Preview of Award 1841435 - Annual Project Report

Cover

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Accomplishments

* What are the major goals of the project?

The Science Center for Marine Fisheries, SCEMFIS, provides academic research products essential for the sustainable management of shellfish and finfish resources. SCEMFIS seeks to simultaneously achieve the goals of sustainable fish and shellfish stocks and sustainable fish and shellfish fisheries. A multi-decadal evolution in fisheries management in the U.S. has formalized the criteria for sustainability and developed sophisticated modeling tools to achieve this goal; but success is limited by insufficient information on the finfish and shellfish stocks and fisheries and insufficient development of numerical applications to surmount the modeling challenges posed by these sustainability goals. Rapid climate change continues to expose the limitations of present-day data resources and assessment, exacerbating the gap between data resource availability and data resource needs. Increasingly complex management requirements continue to reveal limitations in data resources, data analysis, and model construction, thereby limiting the attainment of maximum sustainable yield.

The attainment of the dual goals of sustainable fish stocks and sustainable fishing industries requires a dual focus on (a) the assessment process that determines the status of the stock and (b) the regulatory process that provides the vehicle by which the fishery is managed to optimize stock status while supporting a robust industry on the one hand and, on the other hand, the addressment of constraints, economic and logistical, on the fishery limiting its adaptation to the evolving climatic and managerial environment. SCEMFIS supports an academic research program encompassing both components of the management process and projects directed at improving fishing company performance. SCEMFIS' capabilities encompass the range of oceanographic, fisheries, and marine biological disciplines essential for addressing the data resource and analytical challenges faced by modern-day fisheries management, and scientific fields as widely ranging as food science and marine engineering to address performance issues imposed by climate change and competing uses of the continental shelf.

* What was accomplished under these goals and objectives (you must provide information for at least one of the 4 categories below)?

Major Activities:	Ongoing projects and projects completed in 2022:

1. *Evaluating the impact of plus group definition on the Atlantic and Gulf Menhaden stock assessments: A* simulation study to characterize the impact of including different ages in the plus group on accuracy and precision of model estimates of fishery selectivity and fishing mortality.

2. *Evaluation of alternative approaches to risk-based catch advice*: Time series of catch advice, implied fishing mortality limit or target, and realized catch and fishing mortality will be used to derive the performance of alternative methods for risk-based catch advice.

3. *Ocean quahog population dynamics: validation of estimation procedures for an age-at-length key:* The range of ages at length, the skewed distribution of the number of individuals at age at length, and the variation between sites constrain development of an age-at-length key for ocean quahogs.

4. *Influence of global warming on Atlantic surfclam and ocean quahog:* Analysis of the NEFSC ancillary database and ocean quahog age frequencies has identified issues related to the continued shift in range of these species. Dating of shells in regions not presently inhabited will permit determination of timing of previous occupation a record of historical range shifts.

5. *Could federal wind farms influence continental shelf oceanography and alter shellfish larval dispersal?:* A review of the scientific and grey literature will be conducted to identify relevant information about the possible ways that wind energy areas may interact with seasonal stratification and cold pool stability.

6. *Mid-Atlantic discards analysis*: This project will develop tools in the commercial fishery to reduce bycatch and to promote understanding by the industry of the characteristics of the fishers (gear and sectors) and fishing activity (spatial and temporal patterns) that impact bycatch.

7. *Retrospective analysis of age and growth rates in Atlantic surfclams*: This project proposes to develop a 33-year retrospective spatially-explicit time series of growth rates in surfclams to document the changes in population productivity.

8. *Understanding the utility of archived tag-recapture data for evaluation of movement and mortality estimation*: The Gulf Menhaden Stock Assessment recommended replicating tagging work from 1969 to 1985. Such a study is cost prohibitive, but re-analysis of the previously collected data can provide new insights.

9. *Ocean quahog population dynamics: development of a dataset supporting use of age compositions in the assessment*: SCeMFiS supported acquisition of the first population age frequencies for ocean quahogs in the northwest Atlantic. This project addresses the issue with focus on New Jersey because the influence of Mid-Atlantic Bight (MAB) warming is greatest there.

10. *Evaluation of co-occurrence of surfclams and ocean quahogs at fishable concentrations*: Warming of the Mid-Atlantic continental shelf has initiated a range shift such that an ecotone now exists over much of the offshore range wherein both are jointly found. Regulations prohibit the landing of the two species simultaneously. Fishing in these areas may unduly increase discards and the cost of fishing. The extent of the problem needs to be specified before potential mechanisms to address the present joint-species landing prohibition can be sought.

11. *Development of Improved clam dredge system using theory, CFD, and experiment:* This project will evaluate performance of hydraulic dredges and develop recommendations for improvement.

12. *Developing process and procedures for the refinement of surf clam and ocean quahog shells into calcium carbonate*: The project focuses on turning shell waste into a value-added product, contributing to blue economy efforts and promote sustainability.

13. *What hatchery capacity would be needed to support surfclam fishery mitigation via seeding fishing grounds?* Currently, the United States has over 1.7 million square acres of federal waters under lease for wind energy. This study will evaluate mitigation strategies and other ways to support fishing communities as offshore wind energy expands.

14. *Evaluation of ocean quahog ageing program for providing age data for the assessment; identification of status, uncertainty, and additional research needs*: Ocean quahogs are the oldest animals under federal management, making them particularly vulnerable to climate change. This study will host a workshop to comprehensively evaluate progress made by the SCEMFIS ocean quahog research program.

15. *Menhaden economic impact and management uncertainty*: This project focuses on developing an economic input-output model for the menhaden fishery.

16. *Biostatistical and fishery-dependent sampling of Atlantic thread herring and chub mackerel in the mid-Atlantic region*: This project will conduct a sampling survey of thread herring and Atlantic chub mackerel to collect data on the fish being harvested, including age, length, and weight.

17. *Ocean quahog population dynamics: project completion*: SCEMFIS researchers have worked extensively at expanding our understanding of ocean quahog. This project will complete the Center's ongoing work on ocean quahog.

18. *Genetic and age structure of Southern surfclams*: The surfclam fishery has recently resumed fishing off the coast of Virginia where high bottom water temperatures have led to the deaths of most surfclams during much of the 2010s. To better understand how and why surfclams have returned to this area, this project will conduct genetic testing on a sample of clams from the area.

19. *Squid age estimation using computer assisted tomography technology*: This project will evaluate the use of CAT scan technology as a tool to age squid.

20. *Sea water temperature and cod spawn*ing: This project will assemble the most recent hydrodynamic model outputs to evaluate the reliability of cod spawning sanctuaries to remain critical cod spawning regions into the coming decade.

21. *Combining biotracer and stomach contents analysis to improve understanding of trophic dynamics in the northern Gulf of Mexico*: This project will use stomach content data and stable isotope analysis to estimate the food-web topology and diet matrix for menhaden.

22. *Evaluation of geographic distribution of "charismatic" species*: A SCEMFIS-compiled database presents an opportunity to map regions potentially sensitive to bottom tending gear as a prelude to more intensive surveying by e.g., camera transect.

23. *Leveraging machine learning and catch commercial catch data for development of a discard bycatch mitigation plan in the scup fishery*: This project will evaluate fishery independent data to determine if strong year classes can be detected and examine the spatial, temporal, and gear characteristics in relation to estimated biomass.

24. *EMF impacts on benthos*: This project will evaluate how the EMF environment will be influenced by additional EMF originating with operation of buried transmission cables associated with wind farms.

25. *A clam dredge with integrated pumps***:** This project will examine placement of the pump on the dredge rather than on the vessel, thereby eliminating the hose and ensuring constant pressure at the manifold.

26. *Clam resource distribution, a GIS summary*: This project will assemble historical survey and fishing data to develop GIS layers that illustrate how the overlap of surfclams and ocean quahogs has grown in recent decades.

27. *Metabarcoding the gut contents of predatory fish in coastal Louisiana*: This project will assess the degree to which predators rely on Gulf Menhaden by sequencing DNA from partially digested prey in predator stomachs.

28. *Assessing stranded capital and capital devaluation in the seafood industry due to offshore wind energy development*: This project will assess the potential for stranded capital and capital devaluation in the seafood industry resulting from offshore wind energy development.

Specific Objectives:	The objective of this project is to expand an I/UCRC center focused on marine fisheries, the Science Center for Marine Fisheries or SCEMFIS, and to fulfill the mission and goals of that center. The bylaws establish the mission under which the IAB operates.

Vision Statement: SCeMFiS will provide academic research products essential for the sustainable management of shellfish and finfish resources. SCeMFiS seeks to simultaneously achieve the goals of sustainable fish and shellfish stocks and sustainable fish and shellfish fisheries. A multi-decadal evolution in fisheries management in the U.S. has formalized the criteria for sustainability and developed sophisticated modeling tools to achieve this goal; but success is limited by insufficient information on the finfish and shellfish stocks and fisheries and insufficient development of numerical applications to surmount the modeling challenges posed by these sustainability goals. Rapid climate change continues to expose the limitations of present-day data resources and assessment, exacerbating the gap between data resource availability and data resource needs. Increasingly complex management requirements continue to reveal limitations in data resources, data analysis, and model construction, thereby limiting the attainment of maximum sustainable yield. The attainment of the dual goals of sustainable fish stocks and sustainable fishing industries requires a dual focus on (a) the assessment process that determines the status of the stock and (b) the regulatory process that provides the vehicle by which the fishery is managed to optimize stock status while supporting a robust industry. SCEMFIS supports an academic research program encompassing both components of the management process. SCEMFIS' capabilities encompass the range of oceanographic, fisheries, and marine biological disciplines essential for addressing the data resource and analytical challenges faced by modern-day fisheries management.

Mission Statement: SCEMFIS utilizes academic, recreational and commercial fishery resources to address urgent and emerging scientific problems that could limit sustainable fisheries. SCEMFIS provides academic research products with a goal of enhancing efficient management of shellfish and finfish resources. SCeMFiS provides scientific research products essential in enhancing awareness of the health benefits of sustainable seafood as well as increasing opportunities for valued growth within seafood business sectors.

Research Focus: The science agenda of SCEMFIS includes the development of essential biological data on fish stocks, including fecundity, age structure, and sources of mortality; support for cooperative surveys and survey augmentation needs; improved models of sampling design, population dynamics, habitat, and fishery performance; evaluation of geographic and depth variations in stock structure and how these relate to the genetics, physiology and sexual dimorphism of species; improved approaches to fishing to limit discard reduction through gear innovation, but also through modifications in fleet deployment consistent with oceanographic processes; development of improved sustainability criteria and evaluation of sustainability; improved assessment model formulations to better integrate available data; refined approaches to establishing biological reference points, development of new options for use of processing plant waste products, improvement in fishing gear and post-harvest processing, and evaluation of economics in the fishery.

Significant Results:	A status report for selected funded projects follows.

1. *Ocean quahog population dynamics: validation of estimation procedures for an age-at-length key:* Field collection occurred in August 2017 with ship time supported by the Northeast Fisheries Science Center (NEFSC). About 2,000 clams have been aged. Substantial differences have been observed in the size at age for males and females, indicating the need to generate sex-specific keys and between regions indicating the need to generate regional keys.

2. *The influence of global warming on the Atlantic surfclam and the ocean quahog:* In August 2019, sampling was conducted inshore of the present range of the ocean quahog from New Jersey to Delmarva, "Fossil" ocean quahogs collected have been C-14 dated to determine the time-since-death of these clams. Results reveal multiple cross-shelf range shifts over the last 4,500 yr.

3. *Mid-Atlantic discards analysis*: This project focused on quantifying the taxonomic composition and haul (weight, lbs.) of bycatch species in trawl fisheries. Taxonomic composition and the combination of the taxa and haul weight (lbs.) are best predicted by the location and time of fishing and not by the liner mesh size, cod end mesh size, or gear used.

4. *Evaluating the impact of plus group definition on the Atlantic and Gulf Menhaden stock assessments:* Evaluation of the impact of plus group size for Gulf menhaden is completed. The model performs well under most alternative scenarios, but is sensitive to the degree of doming of the commercial selectivity curve.

