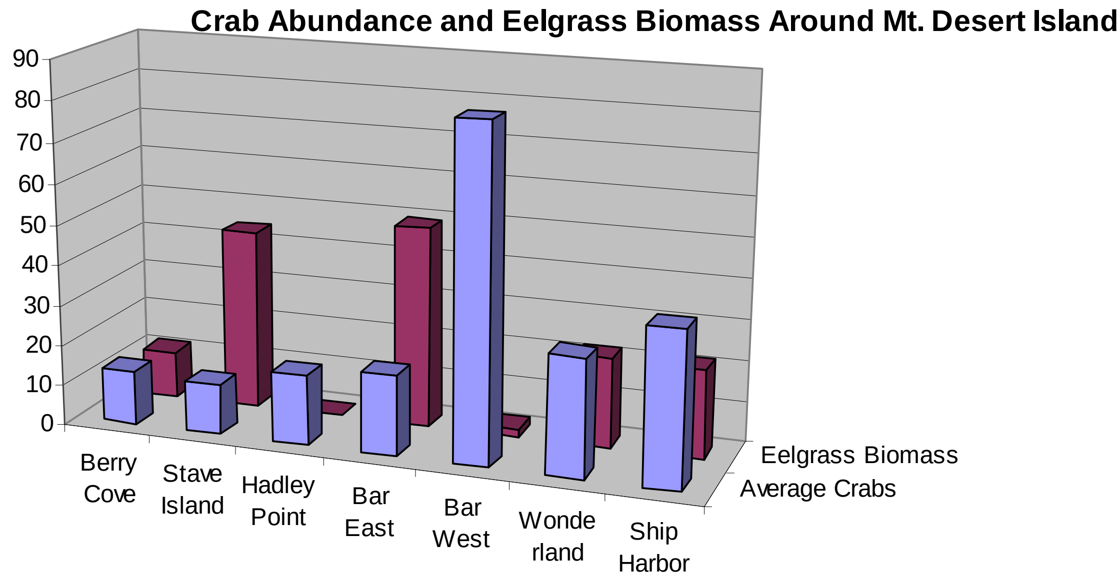
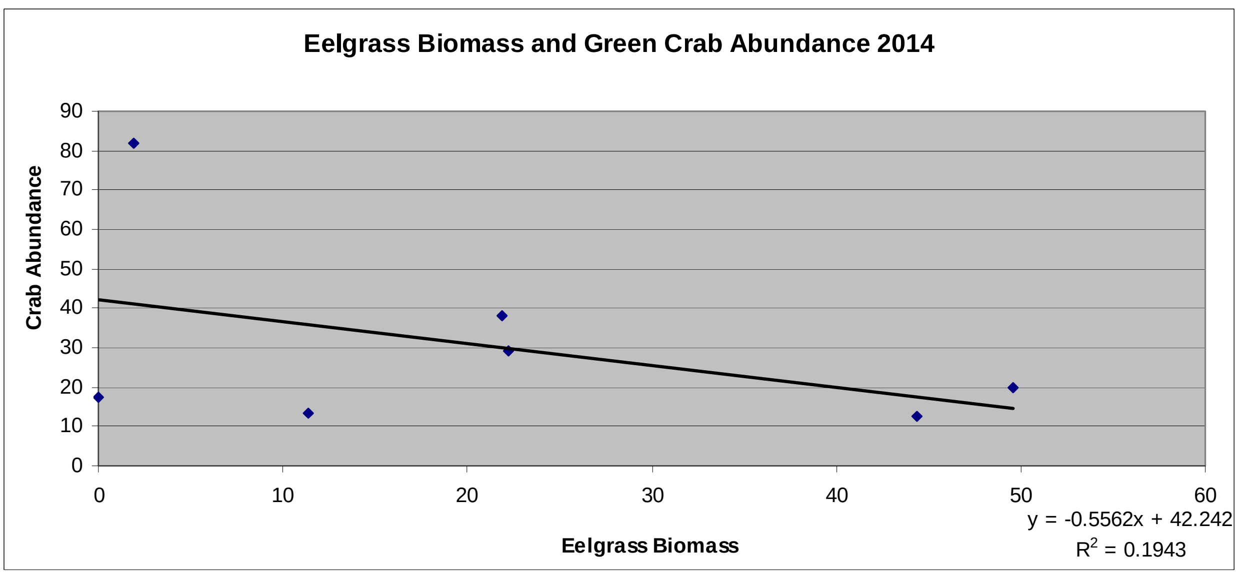


Figure 2. Average eel grass abundance at study sites (average number of vegetative and flowering shoots per meters squared * average maximum flowering plant height (cm)) as a function of the proportion of crabs with northern haplotypes at each study site. There was no significant correlation between average eelgrass abundance and fraction of northern haplotypes between sites. The weak positive relationship between average eelgrass abundance and fraction of northern haplotypes is not significant (Figure 5. $R^2 = 0.25103$, p=.501).

Hot off the Press:
Green Crab Abundance and Eelgrass Biomass





Next steps: Eelgrass biomass does not appear to be related to green crab abundance. Does crab abundance relate to eelgrass density or abundance?