VIRGINIA FISHERY RESOURCE GRANT PROGRAM

FRG 2020-03 Final Report

Do floating oyster growing cages reduce wave energy and offer shoreline protection?

Principal Investigator: Bruce Vogt, Vogt Oyster Co.

Collaborators: Virginia Institute of Marine Science, Center for Coastal Resources Management (CCRM): Donna Bilkovic, Assistant Director; Dave Stanhope; and Kory Angstadt

Introduction

Shellfish aquaculture is a green industry providing ecosystem services, and in the case of our farm location, providing an added benefit of shoreline protection from waves. We wanted to test whether or not floating aquaculture gear at our farm was, in fact, providing shoreline protection. If so, it would be beneficial for the industry to expand the tests to demonstrate this added value and our study will function to provide the blueprint for other industry members to follow. There is ongoing research measuring the value of living shoreline structures for shoreline protection[1] which validates the need for this type of data and provides the basis of our experimental design.

Objectives

Our main objective was to validate that a floating shellfish aquaculture farm has the added benefit of providing shoreline protection from waves and to do this we set up an experiment to measure the wave energy in the area of floating bags and compare it to an area with no shellfish gear. We also wanted to provide a blueprint of the methods and considerations so that additional data could be collected at other shellfish farms and with different gear types. The results of this work will inform other growers how to evaluate their site and will have provided the gear (loggers) available from VIMS to accomplish the data collection.

Methods

The study site was at our lease in Monday Creek, Gloucester County, where we grow oysters with Zapco floating bag system (Figure 1.). We have a Joint Permit Application from VMRC for floating gear. We have roughly 10 longlines (~100 ft) with approximately 30 floating bag units/line deployed perpendicular to the shore. I used a section of 3-5 lines of gear as the test site and an area where there is no gear deployed as the control site.

We partnered with the Virginia Institute of Marine Science, Center for Coastal Resources Management (CCRM) on the experimental design and data collection. The methodology used was consistent with what they use for measuring the value of living shoreline structures for shoreline protection[1]. The wave measurements were collected with RBRsolo D|wave16 loggers from RBR, Ltd. The loggers are fully submersible, compact and lightweight and designed to measure wave pressure and attenuation. For our study we need a total of four units. The VIMS CCRM group is proficient in the use of these meters and the resulting data analysis.

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[1] "Civil Engineering Ph.D. Student Puts Virginia Sea Grant Graduate Fellowship to Work on Living Shorelines" January 17, 2018. https://www.odu.edu/news/2018/1/maura#.XiB9en9KhQI.

We met with VIMS CCRM partners to discuss our study site and determine the logger placement (Figure 2.). The team flew their drone over the site to collect additional onsite information to be able to parameterize their model (SCHISM) for wave attenuation modeling.

Four RBR wave sensors were deployed at the oyster farm site on November 9, 2020. Two at the control site just outside the farm and two inside the farm where the lines of floating bags are expected to buffer the wave activity (Figure 2.). Sensors in the farm were cable-tied to the end poles of the gear lines. Sensors in the control area were connected to poles deployed by CCRM partners. Wave gauges were retrieved on December 10.

Experimental Design Specifics (Figure 3.)

The wave attenuation was measured by a wave logger used for living shoreline evaluations. These loggers are compact and easy to use. Two loggers were borrowed from VIMS CCRM, and two additional units needed for the study were purchased from this grant. The loggers purchased will be the property of VIMS and retained by VIMS for use in future Fishery Resource Grant Program studies at additional industry sites.
Two loggers were deployed at the treatment (gear array) and two for the control. One set of loggers were positioned landward at the start of the gear array (treatment) or at low tide line (control). The other set will be deployed approximately 100 ft seaward (the approximate length of the gear array line). The wave measurements for the treatment will be taken at the point in which it first interacts with the gear and compared with the intensity at the low tide line. The control measurements will measure the wave intensity from 100 ft seaward to the low tide line. It is important the loggers don't move up and down. The control loggers will be deployed on a post at the low tide line where there are no aquaculture arrays in front and approx. 100 ft seaward. The CCRM advisors thought the proposed distances of 100 ft were not a problem based on the distances used in their work. Loggers will not be left out for the entire length of the study. CCRM advisors recommended deploying loggers in several areas at several points throughout the year to capture the extremes of wave energy for comparison - when wave energy is low and high (during storms). CCRM advisors will provide assistance in logger placement as well as provide the data analysis which they will be able to download into a current model. Remaining details will be worked out with advisement from CCRM partners.