5. *Retrospective analysis of age and growth rates in Atlantic surfclams*: The entire dataset of aged surfclams has been obtained from the NEFSC. A reader inter-calibration exercise has been undertaken and published. Estimates of growth rates show changes over time consistent with Mid-Atlantic warming and its effect on surfclam physiology.

6. *Understanding the utility of archived tag-recapture data for evaluation of movement and mortality estimation*: An extensive dataset has been formatted for inclusion into the model and detailed quality assurance and quality control procedures undertaken. Determination of the appropriate model for mortality estimation is in progress,

7. *Ocean quahog population dynamics: development of a dataset supporting use of age compositions in the assessment*: More than 1,500 ocean quahogs have been acquired from two locations on the New Jersey continental shelf. These animals have been shucked and sexed. Ageing is completed and analysis is underway.

8. *Evaluation of the degree of co-occurrence of surfclams and ocean quahogs at fishable concentrations*: The NEFSC survey database has been analyzed to obtain locations where the survey vessel caught significant numbers of both species in the 2016-2019 period. The field program was completed in August 2021 and a cruise report released to the public.

9. *Development of improved clam dredge system using theory, Computational Fluid Dynamics (CFD), and experiment:* A fluid dynamics study has been completed using University of Texas' Texas Advanced Computing Center super-computer to model the flow inside the dredge manifold with various nozzle geometries. This allows determination of the head loss coefficient of the jets, which can then be used to find the optimal operating point of the dredge system, and the corresponding performance requirements of the dredge pump.

10. *Developing process and procedures for the refinement of surfclam and ocean quahog shells into calcium carbonate (CaCO3):* A chemical cleaning procedure has been developed followed by a heating protocol to remove all associated organics. Thermogravimetric analysis (TGA) confirmed the thermal stability of the final samples. X-ray diffraction (XRD) showed that the polymorph is in agreement with commercial CaCO3.

11. *Could federal wind farms influence continental shelf oceanography and alter shellfish larval dispersal? A literature review:* A review of the scientific and grey literature was completed and is available on the SCEMFIS website.

12. *What hatchery capacity would be needed to support surfclam fishery mitigation via seeding fishing grounds?* A project report can be found on the SCEMFIS website.

13. *Evaluation of ocean quahog ageing program for providing age data for the assessment; identification of status, uncertainty, and additional research needs***:** Terms of reference were formulated and the workshop occurred in May 2022. Science advice for additional research was compiled and distributed to the IAB, federal, and academic communities.

14. *Menhaden Economic Impact and Management Uncertainty***:** A project report can be found on the SCEMFIS website.

15. *Biostatistical and fishery-dependent sampling of Atlantic thread herring and Atlantic chub mackerel in the mid-Atlantic region***:** This project is delayed due to fish availability.

16. *Ocean quahog population dynamics: project completion***:** Project reports in the form of publications are in progress.

17. *Genetic and age structure of Southern surfclams***:** Essentially all clams analyzed were identified as *Spisula solidissima* rather than the southern species that has been found inshore.

18. *Squid age estimation using CAT Scan technology***:** A project report can be found on the SCEMFIS website.

19. *Sea water temperature and cod spawn*ing: This project is new.

20. *Combining biotracer and stomach contents analysis to improve understanding of trophic dynamics in the northern Gulf of Mexico*: This project is new.

21. *Evaluation of geographic distribution of "charismatic" species*: This project is new.

22. *Leveraging machine learning and catch commercial catch data for development of a discard bycatch mitigation plan in the scup fishery*: This project is new.

23. *EMF impacts on benthos*: This project is new.

24. *A clam dredge with integrated pumps*: This project is new.

25. *Clam resource distribution, a GIS summary*: This project is new.

26. *Metabarcoding the gut contents of predatory fish in coastal Louisiana*: This project is new.

27. *Assessing stranded capital and capital devaluation in the seafood industry due to offshore wind energy development*: This project is new.

Key outcomes or Other achievements:	- The Industry Advisory Board (IAB) of SCeMFiS met twice, in April and in November, 2022, and convened by conference call in January and in July, 2022. - IAB meetings successfully returned to an in-person format, but retained a virtual option for IAB members and PIs who could not attend in person. - The IAB developed the science agenda for Year 4 of Phase II at its April and November meetings. All projects are currently underway with final reports expected in 2023. These projects continued SCeMFiS' expanded funding footprint with collaborating scientists from Nicholls State University, University of Texas-Austin, University of Massachusetts-Dartmouth, Rutgers University, University of Maryland, Cornell University, and two U.S. private organizations. - In 2022, SCeMFiS supported 28 research projects. Of these, over half were collaborative and involved researchers from more than one research institution. - SCEMFIS successfully completed its first project on product development in keeping with the expanded mission of the center approved in 2019. - SCEMFIS expanded its gear development program, funding design of a new survey dredge, now built and tested at sea, and improvements in hydraulic dredge performance. - In addition to membership fees, SCEMFIS scientists received 6 REU supplement, 1 VRS supplement, and 5 Non-Academic Research Internships for Graduate Students. Placement included private firms (Omega Protein and Atlantic Capes) and federal labs (NOAA-NMFS and the Princeton Geophysical Fluid Dynamics Lab). - SCEMFIS scientists and collaborators received $582,185 from Atlantic Shores to study the influence of wind energy development off the U.S. east coast on the surfclam fishery. This project will use SEFES (Spatially-explicit Fishery Economics Simulator), a model developed through SCeMFiS funding and will provide the first rigorous projections of the effect of future climate change on fish stocks and fishery economics. - A Scallop research set-aside (RSA) project based on the SEFES model was also funded: Science $375,689; Compensation $1,124,300. - SCEMFIS scientists received $399,205 from the NSF Paleo Perspectives on Climate Change program for a proposal entitled: Geographic-scale range shifts of benthic biomass dominants on the continental shelf: Holocene history as a window to the

future in the Mid-Atlantic. This proposal builds on a SCEMFIS-funded project in which subfossil ocean quahog shells were collected and dated, demonstrating their value in the study of long-term climate change in the Mid-Atlantic. The present study focuses on the description of the range dynamics during historical periods of climate change in a region where the hydrodynamics assure an extensive geographic region within which cold temperate and boreal faunas abut and during range shifts transiently overlap.

- SCEMFIS expanded its program on fisheries and climate change including developing a new relationship with the Princeton Geophysical Fluid Dynamics Lab.
- The 2020 initiative addressing the interaction of wind energy development offshore with fisheries and climate change was expanded in 2022 with SCEMFIS developed software being used by 3 federal research programs and a formal press release and video release focused on the Cold Pool. The Cold Pool is the principal environmental organizer for the biota of the U.S. continental shelf north of Cape Hatteras, North Carolina.
- SCEMFIS scientists provided testimony to Mid Atlantic Fisheries Management Council related to species overlap and mixed catch landings for surfclam and ocean quahogs.
- SCeMFiS compiled the following list of press releases for 2022. These press releases were coordinated by Stove Boat, SCEMFIS' public relations firm.

o New Research Looks to Further Reduce Uncertainty and Improve Confidence in Menhaden Assessments - October 27, 2022. SCEMFIS has been at the forefront of investigating new ways to improve the science behind menhaden fisheries, the largest fisheries by weight on both the Atlantic and Gulf coasts. This latest research looks at one of the remaining areas of uncertainty in menhaden science, and how much it potentially affects the accuracy of menhaden assessments.

o New Study: The History of Climate Change Found in Shellfish Shells - August 29, 2022. As parts of the Atlantic Ocean warm at unprecedented rates, researchers are looking to past warming trends to help understand how previous changes in climate have influenced marine life. A new study looks at the fossil record of one of Earth's longest-lived species to provide new insights into historic changes in climate, and the impacts that it caused.

o Climate Change Creating New Conflicts for Surfclam, Ocean Quahog Fisheries as Warming Forces Habitat Shifts - July 21, 2022. Climate change is now affecting long-standing patterns for marine life, with warmer waters pushing species out of their traditional habitats and into newer areas. As these changes become increasingly common, they will create challenges for fishermen, scientists, and regulators. SCEMFIS is examining the extent of the problem on two key shellfish species: surfclams and ocean quahogs.

o New Study Develops Method to Age Ocean Quahog, Longest-Lived Species in the Ocean **-** April 21, 2022. Although ocean quahogs are some of the longest-lived animals in the world and famous for their longevity, many details about their age structure-such as how it affects estimates of recruitment, biomass, and growth-are still not well understood. A newly study finds that ocean quahogs have recruited continuously for over 200 years on Georges Bank, off the East Coast of the U.S., while also providing new tools to researchers and fisheries managers to better understand the species.

o New Acoustic Survey Will Investigate Previously Uncounted Menhaden- January 12, 2022. Despite being one of the largest and most high-profile fisheries on the East Coast, gaps still exist in our understanding of Atlantic menhaden. This is especially true in New England and the Mid-Atlantic. But this winter, a new project will look specifically to count menhaden in these areas, shedding new light on an important but underexamined portion of this species.

o Science Center for Marine Fisheries Approves $126,000 in New Research for 2022 - January 3, 2022.

- SCEMFIS created the following video to highlight Center research and document fisheries ageing techniques.

o SCEMFIS: How climate change is pushing surfclams and ocean quahogs into conflict (July 2022). In fall 2021, SCEMFIS researchers set out on the *F/V Pursuit* to record how climate change is affecting surfclams (*Spisula solidissima*) and ocean quahogs (*Arctica islandica*), as warmer waters push the two formerly separate species into overlapping habitats. Here, the lead scientists on the project join other survey participants and members of the industry to discuss what they found, and what it means for the future of these shellfish and their fisheries.

* What opportunities for training and professional development has the project provided?

Eight graduate students and 13 undergraduates participated in SCeMFiS projects. Thesis/dissertation research is being conducted on menhaden and other forage fish as part of the forage fish research focus, ageing of ocean quahogs to provide data for the age-length key development and improved measures of recruitment and mortality, and surfclam/summer flounder risk assessment, the latter two being intensive modeling projects in support of improved NMFS assessments. Other projects include the influence of global warming on surfclam growth rates and the estimation of historical range shifts for ocean quahogs using C-14 dated shells. Nine REU/VRSs were obtained, 4 to USM, 3 to VIMS, 1 to UT-Austin, and 1 to Rutgers University. Five Non-Academic Research Internships for Graduate Students were obtained in 2022, bringing the total to 7. Mentors include NMFS-NEFSC and the Geophysical Fluid Dynamics Lab in Princeton, Omega Protein, and Atlantic Capes Fisheries. Graduates this year, all of which had internships, have gone on to Ph.D. programs (Auburn, Wyoming), and have been employed by NMFS-NEFSC. NOAA-Coastal Resilience, Restoration, and Assessment, and USFWS

* Have the results been disseminated to communities of interest? If so, please provide details.

Participation in National Marine Fisheries Service (NMFS) working groups has provided venues for dissemination to the management and regulatory communities encompassed by the NMFS-NEFSC and MAFMC (Mid-Atlantic Fisheries Management Council). Presentations at meetings of the American Fisheries Society (AFS), the National Shellfisheries Association (NSA), International Council for Exploration of the Seas (ICES), Coastal and Estuarine Research Federation (CERF), and other meetings, as well as to assessment staff of the NEFSC, Atlantic States Marine Fisheries Commission (ASMFC), and the Gulf States Marine Fisheries Commission (GSMFC) normally provide outreach to a range of academic and federal scientists. SCEMFIS ocean quahog research has been highlighted in the American Institute of Fishery Research Biologists (AIFRB) newsletter. A SCEMFIS staff member serves as the Gulf lead for AIFRB. The SCEMFIS webpage provides public access to all final reports and links to all publications. SCEMFIS continued a relationship with Stove Boat, a fisheries-targeted public relations firm to increase dissemination of SCEMFIS findings to the public at large, with an emphasis on those associated with commercial fisheries and its management. A summary of Stove Boat's activities is found in a preceding portion of this report. Finally, the IAB assigned an IAB liaison to each project to provide frequent contact and information transfer between the PIs and the IAB. In addition, project status has been discussed frequently via emails and conference calls between the IAB and the PIs. Members of the IAB have met frequently with SCEMFIS scientists.

