



**Performance Report for Cooperative Agreement No: NA16SEC4810007
for the Period from March 1, 2018 to August 31, 2018**

University of Maryland Eastern Shore

Living Marine Resources Cooperative Science Center

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I. Accomplishments

There is the option to indicate “not yet started” and include the expected start date in this section. *NOTE: Images, tables, charts, or other graphics may be submitted in support of the Accomplishments section.*

What are the major goals of the project?

The major goals of the LMRCSC are grouped as educational, research, and administrative goals.

Education Goals:

1. Prepare the future workforce for marine and fisheries sciences through the relevant degree programs.
2. Strengthen collaborations across partner universities and professional networks to enhance academic programs in marine and fisheries sciences

Research Goal:

3. Develop an exemplary capacity for scientific collaborations among partner institutions in the NOAA relevant fields of marine and fisheries sciences

Administration Goals:

4. Organizational excellence for effective and efficient management of the programs and activities of the Center
5. Effectively communicate the activities and accomplishments of the Center
6. Assess and evaluate the Center’s goals and objectives

What was accomplished under these goals (recipient must provide information for the 4 categories below)?

1. Major Activities:

Education Goals:

Student Recruitment Activities: The Center used this reporting period to engage in recruitment activities using various strategies including, but not limited to attending professional meetings and campus events. An accounting of these events is listed below by partner institution.

DSU: We advertised online for fisheries/aquaculture students. Also, we requested that former student Nivette Perez-Perez help advertise LMRCSC at DSU in Puerto Rico.

HU: Handed out LMRCSC brochures, spoke to individual students with the required GPA, facilitated summer internship applications at UMES and SSU.

OSU: We accepted a PhD student in cohort 3. A student previously funded on the 2011 LMRCSC grant and other funds was also recruited to the 2016 grant (cohort 2) by receiving a TAB.

RSMAS: We invited potential Ph.D. students to the RSMAS student recruitment event on February 9, 2018. Students visited the campus and met with potential advisors and current graduate students.

Training and Preparation of students for careers in marine and fisheries science:

The Center offered the first “Literacy in NOAA mission related disciplines: A cohort experience” workshop during March 5-9, 2018. Students received instruction from NOAA scientists and Center faculty, contributed to discussions, and participated in activities in the areas of Human Dimensions of Living Resource Management (i.e. Socio-economics); Ecosystem Science (life history, ecology,

habitat assessment); Stock Assessment/Quantitative Ecology; Seafood Safety/Aquaculture; and the integration of all the areas. In the afternoons, students took part in professional development discussions and activities. The schedule of event along with presenters is provided in Table 1.

Table 1: Schedule of Literacy in NOAA Mission Related Disciplines: A Cohort Experience Workshop

Day	Theme (Morning – 8 am to 12 noon & Afternoon – 1:30 pm to 4 pm)		Evening Workshops (4 pm to 5 pm)
1. Mar 5	8:00-9:00 AM Proposal Writing Instructors: Brad Stevens (UMES)	9:00 AM-3:15 PM Human Dimensions of Living Resource Management (i.e. Socio-economics): Dr. Kristy Wallmo (NOAA); Dr. Ayeisha Brinson (NOAA); Dr. Vankita Brown (NOAA)	Conflict and Stress Management Instructor: Dr. D. Hoskins-Brown (SSU)
2. Mar 6	Ecosystem Science (life history, ecology, habitat assessment) Dr. Jessica Miller (OSU); Dr. Howard Townsend (NOAA COL)		4:30pm – 5:00pm Career opportunities and Pathways in marine and fisheries sciences Emarie Ayala-Diaz (Wildlife Biologist, USFWS); Jessica Miller (OSU); Howard Townsend (NOAA COL); Cindy Driscoll (MD DNR)
3. Mar 7	Stock Assessment/Quantitative Ecology Dr. Beth Babcock (RSMAS); Dr. Larry Alade (NOAA); Dr. Brad Stevens (UMES)		
4. Mar 8	Seafood Safety/Aquaculture; and the integration of all the areas Dr. Rose Jagus (UMCES-IMET); Dr. Salina Parveen (UMES); Dr. Ashok Deshpande (NOAA)		Seminar: The etiology of epizootic shell disease in the American lobster, <i>Homarus americanus</i> Dr. Jeffrey D. Shields Department of Aquatic Health Sciences Virginia Institute of Marine Science
5. Mar 9	Proposal Writing contd. – Dr. Brad Stevens (UMES)		

Enhanced engagement with NOAA Scientists to Identify Opportunities for NOAA Experiential Training – The Center has continued to enhance its engagement with NOAA scientists in order to identify mentors for LMRCSC graduate and undergraduate students during the NERTO program and as members of their thesis or dissertation committees.

