Developments in eelgrass mapping methodology using hydrographic multi-beam sonar

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Summary

Our goal is to develop a data collection and processing methodology for water column backscatter data collected with a multi-beam echo-sounder (Teledyne Odom MB1) to determine the presence or absence, percent cover, maximum depth limit, and canopy height of eelgrass beds. Acoustic eelgrass mapping is of particular use in deep waters and turbid estuaries, where aerial imagery does not reveal the necessary detail for analysis. Presented here are updates to this project, including fieldwork completed in the summer and fall of 2015. The three main updates to the project are:

- More comprehensive delineation of the deep edge of eelgrass beds in Portsmouth Harbor
- Trials of a remotely-operated survey vehicle with the same sensor package used for our boat-based multi-beam surveys over eelgrass beds
- Extension of canopy and bottom picks further out across the swath of the multi-beam

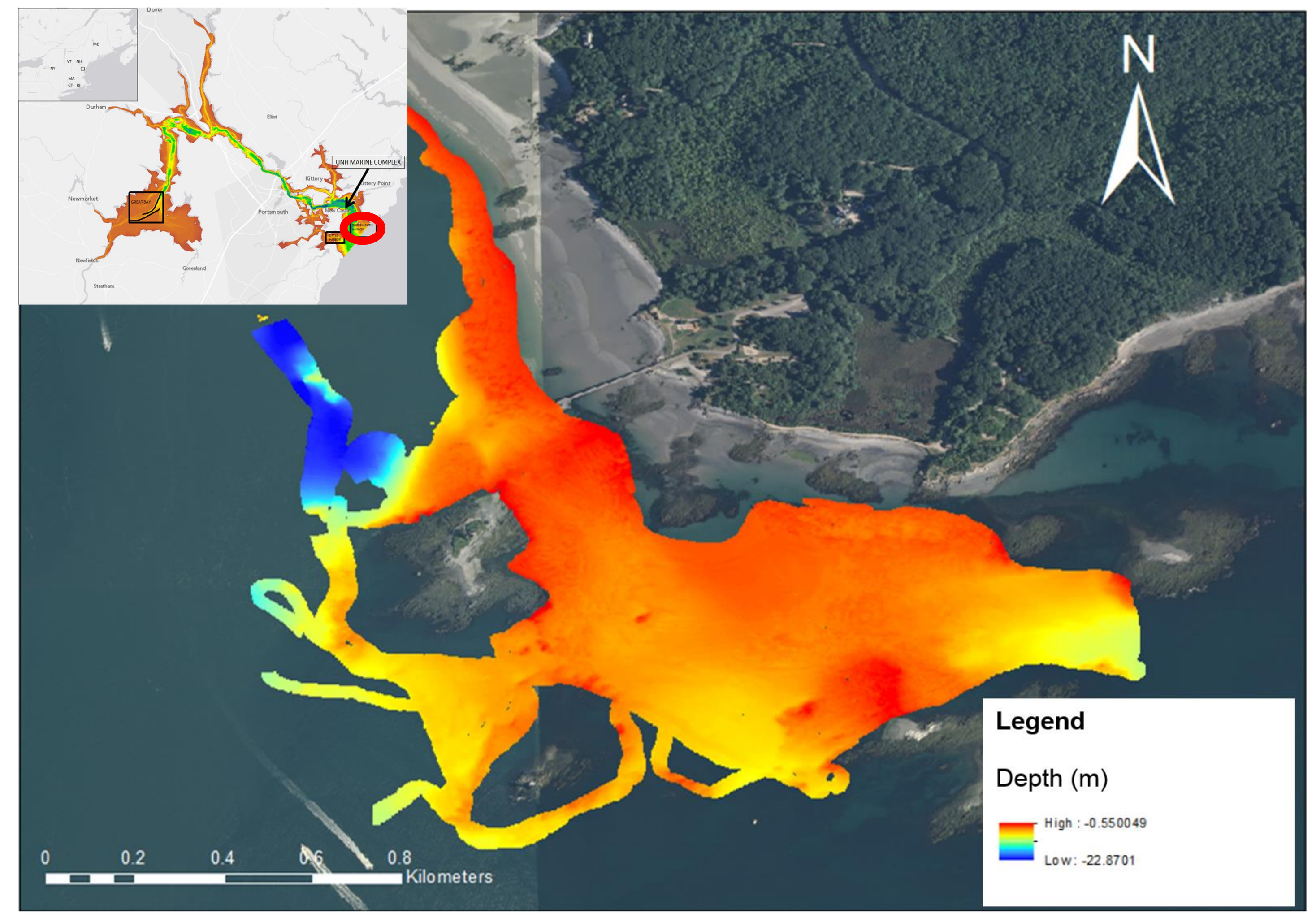
Objectives

The final objectives of this study are to:

- Develop and validate quantitative and repeatable methods for processing water-column backscatter data from a multi-beam echo-sounder for the detection and measurement of eelgrass beds, including maximum depth limit, canopy height and percent coverage.
- Quantify the uncertainties and expected data resolution for our eelgrass measurements and mapping from a multi-beam echo-sounder

Results

Our data processing yields both bathymetry and presence or absence of vegetation, indicated by canopy above a certain height threshold delineated through statistical analysis of the return from the seafloor (figure 7). The two datasets can be easily overlain to obtain a maximum depth limit. At this time, there is no automated delineation of vegetation type (e.g., macroalgae or eelgrass), but vegetation found on rocky terrain usually can be assumed to be macroalgae, based on habitat preferences and drop camera video data.