In 2022, SCEMFIS Operations assisted with seven press releases written by the Stove Boat Communications consulting firm. In addition to distribution on the SCEMFIS website, press releases were served on Saving Seafood, a distribution outlet designed to keep industry members aware of issues and events of concern as well as Accesswire, a press release service and global newswire. Both Saving Seafood and Accesswire have high visibility within the fisheries community.

One video entitled "How climate change is pushing surfclams and ocean quahogs into conflict" was produced and served on the SCEMFIS website as well as YouTube. Plans are underway to also show this video to Mid-Atlantic Fisheries Council members for education purposes since it is a current critical fisheries management issue.

In 2022, SCEMFIS participated in the NSF "Twitter Takeover" and NSF Video Selfies which highlighted graduate and REU student work at various colleges and universities associated with the Center. There were six submissions for SCEMFIS. With regard to social media management in general, SCEMFIS Operations is the admin for Facebook, Twitter, and LinkedIn pages that highlight SCEMFIS accomplishments.

The SCEMFIS Operations also began populating SCEMFIS projects within an AirTable template created by Venturewell for IUCRC Centers. AirTable is a project management system with multiple views and reporting capabilities. It is a workflow management tool for defining, managing, and improving services that deliver information. AirTable helps visualize work, maximize efficiency, and improve project coordination. SCEMFIS projects will be represented visually on Kanban boards, allowing more efficient project tracking, member participation, associated liaisons, finances, and proposals. The goal is to manage projects with multiple components on a single platform and provide reports to IAB members that can be customized.

* What do you plan to do during the next reporting period to accomplish the goals?

SCEMFIS is working well. In the coming period we will expand on product technology to develop alternative value added products from materials that were previously low value waste. We will integrate recent biological data on climate driven changes in fishing target species distributions into flexible management plans that sustain the resource while also serving economic stability for the processing and wholesale sectors. With the advent of wind energy development on the continental shelf, SCEMFIS will expand its biological, fishery, and economics portfolios to include competing uses of the continental shelf. A 2022 workshop peer-reviewing the SCEMFIS ocean quahog research portfolio is anticipated to provide new directions for this research theme. Significant ongoing efforts will remain with focus on management and assessment issues to maintain stock sustainability, both in the finfish and shellfish sectors. SCEMFIS will formally propose the next phase of its program to NSF in 2023.

Products

Books

Book Chapters

Inventions

Journals or Juried Conference Papers
View all journal publications currently available in the NSF Public Access Repository for this award.

The results in the NSF Public Access Repository will include a comprehensive listing of all journal publications recorded to date that are associated with this award.

Sower, Jillian R. and Robillard, Eric and Powell, Eric N. and Hemeon, Kathleen M. and Mann, Roger. (2022). Defining Patterns in Ocean Quahog (Arctica islandica) Sexual Dimorphism along the Mid-Atlantic Bight. *Journal of Shellfish Research*. 41 (3) . Status = Deposited in NSF-PAR doi:https://doi.org/10.2983/035.041.0304 ; Federal Government's License = Acknowledged. (Completed by Mann, Roger on 01/23/2023) Full text   Citation details

LeClaire, Alyssa M and Powell, Eric N and Mann, Roger and Hemeon, Kathleen M and Pace, Sara M and Sower, Jill R and Redmond, Theresa E. (2022). Historical biogeographic range shifts and the influence of climate change on ocean quahogs (*Arctica islandica*) on the Mid-Atlantic Bight. *The Holocene*. 32 (9) 964 to 976. Status = Deposited in NSF-PAR doi:https://doi.org/10.1177/09596836221101275 ; Federal Government's License = Acknowledged. (Completed by Mann, Roger on 01/23/2023) Full text   Citation details

Mann, Roger. (2021). An Ecosystem is Not a Monument, and Other Challenges to Fishing in the 21st Century. *Journal of Shellfish Research*. 40 (2) . Status = Deposited in NSF-PAR doi:https://doi.org/10.2983/035.040.0201 ; Federal Government's License = Acknowledged. (Completed by Mann, Roger on 01/23/2023) Full text   Citation details

Mann, Roger and Southworth, Melissa and Wesson, James and Thomas, John and Tarnowski, Mitchell and Homer, Mark. (2021). Oyster Shell Production and Loss in the Chesapeake Bay. *Journal of Shellfish Research*. 40 (3) . Status = Deposited in NSF-PAR doi:https://doi.org/10.2983/035.040.0302 ; Federal Government's License = Acknowledged. (Completed by Mann, Roger on 01/23/2023) Full text   Citation details

Powell, Eric N.. (2020). Ocean quahogs (Arctica islandica) and Atlantic surfclams (Spisula solidissima) on the Mid-Atlantic Bight continental shelf and Georges Bank: The death assemblage as a recorder of climate change and the reorganization of the continental shelf benthos.. *Palaeogeography palaeoclimatology palaeoecology*. 537 (C) . Status = Deposited in NSF-PAR doi:https://doi.org/10.1016/j.palaeo.2019.05.027 ; Federal Government's License = Acknowledged. (Completed by Mann, null on 01/03/2022) Full text   Citation details

Mann, Roger and. (2020). The Case of the 'Missing' Arctic Bivalves and The Walrus: The Biggest [Overlooked] Clam Fishery on the Planet.. *Journal of shellfish research*. 39 (3) . Status = Deposited in NSF-PAR doi:https://doi.org/doi:https://doi.org/10.2983/035.039.0301 ; Federal Government's License = Acknowledged. (Completed by Mann, null on 01/03/2022) Full text   Citation details

Friedland, Kevin D.. (2020). Trends and change points in surface and bottom thermal environments of the US Northeast Continental Shelf Ecosystem. *Fisheries oceanography*. 29 (5) . Status = Deposited in NSF-PAR doi:https://doi.org/doi:https://doi.org/10.1111/fog.12485 ; Federal Government's License = Acknowledged. (Completed by Mann, null on 01/03/2022) Full text   Citation details

Powell, Eric N.. (2021). The conundrum of biont-free substrates on a high-energy continental shelf: Burial and scour on Nantucket Shoals, Great South Channel.. *Estuarine coastal and shelf science*. 249 . Status = Deposited in NSF-PAR doi:https://doi.org/doi:https://doi.org /10.1016/j.ecss.2020.107089 ; Federal Government's License = Acknowledged. (Completed by Mann, null on 01/03/2022) Full text   Citation details

Punt, André E.. (2021). Performance metrics for alternative management strategies for gray seal-commercial fishery interactions in the Northwest Atlantic. *Fisheries research*. 243 . Status = Deposited in NSF-PAR doi:https://doi.org/doi:https://doi.org/10.1016/j.fishres.2021.106060 ; Federal Government's License = Acknowledged. (Completed by Mann, null on 01/03/2022) Full text   Citation details

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Nesslage, Geneviève M.. (2020). A Simulation-Based Evaluation of Commercial Port Sampling Programs for the Gulf and Atlantic Menhaden Fisheries.. *North American journal of fisheries management*. 40 (4) . Status = Deposited in NSF-PAR doi:https://doi.org/doi:https://doi.org/10.1002/nafm.10459 ; Federal Government's License = Acknowledged. (Completed by Mann, null on 01/03/2022) Full text   Citation details

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Hemeon, Kathleen M.. (2021). Attainability of Accurate Age Frequencies for Ocean Quahogs (Arctica islandica) Using Large Datasets: Protocol, Reader Precision, and Error Assessment. *Journal of shellfish research*. 40 (2) . Status = Deposited in NSF-PAR doi:https://doi.org/doi:https://doi.org/10.2983/035.040.0206 ; Federal Government's License = Acknowledged. (Completed by Mann, null on 01/03/2022) Full text   Citation details

Kuykendall, Kelsey M.. (2019). The effect of abundance changes on a management strategy evaluation for the Atlantic surfclam (Spisula solidissima) using a spatially explicit, vessel-based fisheries model. *Ocean and coastal management*. 169 . Status = Deposited in NSF-PAR doi:https://doi.org/https://doi.org/10.1016/j.ocecoaman.2018.11.008 ; Federal Government's License = Acknowledged. (Completed by Mann, Roger on 03/01/2020) Full text   Citation details

Powell, Eric N.. (2020). Growth and longevity in surfclams east of Nantucket: Range expansion in response to the post-2000 warming of the North Atlantic.. *Continental shelf research*. 195 . Status = Deposited in NSF-PAR doi:https://doi.org/doi:https://doi.org/10.1016 /j.csr.2020.104059 ; ; Federal Government's License = Acknowledged. (Completed by Mann, null on 01/03/2022) Full text   Citation details

Cadrin, Steven X.. (2020). Defining spatial structure for fishery stock assessment.. *Fisheries research*. 221 . Status = Deposited in NSF-PAR
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Leaf, Robert T.. (2019). Construction and evaluation of a robust trophic network model for the northern Gulf of Mexico ecosystem. *Ecological informatics*. 50 . Status = Deposited in NSF-PAR   doi:https://doi.org/https://doi.org/10.1016/j.ecoinf.2018.12.005 ; Federal Government's License = Acknowledged. (Completed by Mann, Roger on 03/01/2020) Full text   Citation details

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Powell, Eric N.. (2019). The intermingling of benthic macroinvertebrate communities during a period of shifting range: The "East of Nantucket" Atlantic Surfclam Survey and the existence of transient multiple stable states. *Marine ecology*. . Status = Deposited in NSF-PAR doi:DOI: 10.1111/maec.12546 ; Federal Government's License = Acknowledged. (Completed by Mann, Roger on 03/01/2020) Full text   Citation details

Cadrin, Steven X.. (2019). "So, where do you come from?" The impact of assumed spatial population structure on estimates of recruitment. *Fisheries research*. 217 156-186. Status = Deposited in NSF-PAR doi:https://doi:10.1016/j.fishres.2018.11.030 ; Federal Government's License = Acknowledged. (Completed by Mann, Roger on 03/01/2020) Full text   Citation details

Liang, Dong and. (2020). A spatial simulation approach to hydroacoustic survey design: A case study for Atlantic menhaden. *Fisheries research*. 222 105402. Status = Deposited in NSF-PAR doi:https://doi.org/10.1016/j.fishres.2019.105402 ; Federal Government's License = Acknowledged. (Completed by Mann, Roger on 03/01/2020) Full text   Citation details

Daley, Taylor T and Leaf, Robert T. (2019). Age and growth of Atlantic chub mackerel (Scomber colias) in the Northwest Atlantic. *Journal of Northwest Atlantic fishery science*. 50 1-12. Status = Deposited in NSF-PAR doi:doi:10.2960/J.v50.m717 ; Federal Government's License = Acknowledged. (Completed by Mann, Roger on 03/01/2020) Full text   Citation details

Licenses

Other Conference Presentations / Papers

Mann,R., E.N. Powell, J.M. Klinck, S. Pace, C.M. Long, T. Redmond, K. Russell (2019). *A 250 year chronology of Arctica islandica in the Mid-Atlantic region of the US continental shelf.*. 5th sclerochronology conference.. Split, Croatia. Status = OTHER; Acknowledgement of Federal Support = Yes

Long,M.C., S. Pace, R. Mann, E.N. Powell, T. Redmond (2019). *A multi-decade record of increasing growth rates in a Mid-Atlantic population of ocean quahogs*. 5th sclerochronology conference. Split, Croatia. Status = OTHER; Acknowledgement of Federal Support = Yes

Poussard, L., E. Powell, D. Hennen (2019). *An analysis of dredge efficiency for ocean quahog and surfclam commercial dredges*. Aquaculture 2019. New Orleans LA. Status = OTHER; Acknowledgement of Federal Support = Yes

Poussard, L., E. Powell, D. Hennen (2019). *An analysis of dredge efficiency for ocean quahog and surfclam commercial dredges.*. CERF 2019 25th biennial conference. Mobile AL. Status = OTHER; Acknowledgement of Federal Support = Yes

