

## NRAC FINAL REPORT

<b>Project Title</b>	Regional Comparison of Off-Bottom Oyster Cages as Marine Habitat in the Northeast
<b>Reporting Period</b>	9/01/ <u>2018</u> - 6/30/ <u>2021</u>
<b>Author (Chair)</b>	Name of person submitting this report. Daphne Munroe
<b>Key Word</b>	Oyster aquaculture, fish habitat, ecosystem service, video-based observation research,
<b>Funding Level</b>	Total funds allocated for this project to date. <i>NOTE: This could be reported by Year. i.e.,</i> <i>Year One: FY 2019, \$ amount \$14,291.74</i> <i>Year Two: FY 2020, \$ amount \$5,697.26</i>
<b>Participants</b>	<p>List participating personnel and respective institutions/agency/business; include outreach representative. Indicate funded participants with an asterisk.</p> <p><b>Name(s)/Role(s):</b> Daphne Munroe, PI  Institution/Agency/Business: Rutgers University  Address(s): 6959 Miller Ave, Port Norris, NJ  Phone(s): 856-785-0074  Email(s): dmunroe@hsrl.rutgers.edu  Funded (Yes/No): No</p> <p><b>Name(s)/Role(s):</b> Lisa Calvo, co-PI, Aquaculture Extension Co-ordinator  Institution/Agency/Business: Rutgers University  Address(s): 6959 Miller Ave, Port Norris, NJ  Phone(s): 856-785-0074  Email(s): lcalvo@hsrl.rutgers.edu  Funded (Yes/No): Yes</p> <p><b>Name(s)/Role(s):</b> Julie Rose, co-PI  Institution/Agency/Business: NOAA Milford Lab  Address(s): 212 Rogers Avenue, Milford, CT  Phone(s): 03-882-6544  Email(s): Julie.rose@noaa.gov  Funded (Yes/No): No</p> <p><b>Name(s)/Role(s):</b> Jenny Shinn, shellfish technician  Institution/Agency/Business: Rutgers University  Address(s): 6959 Miller Ave, Port Norris, NJ  Phone(s): 856-785-0074  Email(s): jenny.shinn@rutgers.edu  Funded (Yes/No): Yes</p> <p><b>Name(s)/Role(s):</b> Theresa Lin, Joey O'Brien, Alexandra Ambrose, Jennifer Gilmore, hourly undergraduate workers  Institution/Agency/Business: Rutgers University  Address(s): 6959 Miller Ave, Port Norris, NJ  Phone(s): 856-785-0074</p>

	<p>Email(s): Funded (Yes/No): Yes</p> <p><b>Name(s)/Role(s):</b> Marc Zitter, Oyster farmer Institution/Agency/Business: Northern Cape Sea Farms Address(s): Phone(s): Email(s): marczitter@gmail.com Funded (Yes/No): No</p>
<b>Project Objectives</b>	<p>List each objective</p> <p>Objective 1: Document interactions of oyster farm gear and wildlife to inform permit processes, which must consider potential farm impacts on endemic species</p> <p>Objective 2: Compare data collected at NJ farm to the wider regional datasets being collected by NOAA Milford Lab</p> <p>Objective 3: Disseminate research findings in a timely manner to farmers and relevant management agencies with interest in issues related to wildlife interactions and habitat provisioning on oyster farms.</p>
<b>Anticipated Benefits</b>	<p>State briefly how the project will benefit the aquaculture industry – directly or indirectly.</p> <p>A lack of science-based information regarding oyster farm and wildlife interactions can result in precautionary regulations that establish barriers to oyster farming, yielding costly gear modifications or preventing oyster farming to occur at all. This stifles industry growth and the economic benefits that stem from such growth. Additionally, demonstrated environmental benefits of oyster farming, such as enhanced biodiversity and habitat provision for important recreational and commercial fisheries, can be used to enhance consumer acceptance of aquaculture, a critical component for driving market expansion. Social license to farm has been identified as a key bottleneck in Northeast shellfish aquaculture industry expansion, and demonstration of environmental benefits provided by aquaculture gear will increase the social carrying capacity of aquaculture operations in coastal communities. Lastly, synergistic agri-tourism/aqua-tourism featuring on-farm recreational fishing could diversify an oyster farmer’s business portfolio, enhancing farm profits.</p>
<b>Project Progress</b>	<p>Summarize concisely for each objective the progress toward accomplishment to date. This has an 8,000 character limit.</p> <p>Objective 1: Videos were collected on an oyster farm as planned in 2018 (~42 hours of video). Video collection was further extended to 2019 at no cost to the project (over 60 hours of video). Videos span the growing season and cameras were set up to concurrently observe farm gear (cages and floating bags), and a control location facing the edge of the marsh adjacent to the farm. All videos have been annotated and data summaries completed. Analysis of the data collected in 2018 is complete, and at least 21 species from 4 phyla were observed, including Chordata, Arthropoda, Mollusca, and Ctenophore. The species were classified as those that utilize oyster reefs as their primary habitat (obligate residents), those that are usually found on reefs (facultative residents), those that are farther ranging and tend to forage on or near reefs (transient resident). Obligatory, resident and transient oyster reef residents of commercial</p>