Scott B. Gudes Public Service Graduate Scholarship in Marine Resource Conservation – Ms. Stephanie Martinez-Rivera (Ph.D. student, UMES) is the Scott B. Gudes Public Service Scholar in Marine Resource Conservation.

Research Goal:

Eleven collaborative research proposals were funded during this period; the titles, names of lead PIs, and the research thematic areas to which they belong are presented in Table 2. These projects are well aligned with NOAA Fisheries research priorities. Seven of the lead PIs of the projects are located at LMRCSC MSIs, hence the projects are helping to build sustainable capacities at the Center MSIs; eight of the lead PIs are graduate students.

Table 2. TAB projects funded for FY 2018

Project #	Lead PI	Project Title	Research Thematic Area	Collaborators
18-01	Brittany King , Ph.D. student, OSU	Underrepresentation in marine and fisheries science professions: how significant life experiences shape a diverse workforce	Social Science	K. Biedenweg, OSU; K. Werner, NOAA; S. Russell, NOAA
18-02	S. Chung , IMET	Baseline Data of Male Reproductive Status for Jonah Crab Management	Assessment	B. Stevens, UMES; Amanda Lawrence, M.S. student at IMET; B. Shank, NOAA
18-03	LaTreese Denson , Ph.D. student, RSMAS	Indices of abundance for King Mackerel in the Gulf of Mexico and South Atlantic improved by incorporating spatiotemporal and environmental variability	Assessment	E. Babcock, RSMAS; D. Hoskins-Brown, SSU; J. Walter, NOAA; J. Thorson, NOAA
18-04	Tara Cox (SSU)	Examining ecosystem health through contaminant analysis of common bottlenose dolphins (<i>Tursiops truncatus</i>)	Assessment	C. Bonin Lewallen, HU; G. Ylitalo, NOAA
18-05	Matthew Ramirez , Ph.D. student, OSU	Integration of habitat-specific growth variation into assessment models: a case study in the Kemp's Ridley sea turtle	Assessment	S. Heppell, OSU; E. Babcock, RSMAS; J. Moore, NOAA; L. Avens, NOAA
18-06	Detbra Rosales , Ph.D. student, UMES	Assessing the Impacts of Harmful Dinoflagellates and <i>Vibrio</i> spp. on Oyster Aquaculture in the Delaware Inland Bays	Healthy Habitats	J. Pitula, UMES; J. Jacobs, NOAA
18-07	Rebecca Wenker , M.S. student, UMES	Cold-water corals in the Mid-Atlantic Bight: Age, colony complexity, and growth	Assessment	B. Stevens, UMES; V. Guida, NOAA
18-08	Eric Lewallen , HU	Genetic-based methods for assessing prey composition and feeding ecology of Pacific lampreys	Assessment	C. Bonin Lewallen, HU; L. Weitkamp, NOAA; L. Park, NOAA
18-09	Brian Galvez , M.S. student, DSU	Diet analysis of juvenile weakfish in the Delaware Bay using stomach content and stable isotope analysis	Assessment	S. Smith, DSU; M. Crawford, UMES; H. Townsend, NOAA
18-10	Andre Price , M.S. student, UMES	Feeding Ecology of Black Sea Bass at Selected Reef Sites using Gut Content and Stable Isotope Analyses	Assessment	B. Stevens, UMES; R. McBride, NOAA
18-11	Enid Munoz , M.S. student, UMES	Assessment of Microplastics and Polybrominated Diphenyl Ethers (PBDEs) in Scallops as Possible	Healthy Habitats	A. Ishaque, UMES; A. Deshpande, NOAA; B. Sharack,

		Indicators of Plastic Pollution from the Georges Bank, Mid-Atlantic, Southern New England, and Gulf of Maine Stock Fisheries		NOAA
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In addition, several projects supported with leveraged funds from various agencies including NOAA, NSF and USDA are on-going at the Center, and new proposals were developed and submitted to various agencies for funding.

Data Management and QA/QC: The Data Management course is being offered again in Fall 2018. Thirteen (13) students are enrolled in it.