Scheld, A., J. Beckensteiner, D. Munroe, E. Powell, L. Solinger, E.E. Hofmann, J.M. Klinck, M. Gonzalez- Diaz (2021). *Assessing economic impacts to the US commercial surfclam fishing industry from offshore wind energy development*. National Shellfisheries Association Annual Meeting. virtual. Status = OTHER; Acknowledgement of Federal Support = Yes

Russell,K., M.C. Long, T. Redmond, S. Pace, R. Mann, E.N. Powell (2019). *Can we discern major meteorological and environmental events in the growth record of the long lived clam Arctica islandica?*. National Shellfisheries Association. New Orleans LA. Status = OTHER; Acknowledgement of Federal Support = Yes

Long,M.C., R. Mann (2019). *Collections of Young Ocean Quahogs: Lessons learned from from the Newest Recruits of the World's Longest-Living Metazoan*. National Shellfisheries Association. New Orleans LA. Status = OTHER; Acknowledgement of Federal Support = Yes

Kathleen Hemeon, Eric Robillard, Eric Powell, Roger Mann, Theresa Redmond, Sara Pace, and Jillian Sower (2021). *Determining Age-Reader Precision and Bias When Aging Arctica Islandica, The Oldest Living Bivalve on Earth.*. National Shellfisheries Association. virtual. Status = OTHER; Acknowledgement of Federal Support = Yes

Laura Solinger, Carolyn Friedman, Eileen Hofmann, Eric Powell, John Klinck, Kathleen Hemeon, and Leanne Poussard (2021). *Development of a generalized transmission and proliferation model for withering syndrome for species of farmed and wild abalone.*. National Shellfisheries Association. virtual. Status = OTHER; Acknowledgement of Federal Support = Yes

Laura K Solinger, Eric N Powell, Steven X Cadrin, and Daniel R Hennen (2021). *Evaluating how complexity of alternative stock assessment models affects perception of summer flounder stock status.*. American Fisheries Society. Baltimore MD. Status = OTHER; Acknowledgement of Federal Support = Yes

Jillian R. Sower, Eric N. Powell, Roger L. Mann, Kathleen M. Hemeon, and Sara Pace (2021). *Examining spatial heterogeneity trends in ocean quahog growth and recruitment*. National Shellfisheries Association. virtual. Status = OTHER; Acknowledgement of Federal Support = Yes

Jillian R. Sower, Eric N. Powell, Roger L. Mann, Kathleen M. Hemeon, and Sara M. Pace (2021). *Examining spatial heterogeneity trends in ocean quahog growth and recruitment*. American Fisheries Society. Baltimore MD. Status = OTHER; Acknowledgement of Federal Support = Yes

Hemeon, K., E. Powell, R. Mann, T. Redmond, S. Pace (2019). *First data-rich age-frequency distributions for the ocean quahog and optimized sample-size detection using age-frequency simulator.*. CERF 2019 25th biennial conference. Mobile AL. Status = OTHER; Acknowledgement of Federal Support = Yes

Alyssa LeClaire, Eric Powell, and Roger Mann (2021). *Historical range shifts and the influence of global warming on ocean quahogs (Arctica islandica)*. National Shellfisheries Association Annual Meeting. virtual. Status = OTHER; Acknowledgement of Federal Support = Yes

Alyssa LeClaire, Eric Powell, Roger Mann, Sara Pace, Kathleen Hemeon, Jill Sower, Theresa Redmond (2021). *Historical range shifts and the influence of global warming on ocean quahogs (Arctica islandica)*. American Fisheries Society. Baltimore MD. Status = OTHER; Acknowledgement of Federal Support = Yes

Daphne Munroe, Eric Powell, Eileen Hofmann, John Klinck, Andrew Scheld (2021). *Interactions and impacts of offshore wind development on east coast shellfish fisheries.*. National Shellfisheries Association. virtual. Status = OTHER; Acknowledgement of Federal Support = Yes

Laura K Solinger, Eric N Powell, Daniel R Hennen, and Steven X Cadrin (2021). *Management strategy evaluation suggests Atlantic surfclam is resistant to current fishing pressure despite uncertainties*. National Shellfisheries Association. virtual. Status = OTHER; Acknowledgement of Federal Support = Yes

Roger Mann (2021). *Managing fisheries in the Mid-Atlantic and New England in the coming decades – moving resource footprints, competing societal needs, and facilitating the discussion*. National Shellfisheries Association. virtual. Status = OTHER; Acknowledgement of Federal Support = Yes

Kathleen M. Hemeon, Eric Robillard, Eric N. Powell, Roger Mann, Theresa Redmond, Sara Pace, Jillian Sower (2021). *Methods for evaluating age-reader error when aging Arctica islandica, the oldest-living bivalve on Earth.*. American Fisheries Society. Baltimore MD. Status = OTHER; Acknowledgement of Federal Support = Yes

Hemeon, K.M., E. N. Powell, R. Mann, M.C. Long (2019). *Ocean Quahog Population Age-Frequency Estimates Through Region Specific Age-Length Key probabilities and Model Simulation.*. National Shellfisheries Association. New Orleans LA. Status = OTHER; Acknowledgement of Federal Support = Yes

Kathleen M. Hemeon, Eric N. Powell, Roger Mann, Theresa Redmond, Sara Pace (2021). *Ocean quahogs: a glimpse into the population structure of the longest-lived, non-colonial animal on Earth using one of the largest age datasets in the world*. American Fisheries Society. Baltimore MD. Status = OTHER; Acknowledgement of Federal Support = Yes

Kathleen M. Hemeon, Eric N. Powell, Roger Mann, Theresa Redmond, Sara Pace (2021). *Ocean quahogs: a glimpse into the population structure of the longest-lived, non-colonial animal on Earth using one of the largest age datasets in the world.*. National Shellfisheries Association. virtual. Status = OTHER; Acknowledgement of Federal Support = Yes

Sara M. Pace, Eric N. Powell, Roger Mann, and Karen Reay (2021). *SCEMFIS 2020: A Year in Review*. National Shellfisheries Association. virtual. Status = OTHER; Acknowledgement of Federal Support = Yes

Sara Pace, Eric Powell, Roger Mann, and Karen Reay (2021). *SCEMFIS 2021: A year in review*. American Fisheries Society. Baltimore MD. Status = OTHER; Acknowledgement of Federal Support = Yes

Alexis Hollander and Roger Mann (2021). *Temporal and Spatial Variation in Growth in the Surfclam Spissula solidissima.*. American Fisheries Society. Baltimore MD. Status = OTHER; Acknowledgement of Federal Support = Yes

T. Sproul (2020). *The State of Navigation Safety Risk Assessments for Offshore Wind.*. NOAA/BOEM Synthesis of the Science Workshop. virtual. Status = OTHER; Acknowledgement of Federal Support = Yes

Eric Powell and Roger Mann (2021). *The confusion of complexity versus dynamics: habitat management and surfclams off Nantucket, Massachusetts, USA*. National Shellfisheries Association. virtual. Status = OTHER; Acknowledgement of Federal Support = Yes

Eric Powell, Roger Mann, Daphne Munroe, Eileen Hofmann, John Klinck (2021). *The potential to model future range shifts of commercial species and their fisheries: a possible new approach*. American Fisheries Society. Baltimore MD. Status = OTHER; Acknowledgement of Federal Support = Yes

Eric Powell, Roger Mann, Daphne Munroe, Eileen Hofmann, and John Klinck (2021). *The potential to model future range shifts of commercial species and their fisheries: a possible new approach.*. National Shellfisheries Association. virtual. Status = OTHER; Acknowledgement of Federal Support = Yes

Powell, E.N., K.M. Kuykendall, R. Mann, S.M. Pace (2019). *The warming of the northwest Atlantic as recorded by the ocean quahog Arctica islandica and the Atlantic surfclams Spisula solidissima*. Aquaculture 2019. New Orleans LA. Status = OTHER; Acknowledgement of Federal Support = Yes

Powell, E., R. Mann, S. Pace (2019). *Warming of the northwest Atlantic as recorded by ocean quahogs and Atlantic surfclams*. CERF 2019 25th biennial conference. Mobile AL. Status = OTHER; Acknowledgement of Federal Support = Yes

Other Products

Other Publications
Leanne Poussard, Eric Powell, and Daniel Hennen (2021). *Discriminating between high- and low-quality field depletion experiments using forensic evidence...* NMFS internal report. Status = OTHER; Acknowledgement of Federal Support = Yes

Patent Applications

Technologies or Techniques

Thesis/Dissertations

Websites or Other Internet Sites

Participants/Organizations

Research Experience for Undergraduates (REU) funding

Form of REU funding support: REU supplement

How many REU applications were received during this reporting period?   3

How many REU applicants were selected and agreed to participate during this reporting period?   3

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Mann, Roger	PD/PI	6
Abbaspourrad, Alireza	Co-Investigator	1
Biston Vaz, Diego	Co-Investigator	1
Gaichas, Sarah	Co-Investigator	1
Guo, Ximing	Co-Investigator	1
Hill, Joshua	Co-Investigator	1
Jensen, Olaf	Co-Investigator	1
Johnson, Blair	Co-Investigator	1
Kinnas, Spyros	Co-Investigator	1
Kohut, Josh	Co-Investigator	1
Miles, Travis	Co-Investigator	1
Moreno, Paula	Co-Investigator	1
Munroe, Daphne	Co-Investigator	1
Nesslage, Genevieve	Co-Investigator	1
Powell, Eric	Co-Investigator	6
Robillard, Eric	Co-Investigator	1
Saba, Vincent	Co-Investigator	1
Scheld, Andrew	Co-Investigator	1
Schueller, Amy	Co-Investigator	1
Leaf, Robert	Faculty	1
Riedel, Ralf	Faculty	1
Sabochick, Christina	Faculty	1
Sproul, Tom	Faculty	1
Whitaker, Justine	Faculty	1
White, Shannon	Faculty	1
Borsseti, Sarah	Postdoctoral (scholar, fellow or other postdoctoral position)	1
He, Yanhong	Postdoctoral (scholar, fellow or other postdoctoral position)	6
Kuykendall, Kelsey	Technician	6
Redmond, Theresa	Technician	1
Southworth, Melissa	Technician	1
Dadmohammadi, Younas	Staff Scientist (doctoral level)	1
Hemeon, Kathleen	Graduate Student (research assistant)	9
Hollander, Alexis	Graduate Student (research assistant)	12

Name	Most Senior Project Role	Nearest Person Month Worked
Klein, James	Graduate Student (research assistant)	6
LeClaire, Alyssa	Graduate Student (research assistant)	10
Marquardt, Alexandria	Graduate Student (research assistant)	1
Solinger, Laura	Graduate Student (research assistant)	9
Sower, Jillian	Graduate Student (research assistant)	12
Spencer, Molly	Graduate Student (research assistant)	1
Stromp, Stephanie	Graduate Student (research assistant)	1
Wilhelm, Catherine	Graduate Student (research assistant)	12
You, Rui	Graduate Student (research assistant)	6
Bellin, Garrett	Undergraduate Student	3
Burden, Ka'Pri	Undergraduate Student	1
Cohn, Olivia	Undergraduate Student	1
Gilsinan, Caela	Undergraduate Student	2
Horwitz, Becca	Undergraduate Student	2
Kukkadi, Faaris	Undergraduate Student	2
Phillips, Brody	Undergraduate Student	3
Schmactenberger, Christian	Undergraduate Student	1
Whelan, Jasmin	Undergraduate Student	3
Wiseman, Brycie	Undergraduate Student	1
Zeng, Shijun	Undergraduate Student	1
Cadrin, Steve	Consultant	1
Egan, Kyle	Consultant	1
Murray, Tom	Consultant	1
Reay, Karen	Consultant	6
Alspach, Tom	Other	1
Bochenek, Eleanor	Other	1
Brown, Jordan	Other	1
Cooke, John	Other	2
Dameron, Tom	Other	1
DiDomenico, Greg	Other	1
Herbert, Scott	Other	1
Himchak, Peter	Other	1
Kaelin, Jeff	Other	1
Kuttel, Francois	Other	1