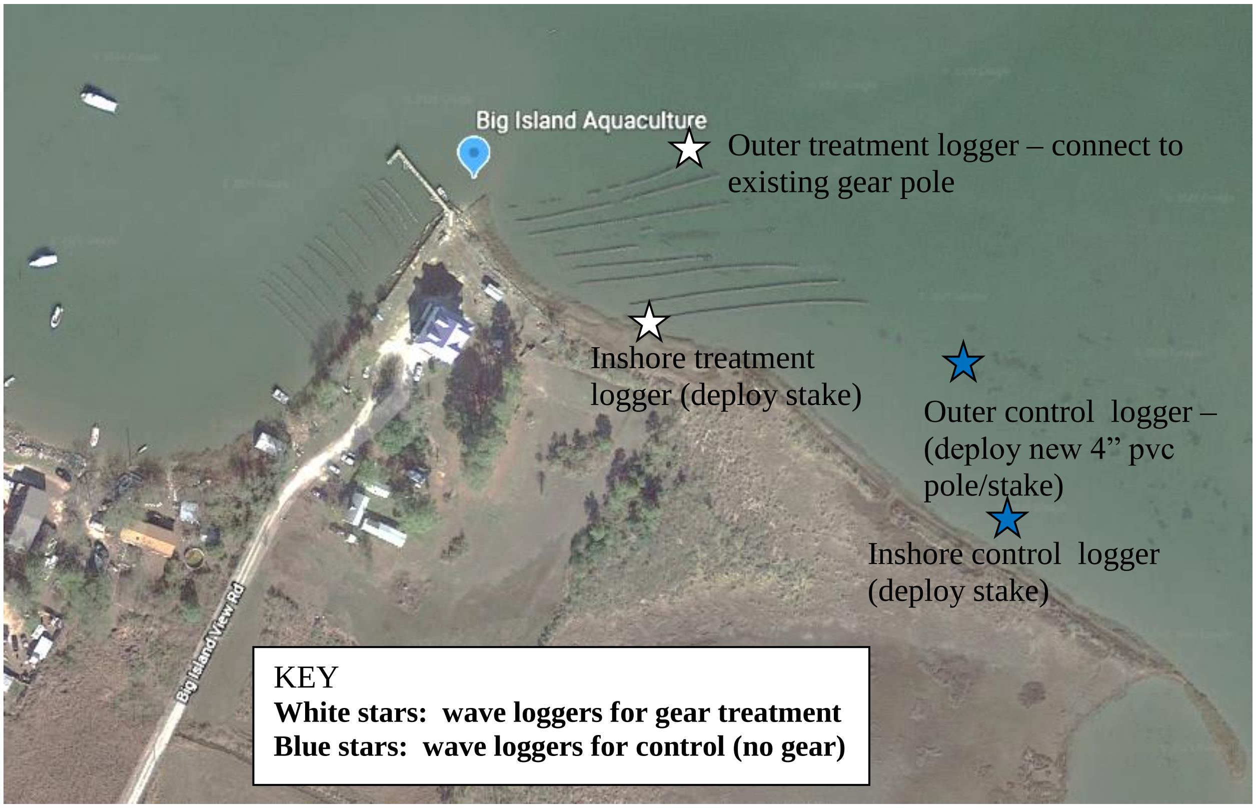
Results

The results measured the reduction in wave energy from aquaculture gear and demonstrate the shoreline protection value of shellfish culture. This FRG study has provided an initial comparison of shoreline protection from aquaculture gear to living shorelines which will be used for further studies. See the VIMS CCRM report for additional details.