Ethical Conduct of Research Training for Students and Faculty:

RSMAS: Research Ethics (RSM 700) is offered every fall, and required for RSMAS graduate students

SSU: Advised students of CITI training available on website

UMES: All students are required to complete the online CITI training in the Responsible Conduct of Research. Graduate students are advised to take MEES 608B: Responsible Conduct of Research

Administration Goals:

- a) Grant funds for FY 2018 have been subcontracted to LMRCSC institutions
- b) The Center advertised vacant personnel positions, including the Postdoctoral Research Fellows (SSU), Communication and Outreach Specialist (UMES), and Coordinator for Budget and Data Management (UMES).
- c) The Center conducted its monthly Executive Committee meetings, and Science Committee meetings

2. Specific Objectives:

The specific objectives of the project are listed under the goals below.

Education Goal 1. Prepare the future workforce for marine and fisheries sciences

Objective 1.1: Recruit students from under-represented groups into marine and fisheries science disciplines

Objective 1.2: Increase retention and degree completion rates for students in marine and fisheries sciences programs

Objective 1.3: Assess the value-added outcomes of degree programs in marine and fisheries sciences at the partner institutions

Education Goal 2. Strengthen collaborations across universities and professional networks to enhance academic programs in marine and fisheries sciences

Objective 2.1: Use relevant research-based curricula to provide students with the highest quality education in marine and fisheries sciences

Objective 2.2: Use Virtual Campus technology to provide students with the opportunity to learn from some of the nation's leading scholars in marine and fisheries sciences

Objective 2.3: Ensure that curricula of degree programs at partner institutions address current challenges and emergent needs within the profession

Objective 2.4: Link students to professional networks and employment opportunities in marine and fisheries sciences

Scientific Research Goal 3. Develop an exemplary capacity for scientific collaborations among partner institutions in the NOAA relevant fields of marine and fisheries sciences

Objective 3.1: Integrate the Center’s research agenda with NOAA Fisheries research priorities in four key thematic areas: ecosystem change and prediction, stock assessment support, habitat research and protection, and safe seafood and aquaculture

Objective 3.2: Foster collaborative research programs to strengthen the research capacities of partner institutions by leveraging the significant strengths and resources of research universities as infrastructure for capacity building

Objective 3.3: Develop faculty recruitment and retention practices that ensure that the collective capacity of scholars affiliated with the Center represents significant concentrations of strength in the four key research thematic areas

Administration Goal 4. Organizational excellence for effective and efficient management of the programs and activities of the Center

Objective 4.1: Establish an Administrative Structure to enhance center operations and provide supportive environment for training and mentoring of students, and for research in marine and fisheries sciences

Objective 4.2: Monitor and ensure compliance with Center Award Conditions

Administration Goal 5. Effectively communicate the activities and accomplishments of the center

Objective 5.1: Develop infrastructure for effective and efficient internal and external communication

Objective 5.2: Develop an effective strategy for communication with students, faculty and administrators within the center, and increase visibility of the center through enhanced communication of its accomplishments to external stakeholders

Administration Goal 6. Assess and evaluate the center’s goals and objectives

Objective 6.1: Assess and evaluate center educational programs

Objective 6.2: Assess and evaluate center research

Objective 6.3: Assess and evaluate administration

3. Significant Results:

Education Goals:

Twenty-three (23) students have been identified/recruited to the Center as members of Cohort 1 (2016 – 2017), including 5 Ph.D., 8 M.S., and 10 B.S. Twenty-one (21) students have been identified/recruited as members of Cohort 2 (2017-2018) including 8 Ph.D., 4 M.S., and 9 B.S. students. So far, ten (10) students have been identified/recruited as members of Cohort 3 (2018-2019) including 3 Ph.D., 2 M.S. and 5 B.S. students. Recruitment for this period is ongoing.

Recruitment of Rising Sophomores for Summer Experiential Training at the LMRCSC:

Consistent with our goal specified in the Implementation Plan, three rising sophomores participated in 2018 summer programs. Those students along with all sophomore undergraduates supported by the center, and unsupported students at partner institutions are receiving guidance regarding applications to the Hollings and NOAA EPP Undergraduate Scholarships.