Name	Most Senior Project Role	Nearest Person Month Worked
Lamonica, Sal	Other	1
Landry, Ben	Other	1
LaVecchia, Daniel	Other	1
Martin, Sam	Other	1
Myers, Joe	Other	1
Pike, Jeff	Other	1
Reichle, Jeff	Other	1
Rome, Monte	Other	1
Simmons, Guy	Other	1
Simpkins, Michael	Other	1
Vanasse, Bob	Other	1
Williams, Jon	Other	1

Full details of individuals who have worked on the project:

Roger L Mann
Email: rmann@vims.edu
Most Senior Project Role: PD/PI
Nearest Person Month Worked: 6

Contribution to the Project: Site Director

Funding Support: Virginia Institute of Marine Science

Change in active other support: No

International Collaboration: No
International Travel: No

Alireza Abbaspourrad
Email: Alireza@cornell.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: PI on shell refinement project

Funding Support: Cornell University

International Collaboration: No
International Travel: No

Diego Biston Vaz
Email: dbistonvaz@fas.harvard.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Faculty on squid ageing project with Roger Mann

Funding Support: Harvard University

International Collaboration: No
International Travel: No

Sarah Gaichas
Email: sarah.gaichas@noaa.gov
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: surf clam age project

Funding Support: NMFS

International Collaboration: No
International Travel: No

Ximing Guo
Email: xguo@hsrl.rutgers.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: PI on surf clam genetics project

Funding Support: Rutgers University

International Collaboration: No
International Travel: No

Joshua Hill
Email: joshua.hill@usm.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: PI on REU project

Funding Support: University of Southern Mississippi

International Collaboration: No
International Travel: No

Olaf Jensen
Email: olaf.p.jensen@gmail.com
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: PI on forage fish project

Funding Support: Rutgers University

International Collaboration: No
International Travel: No

Blair Johnson
Email: blairjohnson@utexas.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: PI on clam dredge design project

Funding Support: University of Texas

International Collaboration: No
International Travel: No

Spyros Kinnas
Email: kinnas@mail.utexas.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: PI on clam dredge design project

Funding Support: University of Texas

International Collaboration: No
International Travel: No

Josh Kohut
Email: kohut@marine.rutgers.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: PI on cold pool project

Funding Support: Rutgers University

International Collaboration: No
International Travel: No

Travis Miles
Email: tnmiles@marine.rutgers.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: PI on cold pool project

Funding Support: Rutgers University

International Collaboration: No
International Travel: No

Paula Moreno
Email: paula.moreno@usm.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Principal Investigator on the Independent advisory team of marine mammal assessments/ researcher on GIS project

Funding Support: The University of Southern Mississippi

International Collaboration: No
International Travel: No

Daphne Munroe
Email: dmunroe@hssrl.rutgers.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Faculty on Wind project

Funding Support: Rutgers University

International Collaboration: No
International Travel: No

Genevieve Nesslage
Email: nesslage@cbl.umces.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: PI for the menhaden survey design project and menhaden sample sufficiency project

Funding Support: University of Maryland

International Collaboration: No
International Travel: No

Eric Powell
Email: Eric.N.Powell@usm.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 6

Contribution to the Project: Center Director

Funding Support: University of Southern Mississippi and NSF

International Collaboration: No
International Travel: No

Eric Robillard
Email: Eric.Robillard@noaa.gov
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: PI on NSF non-academic internship

Funding Support: NMFS

International Collaboration: No
International Travel: No

Vincent Saba
Email: vincent.saba@noaa.gov

Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: PI on NSF non-academic internship

Funding Support: NMFS

International Collaboration: No
International Travel: No

Andrew Scheld
Email: scheld@vims.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: PI on SCeMFiS grant

Funding Support: Virginia Institute of Marine Science

International Collaboration: No
International Travel: No

Amy Schueller
Email: amy.schueller@noaa.gov
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: PI on menhadent project

Funding Support: NMFS

International Collaboration: No
International Travel: No

Robert Leaf
Email: robert.leaf@usm.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Member of the stock assessment team/PI on forage fish project

Funding Support: The University of Southern Mississippi

International Collaboration: No
International Travel: No

Ralf Riedel
Email: ralf.riedel@usm.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Cowrote bycatch report with Robert Leaf

Funding Support: The University of Southern Mississippi

International Collaboration: No
International Travel: No

Christina Sabochick
Email: casabochick@wm.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: GIS mapping project

Funding Support: William & Mary

International Collaboration: No
International Travel: No

Tom Sproul
Email: Tom Sproul
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: PI on wind-far risk project

Funding Support: University of Rhode Island

International Collaboration: No
International Travel: No

Justine Whitaker
Email: justine.whitaker@nicholls.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Faculty - just started project but attended fall meeting

Funding Support: Nicholls State University

International Collaboration: No
International Travel: No

Shannon White
Email: shwhite@wm.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Faculty on GIS projects

Funding Support: William & Mary

International Collaboration: No
International Travel: No

Sarah Borsseti
Email: sarahbor@hsrl.rutgers.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 1

Contribution to the Project: post-doc on wind energy project

Funding Support: Rutgers University

International Collaboration: No
International Travel: No

Yanhong He
Email: yh725@cornell.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 6

Contribution to the Project: Post-doc on shell refinement project

Funding Support: Cornell University

International Collaboration: No
International Travel: No

Kelsey Kuykendall
Email: Kelsey.KuyKendall@usm.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 6

Contribution to the Project: primary SCEMFIS staff member at USM

Funding Support: The University of Southern Mississippi

International Collaboration: No
International Travel: No

Theresa Redmond
Email: Theresa Redmond
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: Virginia Institute of Marine Science

Funding Support: Virginia Institute of Marine Science

International Collaboration: No
International Travel: No

Melissa Southworth
Email: Melissa J. Southworth
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: SCEMFIS technician

Funding Support: Virginia Institute of Marine Science

International Collaboration: No
International Travel: No

Younas Dadmohammadi
Email: younas@Cornell.edu
Most Senior Project Role: Staff Scientist (doctoral level)
Nearest Person Month Worked: 1

Contribution to the Project: Faculty on CaCO3 Project with Ali Abbaspourrad

Funding Support: Cornell University

International Collaboration: No
International Travel: No

Kathleen Hemeon
Email: Kathleen.Hemeon@usm.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 9

Contribution to the Project: GA on ocean quahog project

Funding Support: University of Southern Mississippi

International Collaboration: No
International Travel: No

Alexis Hollander
Email: Alexis H. Hollander
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: GA on surfclam project

Funding Support: Virginia Institute of Marine Science

International Collaboration: No
International Travel: No

James Klein
Email: james.klein@usm.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: research assistant

Funding Support: The University of Southern Mississippi

International Collaboration: No
International Travel: No

Alyssa LeClaire
Email: Alyssa.Leclair@usm.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 10

Contribution to the Project: GA on ocean quahog project

Funding Support: University of Southern Mississippi

International Collaboration: No
International Travel: No

Alexandria Marquardt
Email: armarquardt@vims.edu

Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: research assistant

Funding Support: Virginia Institute of Marine Science

International Collaboration: No
International Travel: No

Laura Solinger
Email: Laura.Solinger@usm.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 9

Contribution to the Project: GA on risk analysis project

Funding Support: The University of Southern Mississippi

International Collaboration: No
International Travel: No

Jillian Sower
Email: Jill.Sower@usm.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: GA on ocean quahog project

Funding Support: University of Southern Mississippi

International Collaboration: No
International Travel: No

Molly Spencer
Email: molly.spencer2000@gmail.com
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: research assistant

Funding Support: The University of Southern Mississippi

International Collaboration: No
International Travel: No

Stephanie Stromp
Email: stephanie.stromp@usm.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: research assistant

Funding Support: The University of Southern Mississippi

International Collaboration: No
International Travel: No

Catherine Wilhelm
Email: Catherine.Wilhelm@usm.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: GA on forage fish project

Funding Support: University of Southern Mississippi

International Collaboration: No
International Travel: No

Rui You
Email: ryou@utexas.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: PhD student on dredge design project

Funding Support: University of Texas

International Collaboration: No
International Travel: No

Garrett Bellin
Email: gabellin@wm.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: REU on GIS mapping project

Funding Support: William & Mary

International Collaboration: No
International Travel: No

Ka'Pri Burden
Email: kapri.t.burden@students.jsums.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: REU

Funding Support: Jackson State University

International Collaboration: No
International Travel: No

Olivia Cohn
Email: ojcohn@wm.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Veteran Student at W&M for Roger Mann

Funding Support: William & Mary

International Collaboration: No
International Travel: No

Caela Gilsinan
Email: cbgilsinan@email.wm.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: Undergraduate on Sheld's project

Funding Support: William & Mary

International Collaboration: No
International Travel: No

Becca Horwitz
Email: horwitzb@carleton.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: REU

Funding Support: Carleton College

International Collaboration: No
International Travel: No

Faaris Kukkadi
Email: faaris.kukkadi@utexas.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: Undergraduate on dredge design project

Funding Support: University of Texas

International Collaboration: No
International Travel: No

Brody Phillips
Email: brody.phillips44@gmail.com
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: REU on EMF project

Funding Support: William & Mary

International Collaboration: No
International Travel: No

Christian Schmactenberger
Email: Christian.Schmactenberger@usm.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: REU

Funding Support: University of Southern Mississippi

International Collaboration: No
International Travel: No

Jasmin Whelan
Email: jnwhelan@email.wm.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: REU

Funding Support: William & Mary

International Collaboration: No
International Travel: No

Brycie Wiseman
Email: Brycie.Wiseman@usm.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: REU

Funding Support: University of Southern Mississippi

International Collaboration: No
International Travel: No

Shijun Zeng
Email: sjzeng@email.wm.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: REU

Funding Support: William & Mary

International Collaboration: No
International Travel: No

Steve Cadrin
Email: scadrin@umassd.edu
Most Senior Project Role: Consultant
Nearest Person Month Worked: 1

Contribution to the Project: member of stock assessment team

Funding Support: none

International Collaboration: No
International Travel: No

Kyle Egan
Email: kyle@stoveboat.com

Most Senior Project Role: Consultant
Nearest Person Month Worked: 1

Contribution to the Project: PI on Stove Boat press release project

Funding Support: Stove Boat

International Collaboration: No
International Travel: No

Tom Murray
Email: Thomas Murray
Most Senior Project Role: Consultant
Nearest Person Month Worked: 1

Contribution to the Project: PI for menhaden economics project

Funding Support: Other

International Collaboration: No
International Travel: No

Karen Reay
Email: kreay@vims.edu
Most Senior Project Role: Consultant
Nearest Person Month Worked: 6

Contribution to the Project: Center Administration, SCeMFiS Web and communications

Funding Support: Virginia Institute of Marine Science

International Collaboration: No
International Travel: No

Tom Alspach
Email: talspach@goeasten.net
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Industry Liaison/IAB member

Funding Support: self supported

International Collaboration: No
International Travel: No

Eleanor Bochenek
Email: bochenek@hsrl.rutgers.edu
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Industry Liaison

Funding Support: self supported

International Collaboration: No
International Travel: No

Jordan Brown
Email: jordan@stoveboat.com
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: PI on Stove Boat video projects

Funding Support: Stove Boat

International Collaboration: No
International Travel: No

John Cooke
Email: john@stoveboat.com
Most Senior Project Role: Other
Nearest Person Month Worked: 2

Contribution to the Project: PI on Stove Boat press release project

Funding Support: Stove Boat

International Collaboration: No
International Travel: No

Tom Dameron
Email: capttomd@gmail.com
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Industry Liaison/IAB Board Member

Funding Support: self-supported

International Collaboration: No
International Travel: No

Greg DiDomenico
Email: gregdi@voicenet.com
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Industry Liason on projects/IAB member

Funding Support: self supported

International Collaboration: No
International Travel: No

Scott Herbert
Email: scottherbert@daybrook.com
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: IAB member