	<p>and recreational importance were observed using farm habitat. Analysis of data from the 2019 videos is ongoing. These data should allow us to test for habitat use relative to farm activity (human presence and boat activity), as well as evaluation of seasonal dynamics in habitat use.</p> <p>Objective 2: The Rutgers (NJ) team met regularly with the NOAA Milford team to discuss findings and compare results. Both groups have prepared manuscripts from their respective studies and intend to submit those papers for peer review to a journal with the intention to have both papers published in the same volume as companion papers. The teams are further collaborating on a collective analysis of the data from NJ, CT, and other sites in the region. Collective analysis efforts are ongoing.</p> <p>Objective 3: Extension specialist Calvo organized a Shellfish Growers Forum in Cape May NJ on October 29, 2019 at which Shinn and Munroe presented the results to date of video collection and analysis to local shellfish farmers. Additionally, presentations of results have been made at the Milford Seminar (2020), and at the American Fisheries Society MidAtlantic Chapter meeting (2019). These meetings are attended by local stakeholders, and management agencies. Further, video clips of fish and other animals interacting with oyster aquaculture gear have been posted on the Munroe Lab YouTube channel (<a href="https://www.youtube.com/channel/UChJoXgBj5zrFoeHIBSDXKjg">https://www.youtube.com/channel/UChJoXgBj5zrFoeHIBSDXKjg</a>), and clips have been promoted on social media via the MunroeLab Twitter feed (the 3 most recent posts from these project results have received over 2,900 impressions). A project description and links to the Munroe Lab YouTube channel and website are included on the NOAA project website. A manuscript has been accepted for publication that describes the results of this work. Finally, the NOAA Milford team has initiated targeted outreach to NOAA GARFO marine habitat resource specialists who lead the EFH consultation process for oyster aquaculture activities in the Northeast.</p>
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**Accomplishments:**