Scott B. Gudes Public Service Graduate Scholarship in Marine Resource Conservation:

Ms. Stephanie Martinez-Rivera (Ph.D. student, UMES) is the Scott B. Gudes Public Service Scholar in Marine Resource Conservation. The center is in the process of selecting a student for

the 2018 scholarship award to be completed by September 2018.

Building of a Strong Center Cohort Community: The LMRCSC has developed plans for continuing to build a strong cohort community at the Center:

- a) The Cohort Experience Workshop was held March 5-9, 2018 at UMES. Students participated in a variety of activities described in Table 1 and provided feedback about the experience. Feedback from the students and instructors are currently being used to improve the Cohort Experience workshop and planning for the next one that will be held March 2019.
- b) Student Seminar Series that was held in Fall 2017 continued in spring 2018.
- c) Data Management course that was taught in Fall 2018; and
- d) Professional Development workshop was offered by Dr. Maggie Sexton biweekly for undergraduate students and monthly for graduate students during the academic year at UMES.
- e) At SSU, students participated in career goal and fall semester planning sessions with Dr. Hoskins-Brown in April 2018.

Research Goals:

Eleven collaborative proposals (Table 2) were funded by the LMRCSC after reviews by the Technical Advisory Board (TAB). Other research projects supported with leveraged funds from agencies such as NOAA, NSF, USDA, are on-going at the LMRCSC.

Administration Goals:

- a) Dr. Dan Cullen began work as a Post-doctoral Research Associate at UMES in March 2018.
- b) At SSU, the Education Expert position has been filled by Dr. Victoria Young.
- c) The Center held its monthly Executive Committee meetings during which plans to execute student development and professional activities were discussed.
- d) The Center held its Science meeting at the AFSC in Seattle in June 2018.
- e) The External Evaluation team of the LMRCSC from the College of Exploration conducted an evaluation of the LMRCSC and prepared a report.

4. Key outcomes or other achievements:

- a) A total of 54 students (23 in Cohort 1, 21 in Cohort 2, 10 in Cohort 3) have been recruited to the Center
- b) External Evaluation of the LMRCSC was conducted during the reporting period and is continuing.
- c) New proposals have been submitted to various agencies to leverage funding in order to support additional students.

What training and professional development were completed during the reporting period for Center post-secondary students, early professionals, postdocs, and faculty?

Students recruited to the Center have begun taking courses to enable them acquire core competences in marine and fisheries science, and are defining their research projects. They have also discussed with their advisors the Student Development Plan. Thirteen (13) students are currently enrolled in the Data Management for Scientists course that is being offered in fall 2018.

SSU: Savannah State University held its Annual Research Day (with poster competition, April 24, 2018); NOAA Enterprise mixer (March 18, 2018); Workshop on "How to Prepare Successful Applications" for federal positions, scholarships, postdoctoral fellowships, and faculty positions (June 28, 2018). Additionally, Dr. Sue Ebanks co-facilitated a 3-day

workshop for the second time (first at Univ. of New Mexico in 2017) at the Earth Educators' Rendezvous (EER), July 2018 at Univ. of Kansas in Lawrence, KS and has been invited to do the workshop again at EER 2019 at Tennessee State University in Nashville, TN. The title of the workshop was: Preparing for an Academic Career.

How have the results been disseminated to communities of interest, including NOAA and other stakeholders?

- Students and faculty attended the NOAA EPP Education and Science Forum at Howard University March 18-21, 2018. Although several scheduled presentations were canceled due to a winter weather event, 9 students made oral presentations and 7 made poster presentations.
- At the August meeting of the American Fisheries Society, Center faculty convened a special session entitled *Meeting NOAA's Needs: Collaborative Research to Conserve Living Marine Resources, Habitats, and Ecosystems*. The session was organized by Dr. Brad Stevens, LMRCSC Distinguished Research Scientist and moderated by Dr. Paulinus Chigbu, LMRCSC Director. Four center students made oral presentations followed by a discussion with NOAA scientists and staff, and scientists and students from other institutions in attendance.

What actions will be taken by the Center during the next reporting period to accomplish the goals?

Education Goals: As examples, the Center will:

- a) Continue its efforts to recruit students into the Center; at present 10 students have been recruited into Cohort 3, including 3 Ph.D., 2 M.S. and 5 B.S.
- b) Offer to students a workshop on Literacy in NOAA related sciences in spring 2019.
- c) Work with sophomores supported during the Summer 2018, as well as other sophomores recruited during Fall 2018 to develop application packages for the NOAA undergraduate scholarship programs.
- d) Continue to engage NOAA scientists in order to enhance research collaborations and identify scientists to serve on graduate student thesis and dissertation committees; work with students to identify sites for NERTO.
- e) Continue to mentor students and encourage them to present research results at professional meetings, and publish their work in peer-reviewed journals.