Funding Support: self supported

International Collaboration: No
International Travel: No

Peter Himchak
Email: phimchak@comcast.net
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: IAB proxy holder for Lamonica Fine Foods

Funding Support: self supported

International Collaboration: No
International Travel: No

Jeff Kaelin
Email: jkaelin@lundsfish.com
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Industry Liaison/IAB Chair

Funding Support: self supported

International Collaboration: No
International Travel: No

Francois Kuttel
Email: fkuttel@westbankllc.com
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: IAB member

Funding Support: self supported

International Collaboration: No
International Travel: No

Sal Lamonica
Email: slamonica@surfsideproducts.com
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Surfside Products

Funding Support: self supported

International Collaboration: No
International Travel: No

Ben Landry
Email: blandry@omegaprotein.com
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Industry Liaison/IAB Board Member

Funding Support: self supported

International Collaboration: No
International Travel: No

Daniel LaVecchia
Email: dlavecchia@lamonicafinefoods.com
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Industry Liaison/IAB member

Funding Support: self supported

International Collaboration: No
International Travel: No

Sam Martin
Email: smartin@atlanticcapes.com
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Industry Liaison/IAB Board Member

Funding Support: self supported

International Collaboration: No
International Travel: No

Joe Myers
Email: joe@seawatch.com
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Industry Liaison/IAB Board Member

Funding Support: self supported

International Collaboration: No
International Travel: No

Jeff Pike
Email: jpike@pikeassoc.com
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: IAB member

Funding Support: self supported

International Collaboration: No
International Travel: No

Jeff Reichle
Email: reichle@lundsfish.com

Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: IAB member

Funding Support: self supported

International Collaboration: No
International Travel: No

Monte Rome
Email: montesan04@yahoo.com
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Industry Liaison/IAB Chair

Funding Support: self supported

International Collaboration: No
International Travel: No

Guy Simmons
Email: guy@seaclam.com
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Industry Liaison/IAB Vice-Chair

Funding Support: self supported

International Collaboration: No
International Travel: No

Michael Simpkins
Email: michael.simpkins@noaa.gov
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Industry Advisory Board

Funding Support: self supported

International Collaboration: No
International Travel: No

Bob Vanasse
Email: bob@stoveboat.com
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: PI on Stove Boat press release project

Funding Support: Stove Boat

International Collaboration: No
International Travel: No

Jon Williams
Email: jwilliams@atlanticredcrab.com
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Industry Liaison/IAB Board Member

Funding Support: self supported

International Collaboration: No
International Travel: No

What other organizations have been involved as partners?

Name	Type of Partner Organization	Location
Atlantic Cape Fisheries, INC	Industrial or Commercial Firms	Cape May, NJ

Name	Type of Partner Organization	Location
Atlantic Red Crab	Industrial or Commercial Firms	New Bedford, MA
Omega Protein	Industrial or Commercial Firms	Houston TX
Sea Watch International	Industrial or Commercial Firms	Easton MD
Surfside Seafood	Industrial or Commercial Firms	Port Norris NJ
Westbank Fishing, LLC	Industrial or Commercial Firms	New Orleans, LA
Bumble Bee Foods	Industrial or Commercial Firms	Cape May NJ
Daybrook Fisheries	Industrial or Commercial Firms	Empire, LA
Intershell International	Industrial or Commercial Firms	Gloucester MA
Lamonica Fine Foods	Industrial or Commercial Firms	Millville NJ
Lunds Fisheries INC	Industrial or Commercial Firms	Cape May NJ
NFI clam committee	Industrial or Commercial Firms	Easton MD
NFI monitoring committee	Industrial or Commercial Firms	Cape May NJ
NMFS-NEFSC	Industrial or Commercial Firms	Woods Hole MA

Full details of organizations that have been involved as partners:

Atlantic Cape Fisheries, INC

Organization Type: Industrial or Commercial Firms
Organization Location: Cape May, NJ

Partner's Contribution to the Project:
Financial support
Collaborative Research

More Detail on Partner and Contribution: IAB member

Atlantic Red Crab

Organization Type: Industrial or Commercial Firms
Organization Location: New Bedford, MA

Partner's Contribution to the Project:
Financial support

More Detail on Partner and Contribution: IAB member

Bumble Bee Foods

Organization Type: Industrial or Commercial Firms
Organization Location: Cape May NJ

Partner's Contribution to the Project:
Financial support

More Detail on Partner and Contribution: IAB member

Daybrook Fisheries

Organization Type: Industrial or Commercial Firms
Organization Location: Empire, LA

Partner's Contribution to the Project:
Financial support

More Detail on Partner and Contribution:

Intershell International

Organization Type: Industrial or Commercial Firms
Organization Location: Gloucester MA

Partner's Contribution to the Project:
Financial support

More Detail on Partner and Contribution:

Lamonica Fine Foods

Organization Type: Industrial or Commercial Firms
Organization Location: Millville NJ

Partner's Contribution to the Project:
Financial support
Collaborative Research

More Detail on Partner and Contribution: IAB member

Lunds Fisheries INC

Organization Type: Industrial or Commercial Firms
Organization Location: Cape May NJ

Partner's Contribution to the Project:
Financial support
Collaborative Research

More Detail on Partner and Contribution: IAB member

NFI clam committee

Organization Type: Industrial or Commercial Firms
Organization Location: Easton MD

Partner's Contribution to the Project:
Financial support
Collaborative Research

More Detail on Partner and Contribution: IAB member

NFI monitoring committee

Organization Type: Industrial or Commercial Firms
Organization Location: Cape May NJ

Partner's Contribution to the Project:
Financial support
Collaborative Research

More Detail on Partner and Contribution: IAB member

NMFS-NEFSC

Organization Type: Industrial or Commercial Firms
Organization Location: Woods Hole MA

Partner's Contribution to the Project:
Financial support
Collaborative Research

More Detail on Partner and Contribution: IAB member

Omega Protein

Organization Type: Industrial or Commercial Firms
Organization Location: Houston TX

Partner's Contribution to the Project:
Financial support

More Detail on Partner and Contribution: IAB member

Sea Watch International

Organization Type: Industrial or Commercial Firms
Organization Location: Easton MD

Partner's Contribution to the Project:
Financial support
Collaborative Research

More Detail on Partner and Contribution: IAB member

Surfside Seafood

Organization Type: Industrial or Commercial Firms
Organization Location: Port Norris NJ

Partner's Contribution to the Project:
Financial support
Collaborative Research

More Detail on Partner and Contribution: IAB member

Westbank Fishing, LLC

Organization Type: Industrial or Commercial Firms
Organization Location: New Orleans, LA

Partner's Contribution to the Project:
Financial support

More Detail on Partner and Contribution:

Were other collaborators or contacts involved? If so, please provide details.
Nothing to report

Impacts

What is the impact on the development of the principal discipline(s) of the project?

The project has gelled a unique coalition of academic scientists, federal agencies, and private sector companies and organizations focused on improving the sustainable management of federal finfish and shellfish stocks while also maintaining sustainable fisheries. The research portfolio for the first nine years represents a range of basic and applied research focused on data collection issues, assessment issues, and management issues, plus an expansion into marine engineering and also into novel uses of industry waste products. This eclectic portfolio is precisely the range of projects envisioned when the Center was established and its Mission statement expanded in 2019 to include product development. In 2022, SCEMFIS funded its first genetics study and expanded its research portfolio pertinent to the interaction of wind energy development on the continental shelf with fisheries and climate change.

The development of the first age frequencies for ocean quahogs permits evaluation of long-term recruitment trends, thereby addressing the primary concern of the MAFMC Science and Statistical Committee (SSC) limiting the allowable biological catch for ocean quahogs. A workshop hosted at University of Massachusetts-Dartmouth to review the ocean quahog program produced a highly positive review and resulted in a list of research options for future projects addressing the development of an improved assessment model for the species. A new forage fish emphasis has addressed the perception that forage fish quotas should be reduced to protect ecosystem services provided by these fish. Projects include evaluation of important assessment metrics for Gulf and Atlantic menhaden now expanded to examine the effectiveness of dock-side monitoring of catch and the analysis of an extensive tagging database, which will provide important information on menhaden movement and mortality. Most recently, the focus has included predator prey relationships with two new projects funded using novel approaches to identify the importance of menhaden as prey for higher trophic levels. Recent analysis of long-term data not heretofore examined on the distribution of surfclam and ocean quahog shells and complex habitat provide additional support for species range shifts offshore into deeper water in the Mid-Atlantic region as global warming proceeds. This research has supported a new NSF-funded project to develop long-term temperature proxies for the Mid-Atlantic region, including estimating the southern extent and inshore-offshore extent of the all-important Cold Pool.

Particulars include the following.

In 2021, SCEMFIS scientists in collaboration with NMFS-NEFSC through a non-academic graduate student internship developed the first aging protocols for ocean quahogs which included estimates of reader precision and bias and promulgated criteria for determining the adequacy of aging precision. This included adaptation of statistical software. A complete description appeared in a recent publication in Journal of Shellfish Research. In addition, as part of the development of accuracy evaluation (as distinct from precision), SCEMFIS carried out the first large scale examination of the radiocarbon reservoir effect for the Mid-Atlantic Bight region of the Northwest Atlantic. A second internship following on this one further examined the use of growth rates to identify age at maturity and expanded the geographic footprint of the research program throughout much of the Mid-Atlantic. A publication pertinent to maturity at age will be published within the month. A third internship mentored by the Princeton Geophysical Research Laboratory addressed issues of long-term climate change and the application of ocean quahog growth rate to assess regional shifts in the Cold Pool, the most important physical oceanographic feature in the Mid-Atlantic region. Ongoing internships include evaluation of pace-setting technology for deepwater oyster aquaculture and the development of a dashboard for Omega Protein. The dashboard acts as a fishery tool that will show the fishery's current harvest control rule thresholds in conjunction with recent catch and abundance timeseries.

In 2019 SCeMFiS began a series of studies designed to examine the influence of wind energy development on U.S. east-coast fisheries and vessel transit. Among these is support from Bureau of Ocean Energy Management (BOEM) to apply SEFES (Spatially-explicit Fishery Economics Simulator), a fisheries simulator developed and originally implemented by SCeMFiS, to the question of wind energy development and its influence on the surfclam fishery, expansion of this model to sea scallops funded by the Sea Scallop Research Set-aside Program for the evaluation of wind energy development on the sea scallop fishery, and by Atlantic Shores Offshore Wind LLC to evaluate the future distribution of Atlantic surfclams relative to the anticipated wind farm footprint. The Atlantic Shores project has provided a 50-year future projection of bottom water temperatures throughout the Mid-Atlantic and a range-shift model for surfclams and ocean quahogs has been developed. The SEFES model is now the most sophisticated model of its kind in the world and one of a very few tracking vessels individually and using captains' behavioral repertoires to address fishing decisions based on biological and assessment constraints.

SCeMFiS showed that growth rates for ocean quahogs have been increasing consistently since 1800 as the Mid-Atlantic warms. This finding has important implications. First, rebuilding capacity for this species has dramatically increased, lessoning the danger posed from overfishing. Second, a key problem in modeling climate change is the absence of bottom water

temperature information to verify (and parameterize) hydrodynamic models. Ocean quahogs provide promise of a unique bottom water proxy for the last ~250 years covering a substantial fraction of the northeastern U.S. continental shelf. Thirdly, global warming is creating havoc with range shifts of biomass dominants on the continental shelf. SCEMFIS has developed evidence of past range shifts, their timing and rapidity, that can inform on expected future conditions. This research program has been expanded by a grant from the NSF Paleo Perspectives in Climate Change program.

The Atlantic surfclam supports one of the largest fisheries on the US northeast coast. In 2021, SCEMFIS surveyed the region of the Mid-Atlantic Bight south of Hudson Canyon to examine the overlap of this species with the offshore and colder-water ocean quahog. The results document extensive overlap of the two species; overlap was rarely observed a decade ago. Results document widespread recruitment offshore by Atlantic surfclam, confirming the rapidity of response of this species to rising bottom water temperatures. The surfclam fishery has requested revised regulations to limit the increase in discarding as an outgrowth of this overlap, the distributional influence on fishery economics has been considered in a publication now in press, and the process of range shift elucidated has been included in the aforementioned Atlantic Shores project to provide the first ever forward projections of biological processes and their influence on fisheries decision-making in the Mid-Atlantic region.