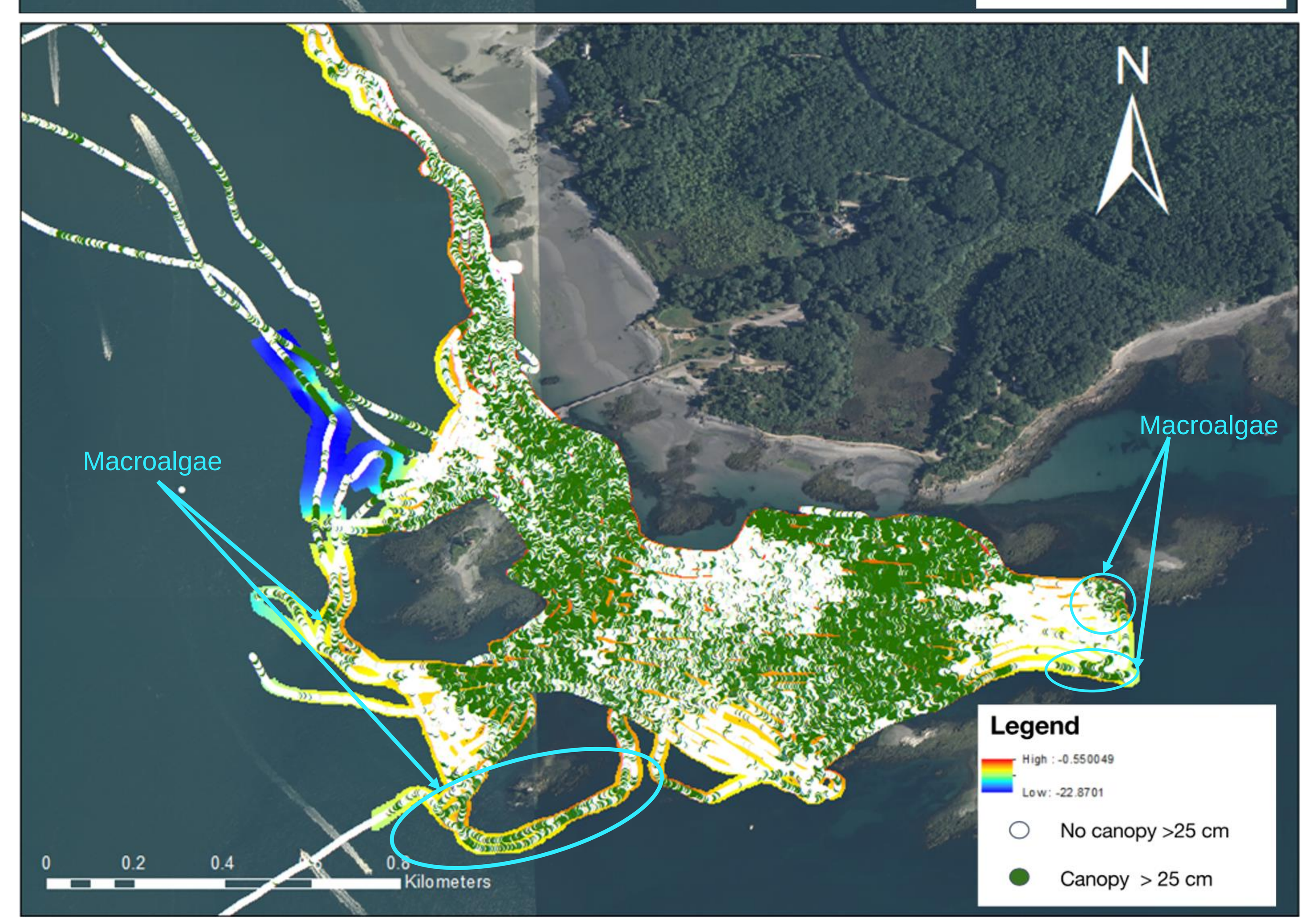


Figure 1 (top): Multi-beam bathymetry collected in July 2015 around Fort Foster in Portsmouth harbor
Figure 2 (bottom): Canopy presence or absence from nadir beam of the multi-beam from the same survey lines as the bathymetry. The maximum depth on the deep edges of the beds was ~7-8 m.

In hydrography, the potential of using unmanned remotely-controlled or autonomous survey vehicles is being explored for surveying shallow or obstacle-filled areas. Through our industry partnerships, we were leant a Teledyne Oceanscience Z-boat (figure 3) that came equipped with the same sensors used for our boat surveys, and achieved similar results for eelgrass detection.