Research Goals: As examples, the Center will:

- a) Continue to seek leveraged funds to support students.
- b) Select projects to fund after TAB review of the proposals
- c) Continue research on TAB funded projects and projects supported with leveraged funds.
- d) Continue efforts to publish results from prior awards and present at scientific meetings

Administration Goals: Examples are given below.

- a) Continue Executive Committee meetings
- b) Continue to collect data for evaluation of Center's activities, programs, and accomplishments
- c) Continue to disseminate information about the Center to the public including producing Newsletters.
- d) Ensure that all students have taken Ethical Conduct of Research Training course
- e) Hold the LMRCSC Board of Visitors (BOV) meeting

II. Products of Award

There are no limitations to the number of entries a Center submits. In reporting, keyword information can be directly pulled from Thomson Search and on Research.gov. *NOTE: Recipient may provide images, tables, charts, or other graphics in support of the Products section. Recipient may include high resolution photos.*

Within the Products section, recipient can list any products resulting from the FY16 CSC award, during the specified reporting period, such as:

Degrees Awarded: Emily Griffin (SSU) completed her M.S. degree in May 2018. Darius Sanford (SSU) completed his B.S degree May 2018.

Publications in Journals:

The following tables contain manuscripts published during this period and those currently under review. A justification of how each manuscript is associated with the LMRCS is included to the right of the citation.

Table 3a. Eighteen (18) publications (1 student author identified by asterisk*) produced by the Center; LMRCS scientists are in bold

Publications in journals	Justification	Status
Babcock, E. A. , Tewfik, A., & Burns-Perez, V. (2018) Fish community and single-species indicators provide evidence of unsustainable practices in a multi-gear reef fishery. <i>Fisheries Research</i> doi: 10.1016/j.fishres.2018.07.003	Leveraged	Published
Barker BD, AZ Horodysky , DW Kerstetter. Hot, or not? Comparative behavioral thermoregulation, critical temperature regimes, and thermal tolerances of the invasive lionfish <i>Pterois</i> sp. versus native western North Atlantic reef fishes. <i>Biological Invasions</i> . 00:000-000.	LMRCS TAB recipient; Leveraged	Published
Bembe, B., Williams, E., Place, A. , Liang, D., & J. Sook Chung (2018) Effects of temperature and photoperiod on hemolymph vitellogenin levels during spawning events of the blue crab, <i>Callinectes sapidus</i> , in captivity (2018). <i>Aquaculture Res</i> ,	Leveraged	Available electronically ahead of print
Bond, M. E., Valentin-Albanese, J., Babcock, E. A. , Hussey, N. E., Heithaus, M. R., & Chapman, D. D. (2018) The trophic ecology of Caribbean reef sharks (<i>Carcharhinus perezii</i>) relative to other large teleost predators on an isolated coral atoll. <i>Marine Biology</i> 165:67. doi: 10.1007/s00227-018-3322-2	Leveraged	Published
Cardeñosa, D., Fields, A.T., Babcock, E. A. , Zhang, H., Feldheim, K., Shea, S. K. H., Fischer, G. A., & Chapman, D. D. (2018) CITES-listed sharks remain among the top species in the contemporary fin trade. <i>Conservation Letters</i> 2018;e12457. doi: 10.1111/conl.12457	Leveraged	Published

