Monitoring performance of shallow, subtidal restoration oyster reefs using advanced technologies: A case study on Felgates Creek reef (York River, VA)

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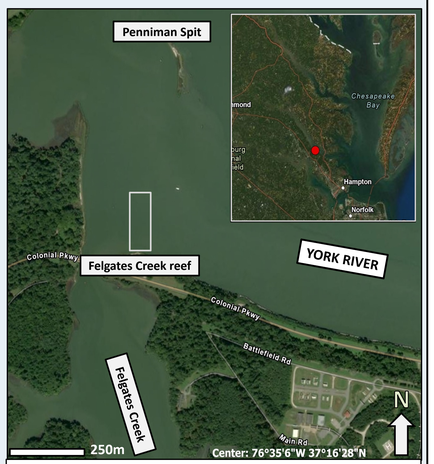
INTRODUCTION

- The Chesapeake Bay native oyster abundance declined sharply in the past two centuries due to overharvesting and disease[1]
- Oyster restoration is underway in Chesapeake Bay tributaries to trigger population recovery, including in the York River (VA)[2]
- Felgates Creek reef is a 0.15-ha, shallow (<3m), subtidal reef in the York River, constructed in 1999[3,4]
- This reef has never been mapped or sampled

RESEARCH GOALS

- Produce a high-resolution map of Felgates Creek reef
- Quantitatively assess reef performance by stratified random sampling



Study site location, gray box indicates location of oyster reef, red dot indicates location relative to surrounding area

METHODS

Mapping

- Sontek M9 Acoustic Doppler Current Profiler (ADCP) used to map Felgates Creek reef
- Sampling strata and random sampling points determined from data output; shallow stratum (A) = reef 0.5-1m deep, deep stratum (B) = reef 1-1.5m deep

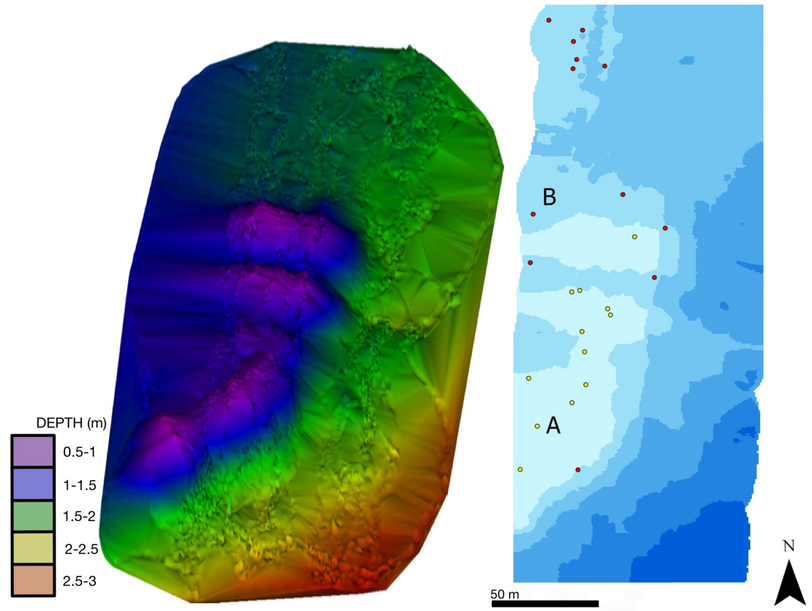
Sampling

- 14 stratified random samples taken (9 shallow, 5 deep)
- A 0.25 m^2 quadrat placed at a GPS sampling location and all oysters were excavated

Left: Acoustic Doppler Current Profiler (ADCP). This device ran transects across Felgates Creek reef to produce a high-resolution 3D model of the reef **Right:** The GPS RTK Base station delivered accurate GPS location to ADCP during profile

Analysis

- Oyster length, height, width, live volume and dry weight measured
- Population structure, abundance, biomass and live volume calculated for total study area



Side-by-side representations of Felgates Creek reef. **Left:** Raster profile constructed using Acoustic Doppler Current Profiler (ADCP) and RTK base station. Purple represents highest relief strata, red the lowest. **Right:** ArcPro map created via ADCP raster used to determine sampling points. Sampling strata (A + B) and sampling locations (red + yellow points) are indicated on this map

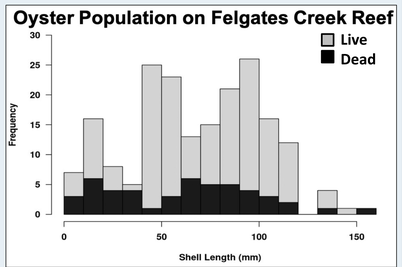
RESULTS & DISCUSSION

Felgates Creek Reef

- Felgates Creek reef was not constructed in the pattern of a natural reef: the reef is divided into four distinct sections which have been altered due to sediment deposition over time; natural reefs normally follow current movement directions
- Poaching is not apparent; shallow reef depth precludes dredging
- The area of the shallow stratum is 829 m^2 and area of the deep stratum is 928 m^2

Population Survey

- Several age classes occupied the reef
- Total oyster abundance = 148,631; shallow abundance = 137,308 and deep abundance = 11,322

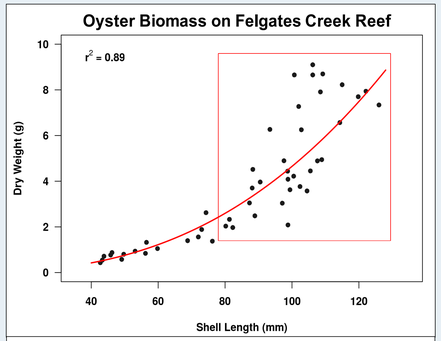


Size frequency distribution of all sampled oysters on Felgates Creek reef. Gray bars represent live oysters and black bars represent dead oysters

RESULTS & DISCUSSION

Population Survey (cont.)

- Oyster density was high in the shallow stratum (58 oysters per m^2)
- Abundance declined sharply from the shallow stratum to deep stratum (3 oysters per m^2)
- Biomass is high as indicated by most sample oysters being larger than legal harvest size (76mm)
- The purple peaks seen on the raster image to the left comprise the shallow stratum and much of the live oyster reef



Biomass on Felgates Creek reef. Most oysters are larger than legal harvest size, indicated by red box. Biomass is a good indicator of reef health when compared over time and can indicate positive and negative reef performance

CONCLUSIONS

- The ADCP + RTK base station units allowed for accurate mapping of a shallow, subtidal reef, which is a promising method for other reefs in similar environments
- The presence of multiple age classes and high oyster densities in the shallow stratum indicate Felgates Creek reef is a functional oyster habitat and possibly suitable for future restoration practices
- Further work will include classifying bottom type of the strata on the reef, calculating oyster biomass and developing a habitat suitability index (HSI) for oyster restoration in this area

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