ACKNOWLEDGEMENTS

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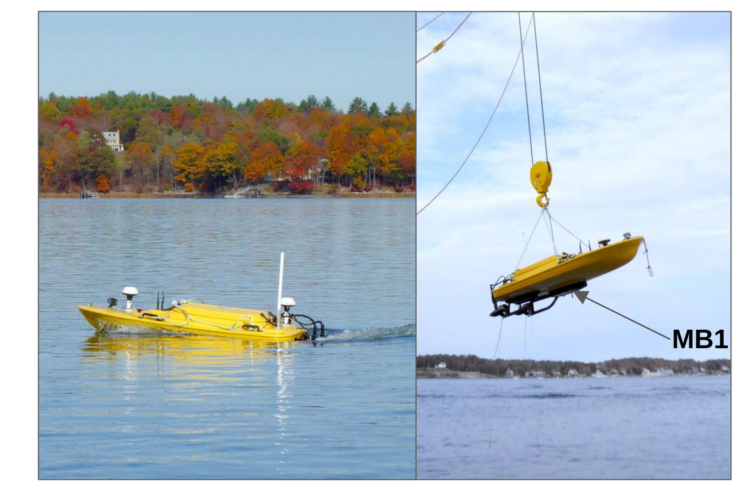
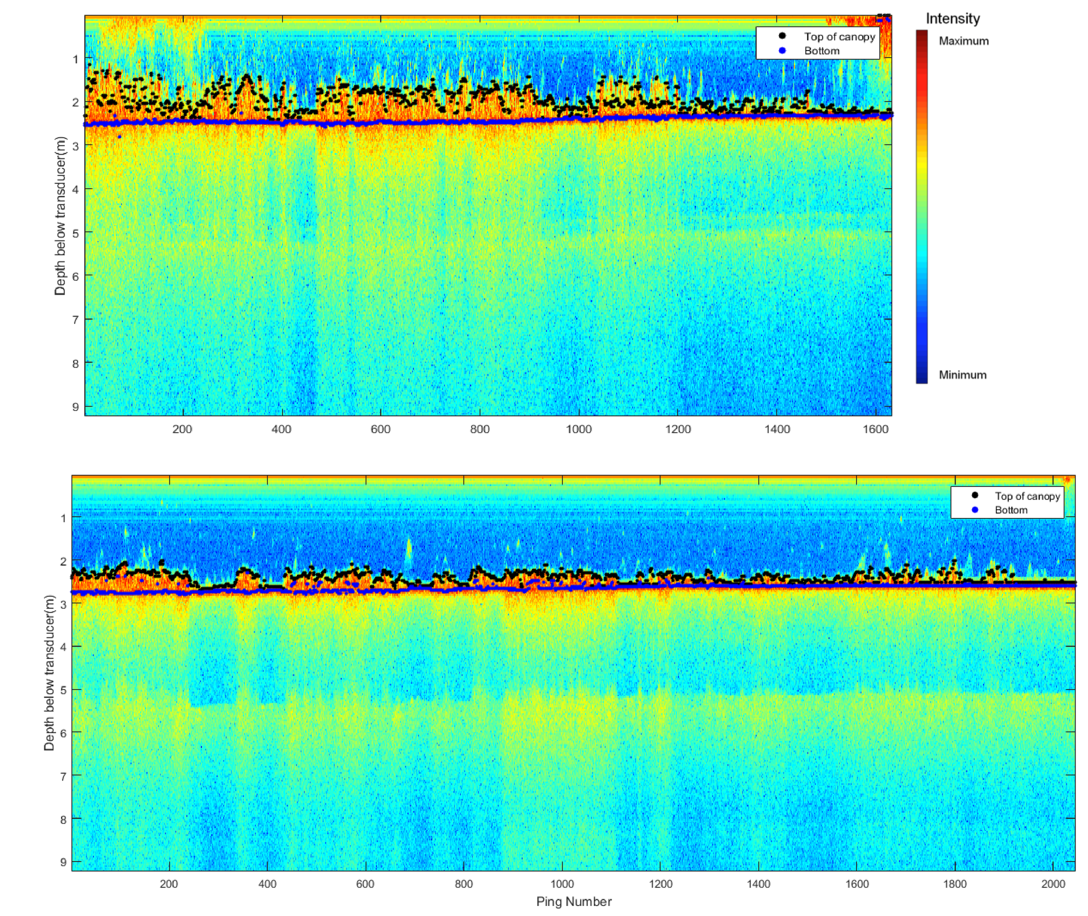


Figure 3 (above): Teledyne Oceanscience Z-boat with Odom MB1 multi-beam echosounder.



Figures 4 & 5: Nadir beam data collected with a boat-mounted MB1 in July (right top) and collected with a Z-boat-mounted MB1 in October (right bottom) in Great Bay. Depth discrepancy is due to tidal stage and canopy structure discrepancy is attributed primarily to seasonality (reproductive shoots, etc).