Discards from commercial fisheries have negative effects on the profitability of fisheries in the Mid-Atlantic. SCEMFIS has used bycatch data from onboard monitoring programs and a machine learning approach to identify areas, gears, and seasons of the year that result in extraordinary bycatch events in the black seabass, summer flounder, scup, and shortfin squid fisheries. These analyses have been used to develop a web-based dashboard so that stakeholders, managers, and scientists can understand and evaluate the region's bycatch temporal and spatial trends.

What is the impact on other disciplines?

The ocean quahog ageing study is establishing methodologies for reconstructing life history dynamics from species with life spans exceeding the length of time of scientific surveys; thereby permitting application of modern stock assessment methods to species that otherwise would require decades of data collection to support them. Ocean quahogs also record environmental change in their growth rates of centennial time scales, thereby recording climate data pertinent to long-term climate change, including global warming and climate cycles such as the Atlantic Multidecadal Oscillation. The project has described the growth dynamics of the first species studied in which global warming is changing population growth curves during the life span of the individuals. Development of a new growth model is ongoing. In addition, the growth record of ocean quahogs identifies the influence of climate cycles on bottom water temperatures over a period of time when other temperature proxies are not available. Of particular note is the finding of evidence of range shifts associated with each of the 4 major cold periods since the Holocene Climate Optimum, including the Neoglacial (~4200 BP), the Dark Ages Cold Period, and the Little Ice Age, providing an opportunity to reconstruct Holocene climate in the Mid-Atlantic Bight, including the footprint of the Cold Pool, for a significant portion of that time period.

SCEMFIS' focus on wind energy development has produced new collaborations with physical oceanographers studying the Cold Pool, the single most important oceanographic feature in the Mid-Atlantic region. This collaboration has interest from electric power companies interested in expanding wind energy development on the continental shelf, as the possible interaction of wind monopoles with the Cold Pool is a singularly important concern. A video recently released by SCEMFIS provides an important layman's introduction to this issue. In addition, the ocean quahog program has provided an opportunity to collaborate with oceanographers studying climate change through a NSF Non-academic Research Internship with the Geophysical Fluid Dynamics Lab in Princeton which runs one of the premier climate models used for predictions of future climate change. Of particular note, SEFES, a model developed by SCEMFIS is now being used to generate the first long-term projections of bottom water temperature impacts in the Mid-Atlantic region. This project will provide the first future predictions of the boreal/cool temperate provincial boundary in the Northwest Atlantic.

What is the impact on the development of human resources?

SCeMFiS grants are supporting graduate student research projects at four separate universities; twelve graduate students participated in the research program. In addition, center science teams are establishing national collaborative networks of scientists that will represent unique human resource capabilities. The center has been very successful in recruiting scientists outside of the center to lead important research projects. Scientists from the University of Rhode Island, Rutgers University, University of Maryland Center for Environmental Science, Cornell University, University of Washington, University of Texas-Austin, Nicholls State University, and University of Massachusetts at Dartmouth are currently leading or have led projects.

The research program at SCeMFiS is highly collaborative. This year, SCeMFiS participated in the Atlantic menhaden assessment. This continues a substantive involvement of SCeMFiS scientists in the NMFS and ASMFC assessment processes and subsequent quota setting. Widespread influence from the center's scientists on regulatory and other government committees and commissions extends the center's research impact and can have a major positive influence on the financial performance of the center's industry members as well as other industry members throughout the country. The ocean quahog workshop provided an additional avenue for technology transfer to improve assessment sciences and maintain stock sustainability for one of the largest shellfish fisheries in the U.S. PIs and Co-PIs include members of the MAFMC and NEFMC SSCs. Through this participation, SCEMFIS has significant input in translating science results into fisheries management and, thus, providing economic benefits for the center's members and other members of the industry. Of note, such activities provide opportunities for graduate students to be involved in the federal decision-making process that underpins the regulation of marine fisheries. Graduate student research has been instrumental in the ocean quahog and surfclam benchmark assessments, the MAFMC deliberations on chub mackerel, and the benchmark assessment for summer flounder. This year, SCeMFiS was awarded five NSF Non-academic Research Internships, all offering students the opportunity to work with NMFS and private-sector scientists in their field. A graduate of SCEMFIS and an earlier awardee of a Non-academic Research Internship is now a lead in the deliberations to limit mortality of northern right whales in the northwestern Atlantic. This whale is extremely endangered. A previous Internship provided the opportunity for this student's post-doctoral employment.

SCeMFiS funding now goes to 20 different PIs at 9 different academic institutions and federal labs and a number of fisheries consulting groups. Over half of all SCeMFiS projects are collaborative across institutions.

SCEMFIS received final reports and/or peer-reviewed publications in lieu for twelve research projects in 2020, including projects addressing economics in the Gulf menhaden fishery, the impact of plus group definition in the Atlantic and Gulf menhaden assessment, the hatchery capacity needed to mitigate the negative impact of wind energy development on the surfclam fishery, the age frequency distributions and growth rates for ocean quahogs, range shifts in ocean quahogs and surfclams as a product of climate change, a novel approach to age squid, new procedures for the refinement of surfclam and ocean quahog shells into calcium carbonate to limit waste, a comprehensive review of discarding in the Mid-Atlantic finfish fisheries, and the integrity of the surfclam assessment model to uncertainty in mortality and recruitment. Sixteen other projects were underway through part or all of 2022. These were affiliated with a range of academic institutions and consulting firms, including besides the two primary SCEMFIS sites, University of Massachusetts-Dartmouth, Rutgers University, University of Maryland, Cornell University, University of Texas at Austin, and Nichols State University. In all, including projects finalized in 2022, over half of center research projects were collaborative efforts that involve multiple research scientists at multiple institutions. This involvement of researchers from multiple organizations is evidence of successful collaborative leadership and teamwork within SCeMFiS.

What was the impact on teaching and educational experiences?

A primary mission of SCEMFIS is to improve the management of federally managed fisheries. Consequent to this is the need to educate, in several ways, the federal scientists and managers charged with maintaining sustainability. To this end, SCEMFIS provides information, via publication, targeted conversations, presentations at agency/council/commission meetings, press releases, and videos, to the range of management agencies, commissions, and councils directly involved in management of the commercial species for which SCEMFIS has funded research. These groups include the National Marine Fisheries Service, the Mid-Atlantic Fisheries Management Council and its Science and Statistical Committee, the New England Fisheries Management Council and its Science and Statistical Committee, the Atlantic States Marine Fisheries Commission and its Gulf counterpart, among others. Added to this are a number of fisheries organizations such as RODA (Responsible Offshore Development Alliance), ROSA (Responsible Offshore Science Alliance), and others. As climate science becomes a greater part of classical higher education curricula, data generated by SCEMFIS studies are increasingly used as examples of species response and distribution changes in marine systems as analogs to that observed in terrestrial systems.

Of particular importance this year, the NMFS-NEFSC has begun routine aging of ocean quahogs taken in their stock survey as an outgrowth of the SCEMFIS ocean quahog research program. SCEMFIS scientists provided expertise and training for NEFSC personnel in August to permit initiation of a standard operating procedure and SCEMFIS data analysis has provided guidance in limiting reader error to maintain levels of precision in the ageing process.

What is the impact on physical resources that form infrastructure?

The center was successful this year in leveraging its research budget to obtain research funding from a number of outside organizations and businesses. This included continued research support from the Sea Scallop Research Set-aside Program and an electric power company, Atlantic Shores Offshore Wind LLC., new research support from the NSF Paleo Perspectives in Climate Change program, as well as additional NSF support in the form of REU, VRS, and Non-academic Research Internships. Total additional grant funding neared $2 million.

What is the impact on institutional resources that form infrastructure?

One SCeMFiS focus is on the expansion of human infrastructure supporting the center beyond that provided by the core academic institutions. To this end, SCeMFiS funding utilizes consultants and other academic institutions as part of its human portfolio, bringing in additional shellfish and finfish expertise, and statistical expertise. This was accomplished through expansion of research on wind energy development on the continental shelf, the influence of climate change on the genetics of surfclams in the southern portion of the range, expertise on bivalve aging techniques, support for application of engineering expertise in development of improved fishing gear, support of food scientists in developing novel uses of processing plant waste products, and support of assessment science for Gulf and Atlantic menhaden and other forage fish. Expansion of the footprint of continental shelf wind farms into traditional fishing grounds for surfclams and ocean quahogs complicates both resource assessment in support of management and access for fisheries. Building on expertise developed in a prior SCEMFIS project focused on construction of a research dredge capable of sampling newly recruited clams on the continental shelf, a second dredge suitable for surveys within the bounds of wind farms has been constructed, deployed in 2022 and calibrated against the NEFSC survey dredge. This new dredge will be integral to both federal assessment and wind farm impact studies for the coming decade and longer. This year, SCEMFIS academic purview included expertise from Cornell University, University of Texas at Austin, University of Massachusetts-Dartmouth, Nicholls State University, University of Maryland, and Rutgers University. SCEMFIS funding also supports undergraduates (REU/VRSs) and graduate students from VIMS, USM, Rutgers, UT-Austin, and Non-academic Research Internships at VIMS and USM.

What is the impact on information resources that form infrastructure?

The SEFES model, which is unique in describing each fishing vessel independently as it operates within the fleet, has been chosen for implementation to evaluate the influence of wind energy development off the U.S. east coast for the Atlantic surfclam and sea scallop fisheries. These two fisheries are among the 3 largest U.S. shellfish fisheries and the sea scallop fishery is the second largest fishery in the U.S. Financial support for applications of this model now exceed $1.5 million.

The research program designed to evaluate surfclam habitat on Georges Bank put into electronic format, for the first time, the ancillary NMFS-NEFSC survey data from 1978-2014 for the southern New England to Georges Bank region, thus providing the basis for routine inclusion of such data in analyses pertinent to that region. This database has now been provided to the NMFS for access by future researchers and has been used to guide survey sampling to reconstruct the history of clam range shifts on the U.S. east-coast continental shelf. The latter supported successful sample collection that is presently providing data on the history of ocean quahog range shifts and is supporting a new NSF project from the Paleo Perspectives in Climate Change program.

SCEMFIS forage fish projects include science support for the Atlantic and Gulf menhaden assessments and the chub mackerel assessment. For the latter, SCEMFIS science is the only available information supporting assessment of this stock.

Several projects have supported the development of web-based tools. One of them addresses discarding. Discards from commercial fisheries have negative effects on the profitability of fisheries in the Mid-Atlantic. SCEMFIS has used bycatch data from onboard monitoring programs and a machine learning approach to identify areas, gears, and seasons of the year that result in extraordinary bycatch events in the black seabass, summer flounder, scup, and shortfin squid fisheries. These analyses have been used to develop a web-based dashboard so that stakeholders, managers, and scientists can understand and evaluate the region's bycatch temporal and spatial trends. A second involves working with Omega Protein to finalize the control rule dashboard. This dashboard acts as a fishery tool that will show the fishery's current harvest control rule threshold in conjunction with recent catch and adult abundance timeseries. The dashboard will also allow the fishery and stockholders to adjust the harvest control rule and see its effects on current fishery status.

SCEMFIS' evaluation of the status of wind energy development relative to commercial fisheries have been used by a range of actors in addressing rising concerns about the inadequacy of the science base necessary to evaluate the influence of monopole farms on the continental shelf ecosystem. Actors include a range of fisheries companies and trade organizations, as well as RODA (Responsible Offshore Development Alliance) and ROSA (Responsible Offshore Science Alliance).

What is the impact on technology transfer?

