

NRAC ANNUAL PROGRESS REPORT

INSTRUCTIONS: An annual progress report for each funded project must be provided to NRAC by June 30 of each year.

Project Title	Quantifying Farm-Scale Ecosystem Services Provided by Eastern Oyster Aquaculture in the Northeast
Reporting Period	05/31/2020- 6/30/2021
Author (Chair)	Daphne Munroe
Key Word	oyster, ecosystem services, water quality, filtration, nutrient trading
Funding Level	Total funds allocated for this project to date.
Participants: Names, Institutions and Contact Info	<p>Dr. Daphne Munroe (Associate Professor) Rutgers, the State University of New Jersey, Haskin Shellfish Research Laboratory, 6959 Miller Ave. Port Norris, NJ 08349 Phone: (856) 785 -0074 ext. 4325 Fax: (856) 785 -1544 Email: dmunroe@hsrl.rutgers.edu</p> <p>Lisa Calvo (Aquaculture Extension Program Coordinator) Rutgers, The State University of New Jersey, Haskin Shellfish Lab, Rutgers Cooperative Extension</p> <p>Janine Barr (Shellfish ecology graduate student) & Arianna Horgan (Ecology undergraduate researcher) Rutgers, The State University of New Jersey, Haskin Shellfish Lab</p> <p>Dr. Danielle Kreeger (Senior Science Director) & Kurt Cheng (Shellfish Coordinator) at Partnership for the Delaware Estuary</p> <p>Dr. Julie M. Rose (Research Ecologist), NOAA Fisheries NEFSC Milford Lab</p> <p>Dr. Skylar Bayer (Assistant Professor), Roger Williams University</p> <p>Cooperating Farmers: Marc Zitter, President, Northern Cape Sea Farms LLC (New Jersey) Brian Harman, Oyster Farm Manager, Cape May Salt Oyster Company (New Jersey) Steve Schafer & Jardar Nygaard, Stella Mar Oyster Company (Connecticut)</p>

	Mark Casey & Brent Hott, Delaware Cultured Seafood Inc. (Delaware)
Project Objectives	<p>The purpose of this project is to provide a scientifically rigorous account of an ecosystem service provided by U.S. east coast oyster farms. Specifically, the project aims to estimate farm-level year-round filtration and nitrogen removal occurring at oyster farms across the region to quantify local farm contribution to improved water quality. Seasonal measurements will be made throughout the year of individual oyster filtration rates, water clearance rates, and nitrogen removal in ambient farm water. These measurements will be scaled up to estimate total farm annual filtration and nitrogen removal using the farm’s standing stock. These measurements will be made using oysters representing a range of sizes, and will be performed at farms spanning a range of habitats and farm types in the region. We will use the data collected to develop an online calculator that farmers can use to estimate the water quality impacts of their farms.</p> <p>Objective 1: Measure farm-specific year-round oyster filtration over a range of oyster sizes, at four farms from the NE region. Experiments will be performed at each farm using farmed oysters (livestock) and natural bay water at each farm.</p> <p>Objective 2: Survey oyster standing stock on each farm, and analysis of prevailing seston composition at each location.</p> <p>Objective 3: Estimate the farm-level filtration capacity for one full year.</p> <p>Objective 4: Develop an online calculator that incorporates the data collected in these, and other related studies in the region, that can be used by farmers to estimate the specific annual water clearance and nitrogen removal characteristics for their farm.</p> <p>Objective 5: Create outreach and extension materials describing results from objectives 1 through 4. These outreach materials will be informed by needs of the farm community, and will target audiences including public, farmers, permitting/management agencies, and seafood buyers.</p>
Anticipated Benefits	State briefly how the project will benefit the aquaculture industry – directly or indirectly.

	<p>To accurately understand the amount of water clearance at a given farm, it is important to understand the differences that may exist among habitats and gear types. Accurate filtration rate calculation is important for oyster farmers because it will help them become more profitable in a way that protects the natural environment and promotes water quality improvements. Accurate filtration rates will inform farmers' role in nutrient remediation efforts through nutrient trading programs, and will help inform the general public – particularly those whose homes benefit from views of clean healthy waterfront – about the scope of shellfish farming in maintaining healthy coastal habitats.</p>
<p>Project Progress</p>	<p>Summarize concisely for each objective the progress toward accomplishment to date. This has an 8,000 character limit.</p> <p>Objective 1: To date, 15 independent experiments have been done at four oyster farms regionally. This includes 5 at a farm in CT, 2 at a farm in NJ backbay, 6 at a farm in Delaware Bay, and 2 at a farm in DE Inland Bay. These experiments cover a range of seasons and reflect a variety of water quality and environmental conditions. A further 4 are planned over the next 6 to 12 months. In each experiment, oyster filtration, assimilation efficiency, and nitrogen removal are measured, along with water quality and environmental parameters.</p> <p>Objective 2: Oyster standing stock at our partner farms has been surveyed twice (once in early 2020, and again at the end of the 2020 growing season). Seston (water quality) has been tracked at farm sites monthly for 5 months.</p> <p>Objective 3: This will begin once experiments (Objective 1) is complete.</p> <p>Objective 4: This will begin once farm-level filtration is estimated (Objective 3).</p> <p>Objective 5: Presentations have been made at the National Shellfisheries Association annual meeting, and at the Partnership for the Delaware Estuary Science Summit that describe the project and progress to date.</p>
<p>Accomplishments:</p>	
<p>Outreach Overview</p>	<p>Describe in general how your results have been extended to the intended users. OR, if they haven't yet, explain when & how this will occur.</p>