Figure 1. Study site location

Figure 2. Google earth site location and initial planning notes

Figure 3. Revised logger positions for initial testing



VIMS, Donna Marie Bilkovic, Kory Angstadt
9 Sept 2021
Big Island Wave Attenuation Study

STUDY DESCRIPTION

To evaluate the effect oyster aquaculture floating cages may have on wave attenuation and thus shoreline stability, we placed pressure loggers on and offshore of floating cages at Big Island, Bena, VA and on and offshore an adjacent shoreline without cages to serve as a control (Fig. 1). Preliminary data were collected from 09 Nov 2020 to 10 Dec 2020. Water pressure loggers were then placed on site to capture varied wave conditions from 17 May 2021 and to 30 Jun 2021 (Fig. 2). During preliminary data collection in the Fall 2020, the winds originated out of the North 33% of the time. During the Summer 2021 study, 34% of the time winds originated in a Southwesterly direction, and 24% of the time being a North wind. Wave data were processed using a MatLab script developed by Rebecca Morris (University of Melbourne). The code is designed to process water pressure data to determine wave properties at various points. There are options included to correct for atmospheric pressure, water temperature, and salinity. The predicted wave height at the shore was then compared with the observed wave height at the shore. We then compare the slopes of the regressions for the oyster cage site vs the control site to determine the percentage of wave reduction that occurred as a result of the floating oyster cages.

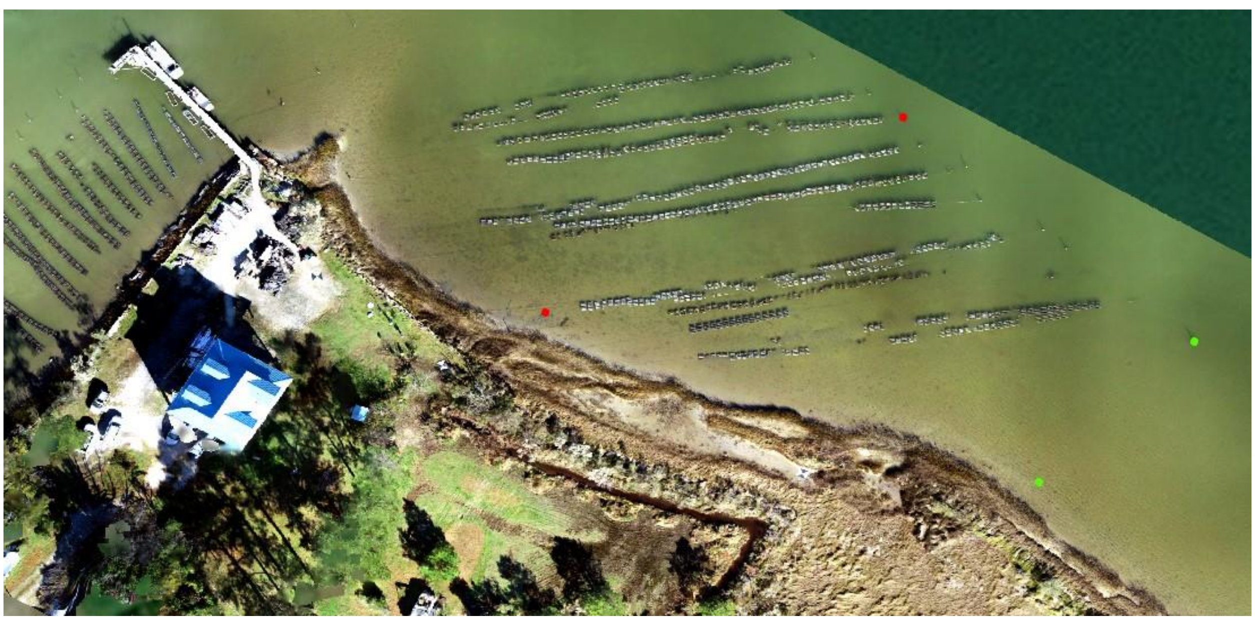


Figure 1. Set up of Big Island Wave Attenuation study. Red marks are the locations of the wave gauges used in the Oyster treatment measurements and the Green marks are the location of the gauges used as the Control (No oyster cages present) measurements.


Figure 2. Example of the deployment of RBR Solo wave gauges.

FINDINGS

Wave analysis indicates that during the time of logger deployment, the oyster cages were more than 30% better at attenuating waves than the control site which has no cages (Fig 3).