<p><b>Outreach Overview</b></p>	<p>Describe in general how your results have been extended to the intended users. OR, if they haven't yet, explain when &amp; how this will occur.</p> <p>Extension specialist Calvo organized a Shellfish Growers Forum in Cape May NJ on October 29, 2019 at which Shinn and Munroe presented the results to date of video collection and analysis to local shellfish farmers. Additionally, presentations of results have been made at the Milford Seminar (2020), and at the American Fisheries Society MidAtlantic Chapter meeting (2019). These meetings are attended by local stakeholders, and management agencies. Further, video clips of fish and other animals interacting with oyster aquaculture gear have been posted on the Munroe Lab YouTube channel (<a href="https://www.youtube.com/channel/UChJoXgBj5zrFoeHIBSDXKjg">https://www.youtube.com/channel/UChJoXgBj5zrFoeHIBSDXKjg</a>), and clips have been promoted on social media via the MunroeLab Twitter feed (the 3 most recent posts from these project results have received over 2,900 impressions). A project description and links to the Munroe Lab YouTube channel and website are included on the NOAA project website. A manuscript has been submitted for peer review that describes the results of this work. Finally, when the analysis of 2019 video is complete, the NOAA Milford team will facilitate targeted outreach to NOAA GARFO marine habitat resource specialists who lead the EFH consultation process for oyster aquaculture activities in the Northeast.</p>
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<p><b>Targeted Audiences</b></p>	<p>Provide information on the <b>target audience</b> for efforts designed to <b>cause a change in knowledge, actions, or conditions.</b></p> <p>Posting videos to social media, and presenting results at meetings is intended to provide information to the general public and recreational fishing community, for whom we intend to provide them with greater knowledge about the habitat provisioning on oyster farms, and the ecological services that the farms provide in coastal habitats.</p> <p>Presenting results at scientific meetings, and in peer reviewed manuscripts is intended to provide information to the scientific, regulatory and management community who are tasked with making decisions about permitting and leasing in areas where there may be habitat and wildlife trade-offs to consider. Additional targeted outreach, through in-person meetings or virtual discussions (e.g. Google Meet), to regulatory colleagues at NOAA is intended to directly inform the EFH consultation process for oyster aquaculture activities in the Northeast.</p> <p>Finally, we are conveying the knowledge gained in this project to farmers via growers forums and through social media with the intention that they may be able to use this information to demonstrate ecological benefits from their farms, which can be used to enhance consumer acceptance of aquaculture and promote brands.</p>
<p><b>Outputs:</b></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> <ul style="list-style-type: none"> <li>• A New Jersey Shellfish Grower's Forum was organized on Oct. 29, 2019, in Cape May, NJ by extension specialist Calvo during which Shinn and Munroe presented "A Fish's Eye View, Shellfish Farms as Marine Habitat" to local shellfish farmers.</li> <li>• Video clips of fish and other animals interacting with oyster aquaculture gear have been posted on the Munroe Lab YouTube channel (<a href="https://www.youtube.com/channel/UChJoXgBj5zrFoehIBSDXKjg">https://www.youtube.com/channel/UChJoXgBj5zrFoehIBSDXKjg</a>), and clips have been promoted on social media via the MunroeLab Twitter feed.</li> <li>• Select video clips of fish and invertebrates interacting with aquaculture habitat were spliced together, along with data on species id and abundance. These videos, data, and site information were provided to an effort compiling similar information from around the country to be part of a virtual ocean exploration tool called Virtual Field: Ecosystem Exploration Project, sponsored by NSF. This information can be used by undergraduate educators and students nationwide and we hope our videos will create awareness in a group that may be naïve to the ecosystem benefits of shellfish aquaculture. <a href="#">Here is the ecosystem exploration page</a> that includes our video clip series and the lesson created from it.</li> <li>•</li> </ul>
<p><b>Outcomes/Impacts:</b></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. <b>Outcomes/impacts are defined as changes in Knowledge, Action, or Condition.</b></p>

	<p>Knowledge — Project findings demonstrate an important environmental benefit of oyster farming — enhanced biodiversity, including both recreationally and commercially valuable species.</p> <p>Action— The findings were presented to stakeholders (resource managers and regulators, researchers, shellfish growers, shellfish consumers, and the public at large) to support the implementation of evidence-based regulations, increase the social carrying capacity of aquaculture, and to promote synergistic agri-tourism/aqua-tourism featuring on-farm recreational fishing.</p> <p>Condition—Project findings contribute to a growing body of literature indicating the ecological value of oyster farms and provide validation of novel methodologies to assess wildlife – shellfish farm interactions in-situ.</p>
<p><b>Impacts Summary</b></p>	<p>Provide short statements (2-3 sentences) about each of the following: (pre-established fields for Researchers to complete short statement answers)</p> <p>1. <b>Relevance:</b> Issue – what was the problem?  A lack of science-based information regarding oyster farm and wildlife interactions can result in precautionary regulations that establish barriers to oyster farming, yielding costly gear modifications or preventing oyster farming to occur at all. Demonstration of environmental benefits of oyster farming, such as enhanced biodiversity will enable the implementation of evidence-based regulations, increase the social carrying capacity of aquaculture, promote synergistic agri-tourism/aqua-tourism featuring on-farm recreational fishing.</p> <p>2. <b>Response:</b> What was done?  Research employing underwater on-farm video cameras was conducted to document interactions of oyster farm gear and wildlife seasonally over two years. Regional comparisons were made between similar assessments conducted in New Jersey coastal bays and in Long Island Sound, Connecticut. Results were shared with industry, academic, and general stakeholders via presentations at national, regional, and local meetings, on-line video postings, and in popular and scientific publications.</p> <p>3. <b>Results:</b> How did your work make a difference (<b>change in knowledge, actions, or conditions</b>) to the target audiences?  More than 100 hours of video recordings demonstrated the occurrence of at least 21 species from 4 phyla. Obligate, resident and transient oyster reef residents of commercial and recreational importance were observed using farm habitats supporting the conceptual model that oyster farms function similar to oyster reefs, enhancing biodiversity and ecosystem health. Such information will belay some concerns of negative wildlife interactions, providing evidence for reducing precautionary regulations, while building social capital for aquaculture as an environmentally beneficial activity.</p> <p>4. <b>Recap:</b> One- sentence summary  On-farm video documentation demonstrated that oyster farms provide important habitat for a diverse assortment of species – including recreationally and commercially important species, paralleling natural oyster reef habitat, supporting oyster farms as having significant ecological and environmental benefits.</p>