Chintapenta, K., Coyne, K., Pappas*, A. , Lee, K., Dixon, C., Kalavacharla, V., Ozbay, G. (2018) Diversity of Diatom Communities in Delaware Tidal Wetland and Their Relationship to Water Quality. <i>Front. Environ. Sci.</i> DOI=10.3389/fenvs.2018.00057	LMRCSC Cohort 1 student (ECSC)	Published
Grüss, A., Perryman, H. A., Babcock, E. A. , Sagarese, S. R., Thorson, J. T., Ainsworth, C. H., Anderson, E. J., Brennan, K., Campbell, M. D., Christman, M. C., Cross, S., Drexler, M. D., Drymon, J. M., Gardner, C. L., Hanisko, D. S., Hendon, J., Koenig, C. C., Love, M., Martinez-Andrade, F., Morris, J., Noble, B. T., Nuttall, M. A., Osborne, J., Pattengill-Semmens, C., Pollack, A. G., Sutton, T. T., & Switzer, T.S. (2018) Monitoring programs of the U.S. Gulf of Mexico: inventory, development and use of a large monitoring database to map fish and invertebrate spatial distributions. <i>Reviews in Fish Biology and Fisheries</i> doi: 10.1007/s11160-018-9525-2	Leveraged	Published
Haq, S, Bachvaroff, TR, and Place, AR. (2017) Characterization of Acetyl-CoACarboxylases in the Basal Dinoflagellate <i>Amphidinium carterae</i> . <i>Marine Drugs</i> 15:149; doi: 10.3390/md15060149.	Leveraged	Published
Janouškovec J, Gavelis GS, Burki F, Dinh D, Bachvaroff TR, Gornik SG, Bright KJ, Imanian B, Strom SL, Delwiche CF, Waller RF (2017). Major transitions in dinoflagellate evolution unveiled by phylotranscriptomics. <i>PNAS</i> , 114(2) E171-E180, doi: 10.1073/pnas.1614842114.	Leveraged	Published
Liu, CL, Place, AR & Jagus, R. (2017) Use of antibiotics for maintenance of axenic cultures of <i>Amphidinium carterae</i> for the analysis of translation, <i>Marine Drugs: Advances and New Perspectives in Marine Biotechnology</i> II, 15(8): E242. doi: 10.3390/md15080242.	Leveraged	Published
Lycett, K., J. Sook Chung, & Pitula J. (2018) The relationship of blue crab (<i>Callinectes sapidus</i>) size class and molt stage to disease acquisition and intensity of <i>Hematodinium perezii</i> infections. <i>PlosOne</i> 13: e192237.	Leveraged	Published
Mayor, E.D. and Chigbu, P. (2018). Mysid shrimp dynamics in relation to abiotic and biotic factors in the coastal lagoons of Maryland, Mid-West Atlantic. <i>Marine Biology Research</i> . DOI: 10.1080/17451000.2018.1472384.	LMRCSC	Published
Morales-Núñez, A.G. and Chigbu, P. (2018). First record of the isopod <i>Ianiropsis cf. serricaudis</i> (Crustacea: Peracarida: Janiridae) in Maryland Coastal Bays, USA. <i>ZooKeys</i> 747: 115-139.	LMRCSC	Published
Ogburn, M, Banglely, C. J, Aguilar, R., Curran, M. C., Webb, S. F., Hines, A. H. (2018) Migratory connectivity and philopatry of cownose rays <i>Rhinoptera bonasus</i> along the Atlantic coast, USA. <i>Marine Ecology Progress Series</i> 602:197-211	Leveraged	Published

Oseji, O.F., Chigbu, P. , Oghenekaro, E., Waguespack, Y., and Chen, N. (2018). Spatial and temporal patterns of phytoplankton composition and abundance in the Maryland Coastal Bays: the influence of freshwater discharge and anthropogenic activities. <i>Estuarine, Coastal and Shelf Science</i> 207: 119-131.	LMRCSC	Published
Roy, S, Jagus, R , Morse, D. (2018). Translation and translational control in dinoflagellates. <i>Microorganisms</i> , ahead of print.	Leveraged	Available electronically ahead of print
Williams, EP, Place, AR & Bachvaroff, T.R (2017). Transcriptome Analysis of Core Dinoflagellates Reveals a Universal Bias Towards “GC” Rich Codons. <i>Mar. Drugs</i> , 15:125; doi:10.3390/md15050125B.	Leveraged	Published

Table 3b. Four (4) publications under review or accepted (2 student authors identified by *) were produced by the center