Percentage wave height reduction:
Oyster = 67% *R^2 = 0.49, p <0.0001 (linear regression)*
Control = 36% *R^2 = 0.78, p <0.0001 (linear regression)*

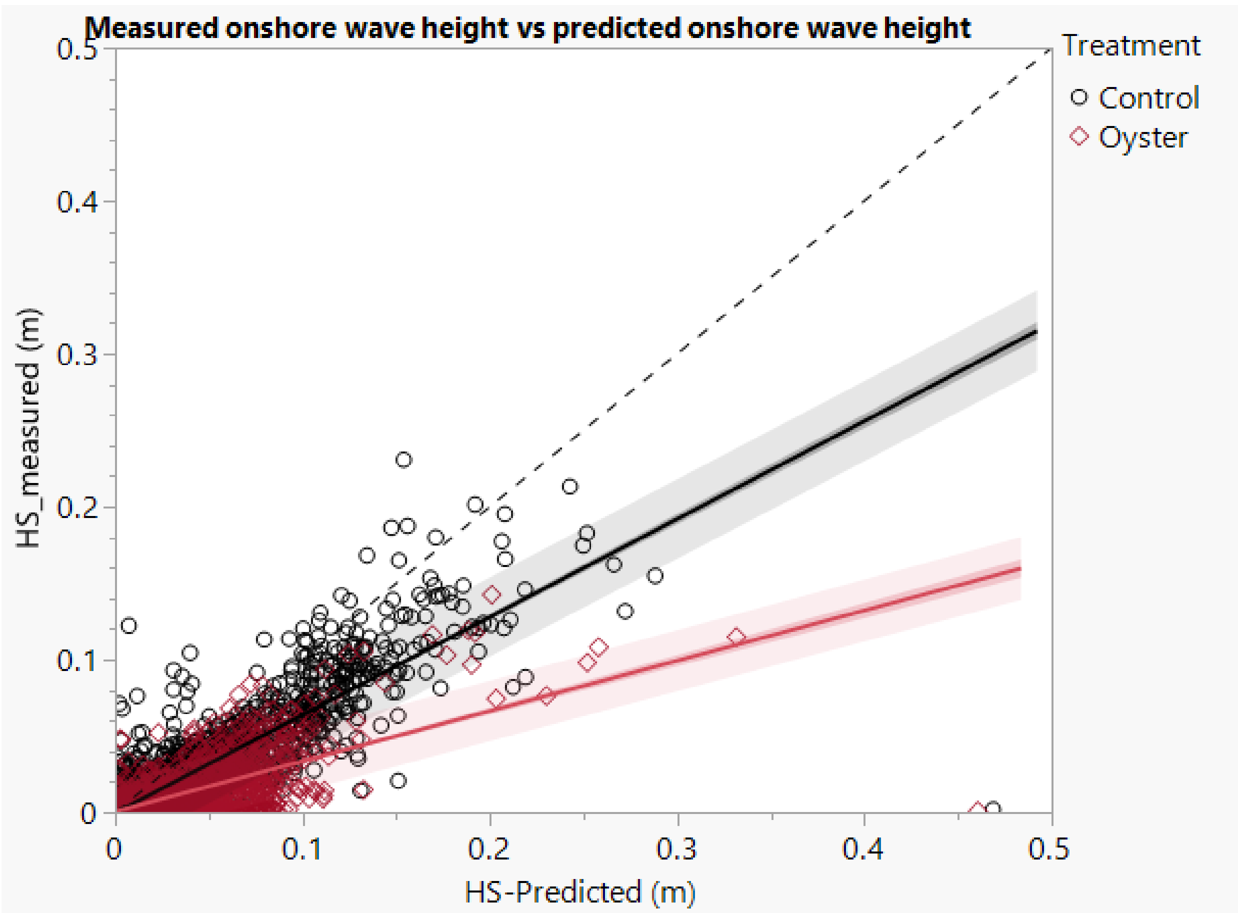


Figure 3. Comparisons of measured (y-axis) and predicted (x-axis) significant wave height (m) for control (R^2 = 0.78) and oyster cages (R^2 = 0.49). Values below the dotted line indicate a decrease in wave height. The shaded area is the 95% confidence interval.