<p><b>Publications</b></p>	<p>Follow the format to list publications in the following categories:</p> <ul style="list-style-type: none"> <li>• Presentations: <ul style="list-style-type: none"> <li>○ Oral</li> </ul> <p>Shinn, J., Munroe, D., Ambrose, A., Calvo, L. 2021. Video Documentation of the Marine Community Utilizing Oyster Farm Habitat. Oral presentation, 113th National Shellfisheries Association Annual Meeting, Virtual, March 22-25, 2021.</p> <p>Ambrose, A., Munroe, D., Shinn, J., Calvo, L. 2021. Video Documentation of the Marine Community Utilizing Oyster Farm Habitat. Oral presentation, Delaware Estuary Science and Environmental Summit, Virtual, March 1-3, 2021.</p> <li>○ Posters</li> </li></ul> <p>Shinn, J., Munroe, D., Lin, T., O'Brien, J., Calvo, L. 2020. A Fish's-Eye-View: Shellfish Farms as Marine Habitat in New Jersey. Poster presentation at Milford Aquaculture Seminar, Shelton, CT, Jan. 13 -15, 2020.</p> <p>Shinn, J., Munroe, D., Lin, T., O'Brien, J., Calvo, L. 2019. A Fish's-Eye-View: Shellfish Farms as Marine Habitat in New Jersey. Poster presentation at MidAtlantic Chapter meeting of American Fishery Society. Lewes, DE. Nov. 21, 2019.</p> <ul style="list-style-type: none"> <li>• Peer-reviewed: <ul style="list-style-type: none"> <li>○ Print (journal, etc.)</li> </ul> <p>Shinn, J.P., Munroe, D.M., Rose, J. A 2021. Fish's-Eye-View: Shellfish Farms as Marine Habitat In New Jersey. <i>In Press</i> Aquaculture Environment Interactions. DOI: <a href="https://doi.org/10.3354/aei00407">https://doi.org/10.3354/aei00407</a></p> <li>○ Digital (websites, videos, etc.)</li> </li></ul> <ul style="list-style-type: none"> <li>• Non-Peer-reviewed: <ul style="list-style-type: none"> <li>○ Extension factsheets</li> </ul> <p>None at this time.</p> <li>○ Popular articles</li> </li></ul> <p>We worked with one of our project suppliers to write a public-facing article about this project. The post can be found here:</p> <p><a href="https://cam-do.com/blogs/camdo-blog/customer-footage-studying-oyster-farm-and-aquatic-wildlife-interaction-with-blink">https://cam-do.com/blogs/camdo-blog/customer-footage-studying-oyster-farm-and-aquatic-wildlife-interaction-with-blink</a></p> <li>○ In response to the academic shutdown caused by COVID-19 pandemic, the Organization of Biological Field Stations (OBFS) launched an emergency</li>
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	<p>grassroots effort to create and distribute virtual learning resources from field stations and marine laboratory (FSMLs) to support faculty, students, and others. Here is the <a href="#">ecosystem exploration page</a> that includes our video clip series and the lesson created from it.</p> <p>○</p>			
<b>Students/Participants:</b>	<p>Provide the following information for <b>every</b> student that worked with you during the reporting period:          No students worked with us during the project period. We anticipate that the database being developed from the 2019 videos, and the regional comparisons could support a masters student project in the future.</p> <ul style="list-style-type: none"> <li>• Name:</li> <li>• Whether Degree was completed during the reporting period (name, yes/no):</li> <li>• New or Continuing Student:</li> <li>• Capstone/Thesis Title (actual or anticipated):</li> <li>• Date of Graduation:</li> <li>• Provide link to thesis/dissertation document:</li> </ul>			
<b>Partnerships</b>	<p>List any partners that you worked with on your project. Provide the following information for each Partner:</p>			
	<p><b>Partner</b> Northern Cape Sea Farms</p>	<p><b>Specific Type</b> Oyster Farm</p>	<p><b>Level</b> Partner</p>	<p><b>Nature of Partnership</b> Provided access to farm site and assistance while on farm.</p>
	<p>NOAA Milford Lab</p>	<p>Shellfish Lab</p>	<p>Collaborator</p>	<p>Assisted with project planning, interpretation of results, and writing manuscript.</p>