SCEMFIS has addressed the potential use of clam shell waste in evaluating its use in carbonate requiring industries. Results include recommendations for processing to provide a refined product, including (1) that the coarse grinded shell should be washed with hot water (~95 °C) in order to be ready for chemical cleaning or oven heating, the use of a 5 w% NaOH solution, a 5 w% H_2O_2, or even a 5 w% bleach solution at high temperature (~75 °C) for chemical cleaning, use of an electrical furnace to heat the samples in order to remove the remaining organic matter, use of a high speed, vibrating ball-mill for grinding and micronizing the washed and/or oven treated material. Thermogravimetric analysis confirm the thermal stability of the final samples and showed the importance of the washing/cleaning/heating steps. Scanning electron microscopy (SEM) of the ball-milled samples confirmed the presence of micronized $CaCO_3$ and submicron particles. SCEMFIS IAB members are considering next steps in the development of this new economic opportunity.

Scientists produced the first population age frequencies for ocean quahogs in the Northwest Atlantic more than doubling the number available worldwide. To accomplish this, SCeMFiS scientists have developed an improved method for aging clams. This received an NSF Breakthrough award in 2020. *Arctica islandica* (ocean quahog) is the longest-lived bivalve on Earth. Individuals on the deep continental shelf off Georges Bank can survive for centuries, and in the colder, boreal waters of Iceland, ages over 500 years can be reached. Ocean quahog landings in the United States represent a $24 million industry, yet assessment models operate with no age data due to the substantial sample size required to develop adequate population age distributions for such a long-lived species, the unknown error associated with age estimates, and the extensive time and financial investment required to create production-scale age datasets. Inclusion of age data for this species requires precision metrics to evaluate aging uncertainty such as percent agreement, percent error, coefficient of variation, and tests of bias. These metrics have been developed and tested and reported in a recent publication in *Journal of shellfish Research*. A three-fold error protocol was developed. Error thresholds were established for each of the three error methods: bias, precision (ACV less than 7%), and error frequency (less than 10%). A recent training session by SCEMFIS scientists initiated a program of routine data collection of ocean quahog ages from the federal survey by the NEFSC.

A SCEMFIS evaluation of the economic value of the Gulf Menhaden fishery in Louisiana and Mississippi found that the total economic impact in 2019 exceeded $309 million, with 2,059 associated jobs, labor income of $184.8 million, and over $25 million in state and local tax revenue.

In 2019 SCeMFiS began a series of studies designed to examine the influence of wind energy development on U.S. east-coast fisheries and vessel transit. Among these is the acquisition of $500,000 in support from BOEM based on the application of SEFES (Spatially-explicit Fishery Economics Simulator), a fisheries simulator developed and originally implemented by SCeMFiS, to the question of wind energy development and its influence on the surfclam fishery. SEFES is a unique model in incorporating vessel specific and captain specific behaviors in evaluating fishery performance. As of this writing, this model has also been chosen by the Sea Scallop Research Set-aside Program for the evaluation of wind energy development on the sea scallop fishery, including $375,689 for science and $1,124,300 for compensation fishing. In addition, $582,185 has been obtained from Atlantic Shores Offshore Wind LLC to evaluate the future influence of wind energy development on Atlantic surfclams as impacted by climate change. Supporting this effort, SCeMFiS has funded projects aimed at evaluating the influence of global warming on the U.S. surfclam and ocean quahog fisheries, two of the nation's three largest shellfish fisheries. These projects have

identified the progress of shifts in range, the mechanisms behind range shifts, the rapidity of such range shifts and the economic and biological conflicts issuing from such range shifts. These data have been used to configure SEFES for 50-year future projections of the stock and fishery.

In 2021, SCEMFIS initiated a new research focus designed to improve fishing technology through optimizing fishing gear. The focus on hydraulic dredges includes bringing into the SCEMFIS PI community hydraulic engineers who have developed an excel sheet tool in which the user can enter the main parameters of the dredge system (hose length and diameter, diameter and number of jets, as well as head loss coefficient fjet of the jets) in order to determine the demand curve of the system (total pump head vs. flowrate), end eventually determines the operating condition for a given pump. The method provides the corresponding flowrate, velocity of jets, total head, efficiency and break horsepower (BHP) of the pump. Computational Fluid Dynamics has been applied on a reduced replica of a manifold and jets to determine the detailed viscous flow patterns inside the manifold and out of the jets. This permits determination of the head loss coefficient fjet of the jets, which can be used to find the operating point of the dredge system, and the corresponding performance of a given pump. This is the first engineering study of a hydraulic clam dredge.

The initiation of wind energy development has produced concerns over the viability of federal stock surveys due to the limitations of sampling within wind farms. SCEMFIS designed a downsized survey dredge to address this limitation. In 2022, this dredge was fabricated and deployed at sea, and successfully calibrated against the NEFSC survey dredge.

SCEMFIS is taking a leading role in the effort to redefine "complex habitat" as the basis for establishment of habitat management areas. The northwest Atlantic is a relatively unique area in combining drowned glacial moraines, often the hard-bottom basis for complex epibenthic communities, with high current velocities generating migrating sand waves that continually bury and expose glacial tills. SCEMFIS' data clearly show that the presence of glacial till in and of itself is insufficient to designate an area as complex habitat. SCEMFIS research also shows that the importance of complex habitat has declined changed with the northward shift in range of importance commercial and charismatic boreal species, such as cod and horse mussels.

SCeMFiS has recently supported a "High" priority research need for improving the assessment of Gulf Menhaden: improving estimates of natural mortality of the stock. Recent research has shown, for Atlantic Menhaden, that natural mortality may be higher than previously estimated. This has import to fishery management because it indicates that the stock may be more productive and thus more resilient to harvest. To begin to understand the mortality dynamics of Gulf Menhaden, the second largest fishery in the United States (by weight), the research group performed exploratory analysis to understand the feasibility of using a comprehensive reanalysis of the tag and recapture data collected during the 1970's and 1980's. This was a joint federal and industry effort. Because of the costs of this tagging work, it is unlikely that such a large-scale tagging study will ever be performed again. However, leaps in the computational power and statistical modeling approaches in recent decades have made re-analysis of the previously collected tagging data a very worthwhile endeavor.

What is the impact on society beyond science and technology?

SCeMFiS provides academic research products with a goal of enhancing efficient management of shellfish and finfish resources. SCeMFiS provides scientific research products essential in enhancing awareness of the health benefits of sustainable seafood. Improving sustainability, an important part of this mission, will provide long-term support for coastal economies, by maintaining viability of coastal fishing companies, dealers and processors, and a range of other businesses supporting commercial fishing. SCEMFIS research supports businesses from Virginia to Massachusetts and Mississippi and Louisiana in the Gulf of Mexico. Three examples follow. (1) SCeMFiS research and support for the surfclam and ocean quahog assessments directly impacts jobs in New Bedford, MA, Atlantic City, Bivalve, Millville, and Pt. Pleasant, NJ, and Nanticoke and Easton, Md. (2) SCEMFIS research supports the finfish fisheries of the Mid-Atlantic including summer flounder and Atlantic menhaden. A recent SCeMFiS economics analysis of summer flounder shows that the direct impacts of the fishery and marketplace were $151.1 million in output (sales), 1,688 associated jobs, which required $58.9 million in labor income. Further, $94.6.6million in wages and salaries, interest, rent, profits, and indirect taxes paid by businesses ("total value added") was associated with this overall level of direct activity. The cumulative impacts of the fishery and marketplace were $259.9 million in output (sales), 2,342 associated jobs, which required $96.7 million in labor income. Further, $159.4 million in wages and salaries, interest, rent, profits, and indirect taxes paid by businesses, ("total value added") was associated with the flounder commercial harvest and markets in 2018. Similar analyses for scup, surfclam, and squid are available on the SCEMFIS website. (3) SCEMFIS has taken a leading role in expressing concern about the integrity of the ecosystem of the northwest Atlantic continental shelf during a period of global warming. Two videos and a series of reports and publications focus on the Cold Pool which supports the largest shellfish fisheries in the U.S. Recent publications document the range shift dynamics presently underway for Atlantic surfclams and the recent history of range shifts for this species and ocean quahogs. SCEMFIS press releases continue to highlight the seriousness of the issue of global warming in the northwest Atlantic for the commercial stability of northwest Atlantic commercial fisheries.

The high demand for renewable energy has stimulated the development of offshore wind farms along the east coast of the United States. It is expected that the Atlantic surf clam industry will be negatively impacted due to overlap between commercial fishing grounds and wind lease areas. SCEMFIS explored the economic viability of a large-scale surfclam hatchery to offset additional costs, reduced revenues, and potential job losses associated with the displacement of the fishing fleet. A technoeconomic cost model and Monte Carlo analyses were employed to explore the variability of costs. The analysis suggests that 374M to 2.1B clams are needed at the end of the hatchery stage to produce one-million bushels of market-sized surf clam. The calculated hatchery costs range from $2.8M - $13.3M and nursery costs range from $800K-$1.8M, with total production costs ranging from $3.6M to $15.1M. Under current market conditions where surf clams regularly sell for $14- $17/bushel, this analysis suggests that a large-scale hatchery could be a viable mitigation method.

In addition, SCeMFiS research addressing sustainable fisheries has aided in the acquisition of approval as sustainable by the prestigious Marine Stewardship Council (MSC) for Gulf menhaden and Atlantic menhaden, longfin squid, Atlantic surfclam, and ocean quahog. These fisheries reap financial benefits by being able to display the MSC seal on their products. SCeMFiS continues to emphasize research support for sustainability.

This year, SCeMFiS continued a program to look at multiple use conflicts on the continental shelf with a focus of the conflict of fishing and vessel transit with offshore wind energy development. SCEMFIS has directly supported three projects and SCEMFIS models of the fishing industry have resulted in total additional funding exceeding nearing $2 million to address this issue. This conflict, along with the impact of global warming, represent the singular challenges to U.S. east-coast fisheries present today.

Climate change continues to be a focus of many SCEMFIS research grants. Most of these are directed at management, assessment and sustainability issues, but recent work has provided an opportunity to directly improve the understanding of past climate through the use of the ocean quahog as a temperature proxy. This is the first significant proxy for bottom water temperatures in the Mid-Atlantic Bight and provides the opportunity to improve hydrodynamics simulations of past and future climate and consequently climate modeling. As the Northwest Atlantic is warming at a rate faster than most of the world's oceans, improvement in proxies to verify climate and oceanographic models is critical for planning for future climate change. In 2022, SCEMFIS data were instrumental in developing a new NSF-funded initiative out of the Paleo Perspectives in Climate Change program designed to directly develop growth rate to temperature relationships to permit widespread reconstruction of bottom water temperatures throughout the Mid-Atlantic region.

What percentage of the award's budget was spent in a foreign country?
Nothing to report.

Changes/Problems

Changes in approach and reason for change
Nothing to report.

Actual or Anticipated problems or delays and actions or plans to resolve them

Inadequate access to ship operations funding to support at-sea research on UNOLS ships has significantly impeded initiatives requiring time at sea.

Changes that have a significant impact on expenditures

The NMFS failed to meet NSF's deadline for their IAA; consequently, certificates reported later show a financial shortfall. As an attached document from the NMFS confirms, this shortfall will be corrected early in 2023 (see attachment with certificates).

Significant changes in use or care of human subjects
Nothing to report.

Significant changes in use or care of vertebrate animals
Nothing to report.

Significant changes in use or care of biohazards
Nothing to report.

Change in primary performance site location
Nothing to report.

Special Requirements

Responses to any special reporting requirements specified in the award terms and conditions, as well as any award specific reporting requirements.

Attached is
1. the Evaluator's report
2. A certificate of membership fees received for members affiliated with USM.
3. A certificate of membership fees received for members affiliated with VIMS.
4. An explanation and promissory email from NMFS for the delinquency of their IAA for this year.

Supporting Files

Filename	Description	Uploaded By	Uploaded On
SCeMFiS 2022 - Annual Evaluator Report - 1841112, 1841435.pdf	Evaluator report	Roger Mann	01/17/2023
SCEMFIS membership signed.pdf	USM membership certificate	Roger Mann	01/17/2023
Simpkins.pdf	NMFS statement on membership fee	Roger Mann	01/17/2023
VIMS_certification_signed AT.pdf	certification of VIMS memberships	Roger Mann	01/23/2023