Publications in journals	Justification	Status
Oghenekaro, E.U. and Chigbu, P. (2018). Population dynamics and life history of marine cladocerans in the Maryland Coastal Bays. <i>Journal of Coastal Research</i> .	LMRCSC PI	In Revision
Schultz, E., Hoskins-Brown, D. Amon-Lewis, K. (2018). Summary statistics of green sea turtle, <i>Chelonia mydas</i> , nesting data from the East End beaches of St. Croix, U.S. Virgin Islands with recommendations for long-term sea turtle nesting data collection and management. <i>Caribbean Journal of Science</i>	other LMRCSC activity	under review
Schweitzer*, C. C., A. Z. Horodysky , A. L. Price*, and B. G. Stevens . In Press. Impairment indicators for delayed mortality in black sea bass (<i>Centropristis striata</i>) bycatch in the commercial trap fishery using a condition index. <i>Fisheries Research</i> .	TAB	In Press
Walters, Tina L., Lauren M. Lamboley, Natalia B. López-Figueroa, Áurea Rodríguez, Deidre M. Gibson and Marc E. Frischer. Diet and trophic interactions of a globally significant gelatinous marine zooplankter, <i>Doliolietta gegenbauri</i> (Uljanin, 1884).	LMRCSC PI	In Revision

Table 3c. Books: 2 books were produced by the center; LMRCSC scientists are in bold

Books	Justification	Status
Cuker, B. E. , Crawford, M.K., and R. Chambers. 2017. Renewable Energy and Environmental Sustainability, D. Gosselin, Ed., InTeGrate's Earth-focused Modules and Courses Peer Reviewed Collection, https://serc.carleton.edu/163286	Leveraged	Published
Stevens, B. G. 2018. The Ship, the Saint, and the Sailor: The Long Search for the Legendary Kad'yak. Ingram Press, San Diego, CA.	Other	Published

Table 3d. One book chapter was produced by the center; LMRCSC scientists are in bold.

Book chapters	Justification	Status
Archer, R., Davis, F., Gragg, R., Ebanks, S. (2018) HBCUs Broadening Participation in Geosciences (a journey through InTeGrate). David Gosselin, Springer	Leveraged	Published

Table 3e: One (1) M.S. thesis was produced by the center; LMRCSC students are in bold.

Theses/Dissertations	Justification
Griffin, E. Stock Structure of Common Bottlenose Dolphins (<i>Tursiops truncatus</i>) Through Photo-Identification and Genetic Analyses. Retrieved from Proquest	LMRCSC Cohort 1 student

Conference Papers, Posters and Presentations:

The following tables contain presentations made during this period. A justification of how each manuscript is associated with the LMRCSC is included to the right of the citation.

Table 4a. Twenty-one (21) oral presentations (10 student presenter)

Oral presentations at professional meetings	Justification
Almodovar-Acevedo*, L., and Stevens, B.G. (2018). Effect of Temperature on Respiration Rates of Black Sea Bass and Applications in Modeling. American Fisheries Society 148 th Annual Meeting, Atlantic City, NJ, August 21, 2018.	TAB Project (cohort 2 student)
Almodóvar-Acevedo, L.*; Stevens, B. (2018). Effect of temperature on juvenile black sea bass respiration rates. Oral presentation at the NOAA EPP/MSI Biennial Education and Science Forum. Washington DC.	TAB Project (cohort 2 student)
Bachvaroff, T.R. (2017). Scaling ribosomal RNA differences within dinoflagellates for species identification 9th U.S. Conference on Harmful Algae. Baltimore, MD. 2017.	Leveraged
Cruz-Marrero*, W., C. Tuohy, R. Appeldoorn, and B. G. Stevens (2018). Comparing Divers and Camera Sled Surveys: An Improvement for Fisheries Independent Data for Queen Conch in Puerto Rico? American Fisheries Society 148 th Annual Meeting, Atlantic City, NJ, August 21, 2018.	Leveraged
Cullen, D. , and B. G. Stevens (2018). Application of Systematic Adaptive Cluster Sampling for the Assessment of Black Sea Bass <i>Centropristis striata</i> Abundance. American Fisheries Society 148 th Annual Meeting, Atlantic City, NJ, August 21, 2018.	TAB Project
Galvez, B.* , Neilan, B., Greco, M., Oliver, D., Ozbay, G., Smith, S. (2018) Diet Analysis of Weakfish (<i>Cynoscion regalis</i>) from the Delaware Bay using stable isotope and stomach content analyses. Presented at the NOAA EPP meeting, Washington, D.C., April 2018.	TAB Project; Cohort 1 student
Galvez, B.* , Neilan, B., Greco, M., Ozbay, G., Townsend, H., Smith, S. (2018) Stable Isotope Analysis of Juvenile Weakfish (<i>Cynoscion regalis</i>) from the Delaware Bay. Presented at the American Fisheries Society meeting, Atlantic City, NJ, 2018.	TAB Project; Cohort 1 student