	<p>Two presentations have been made at science conferences that describe the project and progress to date. We will additionally create targeted outreach and extension materials tailored to and based on farmer needs. These may include factsheets, postcards, and informative videos that describe the results of the project (these require completion of objectives 1-4 before they can be finalized). In addition, we will attend farmer relevant meetings (such as the Northeast Aquaculture Conference & Expo, and the Maryland Waterman’s Expo), provide factsheets and updates, and give a talk at the Shellfish Growers Forum hosted by Rutgers and coordinated by Calvo in Cape May</p>
<p>Targeted Audiences</p>	<p>Provide information on the target audience for efforts designed to cause a change in knowledge, actions, or conditions.</p> <p>Our primary target audience are shellfish farmers, to whom we intend to provide information relevant to the role of their farms in improvement of coastal water quality.</p> <p>A secondary audience is the general public, to whom we intend to extend information about the beneficial role of shellfish (oyster) farms to promote healthy coastal ecosystems.</p> <p>Finally, managers and policy makers are also a target audience, to whom we intend to provide rigorous and quantified data supporting the role that shellfish (oyster) farms play in improving water quality over a wide range of seasonal and environmental conditions.</p>
<p>Outputs:</p>	<p>Outputs are tangible, measurable products (website, events, workshops, products [AV, curricula, models, software, technology, methods, websites, patents, etc.], trainees, etc.). Do NOT include publications as they’re listed separately.</p> <p>Nothing to report at this time.</p>
<p>Outcomes/Impacts:</p>	<p>Describe how findings, results, techniques, or other products that were developed or extended from the project generated or contributed to an outcome/impact. Outcomes/impacts are defined as changes in Knowledge, Action, or Condition.</p> <p>Nothing to report at this time.</p>
<p>Impacts Summary</p>	<p>Provide short statements (2-3 sentences) about each of the following:</p>

	<p>(pre-established fields for Researchers to complete short statement answers)</p> <ol style="list-style-type: none"> 1. Relevance: Issue – what was the problem? Oyster filtration is known to be influenced by hydrodynamics, oyster size, temperature, salinity, and seston quantity and quality. Although filtration is highly variable, average rates are often used in estimates of ecological filtration; therefore, there is a need for accurate, science-based farm-specific estimates of filtration that account for this realistic variation. 2. Response: What was done? Experiments in collaboration with oyster farm partners are underway. Sample analysis and data collection are ongoing. 3. Results: How did your work make a difference (change in knowledge, actions, or conditions) to the target audiences? Ongoing 4. Recap: One- sentence summary Ongoing
<p>Publications</p>	<p>Follow the format to list publications in the following categories:</p> <ul style="list-style-type: none"> • Presentations: <ul style="list-style-type: none"> ○ Oral <p>Two presentations, listed below, have been made at science conferences.</p> <p>Barr, J., Munroe, D., Calvo, L., Kreeger, D., Cheng, K., Rose, J., Bayer, S. 2021. Nutrients, Salinity, and Oysters: The Impact of Extreme Precipitation Events on Eastern Oyster (<i>Crassostrea virginica</i>) Ecosystem Services in the Delaware Bay. Oral presentation, Delaware Estuary Science and Environmental Summit, Virtual, March 1-3, 2021. Winner - best student presentation.</p> <p>Barr, J., Munroe, D., Calvo, L., Kreeger, D., Cheng, K., Rose, J., Bayer, S. 2021. Quantifying farm-scale ecosystem services associated with Eastern oyster aquaculture in the Northeast. Oral presentation, 113th National Shellfisheries Association Annual Meeting, Virtual, March 22-25, 2021.</p> <ul style="list-style-type: none"> ○ Posters • Peer-reviewed: <ul style="list-style-type: none"> ○ Print (journal, etc.) ○ Digital (websites, videos, etc.) • Non-Peer-reviewed:

	<ul style="list-style-type: none"> ○ Extension factsheets ○ Popular articles <p>Barr, J. 2020. Measuring Oyster Filtration. Delaware Estuary News, 31(1): 6-7.</p>			
Students/Participants:	<p>Provide the following information for every student that worked with you during the reporting period:</p> <ul style="list-style-type: none"> • Name: Janine Barr • Whether Degree was completed during the reporting period (name, yes/no): MSc. No (ongoing) • New or Continuing Student: New • Capstone/Thesis Title (actual or anticipated): Farm-Scale Filtration Provided by Eastern Oysters and Impacts of Low Salinity Events on Filtration • Date of Graduation: Jan. 2022 (anticipated) • Provide link to thesis/dissertation document: • Name: Arianna Horgan • Whether Degree was completed during the reporting period (name, yes/no): BSc. No (ongoing) • New or Continuing Student: New • Capstone/Thesis Title (actual or anticipated): Changes in gut transit time due to water quality. • Date of Graduation: May 2022 (anticipated) • Provide link to thesis/dissertation document: 			
Partnerships	<p>List any partners that you worked with on your project. Provide the following information for each Partner:</p>			
	Partner Partnership for the Delaware Estuary	Specific Type Subcontractor / Non-profit Organization	Level Unknown	Nature of Partnership Research Collaboration
	Partner Northern Cape Sea Farms LLC	Specific Type Industry	Level Local	Nature of Partnership Collaborator
	Partner Cape May Salt Oyster Company	Specific Type Industry	Level Local	Nature of Partnership Collaborator

	Partner Stella Mar Oyster Company	Specific Type Industry	Level Local	Nature of Partnership Collaborator
	Partner Delaware Cultured Seafood Inc.	Specific Type Industry	Level Local	Nature of Partnership Collaborator
	NOAA Milford Laboratory	Government	Federal	Research Collaborator