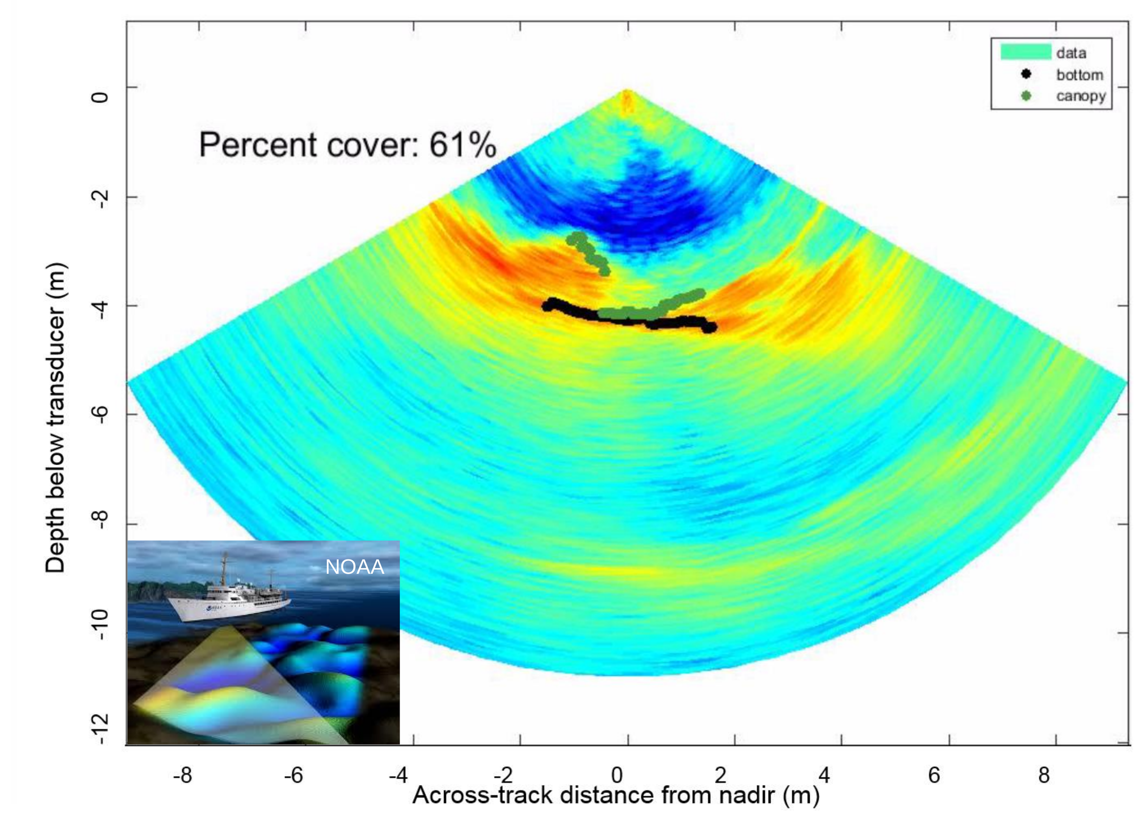


Figure 6: A stacked ping of water column data with signal-based canopy (green) and substrate (black) detections in beams +/- 20° of the central (nadir) beam

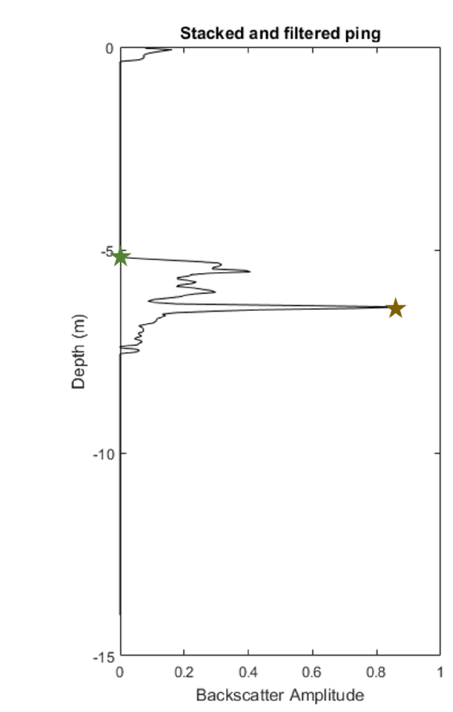


Figure 7: A nadir beam trace (backscatter intensity vs. depth) showing the location of the canopy (green) and substrate (black) detections.

Conclusions & Future Work

Our 2015 field season produced promising results for maximum depth limit mapping, the use of an unmanned platform for acoustic surveying of eelgrass beds, and extending canopy and substrate detections further across the swath of the multi-beam water column data. Combining the bathymetry data and canopy detections from the nadir beam water column data effectively delineated the location and depth of the deep edges of eelgrass beds in Portsmouth harbor. The Z-boat equipped with a multi-beam sonar was an efficient tool for acoustic eelgrass surveying due to its ability to access shallower, rockier areas, and its portability. Further work will investigate more image- and signal-processing methods for extending the detection of eelgrass across the entire swath, depth-dependent and sidelobe artifact removal, more efficient survey procedures for deep-edge detection, and the effects of currents on the acoustic response of the canopy.