Gonsior, M, Leanne Powers, Philippe Schmitt-Kopplin, Mourad Harir, Feng Chen, Ernest Williams, & Allen R. Place (2017). Disinfection by-products arising from <i>Microcystis aeruginosa</i> algal DOM. 9th U.S. Conference on Harmful Algae. Baltimore, MD.	Leveraged
Green, S.* (2018). Elucidating the presence and expression of the crustacean hyperglycemic hormone of the red deep-sea crab, <i>Chaceon quinquegens</i> . Presented at the American Fisheries Society meeting, Atlantic City, NJ, 2018.	TAB Project; Cohort 2 student
Hanif, A.* (2018). Insights into the gut microbiome and diet of Atlantic menhaden. Presented at the American Fisheries Society meeting, Atlantic City, NJ, 2018.	TAB Project; Cohort 2 student
Jagus, R. (2017). Dinoflagellates: Eukaryotes that are not plants, fungi or metazoa. EMBL Conference on Translational Control, Heidelberg, Germany.	Leveraged
King*, Brittany. (2018). Underrepresentation for racial and ethnic groups in fisheries science profession. Presented at the International Symposium on Society and Resource Management, Snow Bird, UT, June 2018. Oral	LMRCSC Cohort 2 student
Lawrence*, A. (2018). Isolating insulin-like androgenic gland (IAG) hormone cDNA sequence of the red deep-sea male crab, <i>Chaceon quinquegens</i> . Presented at the American Fisheries Society meeting, Atlantic City, NJ, 2018.	TAB Project; Cohort 1 student
O'Farrell*, H. and Babcock, E.A. (2018). Evaluation of Environmental Conditions as Predictors for Mako Shark CPUE using Generalized Linear Mixed Modeling and Quantile Regression. Presented at NOAA EPP Forum. Washington, DC. March 2018	LMRCSC Cohort 1 student
Oliver*, I. (2018). Seasonal changes affect the accumulation of starch in <i>Spartina alterniflora</i> rhizomes. Presented at NOAA EPP Forum, March 2018.	Cohort 1 student
Olsen, N. A., and B. G. Stevens. Reproductive Biology and Size at Sexual Maturity of Jonah Crabs (<i>Cancer borealis</i>) in the Mid-Atlantic Bight. American Fisheries Society 148 th Annual Meeting, Atlantic City, NJ, August 21, 2018.	TAB Project
Place, AR, Ernest Williams, Saddef Haq and Tsvetan R. Bachvaroff (2017). Some Assembly Required - Beyond the type I, II and III polyketide synthase paradigms in dinoflagellates. 9th U.S. Conference on Harmful Algae, Baltimore, MD, Sept 6-9, 2017.	Leveraged
Schweitzer, C. C*. and Stevens, B. G. (2018). The effectiveness of increasing connectivity between two patch reefs for increasing site fish abundance in the Mid-Atlantic. Presented at Ecological Society of America, New Orleans, LA August 2018.	Cohort 1 student
Stevens, B. G. (2018). Supporting NOAA with Research Education at the Living Marine Resources Cooperative Science Center. American Fisheries Society 148 th Annual Meeting, Atlantic City, NJ, August 20, 2018.	LMRCSC PI
Stevens, B. G., and T. J. Miller (2018). Status and Trends of World Crab Fisheries. American Fisheries Society 148 th Annual Meeting, Atlantic City, NJ, August 22, 2018.	Leveraged

Stevens, B. G. , J. Wilson, N. A. Olsen, and S. Martinez* (2018). Direct Aging of Red Deep-Sea and Jonah Crabs, and Implications for Lifetime Reproduction. American Fisheries Society 148 th Annual Meeting, Atlantic City, NJ, August 21, 2018.	Leveraged
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Posters: 24 (*14 student presenters)

Poster presentations at professional meetings	Justification
Broemsen, L, Daniel D. Kepple, Allen R. Place and Matthew W. Parrow. (2017) Image Cytometry (ICM) as a method for cell cycle analysis of mixotrophic cultures and field bloom samples of <i>Karlodinium veneficum</i> . 9th U.S. Conference on Harmful Algae. Baltimore, MD. 2017	Leveraged
Campbell, N., C. Vinson, and C. Pride. (2018) Outrunning sea-level rise: A study of seasonal sediment accretion rates in salt marshes of Savannah, GA. HBCU Climate Change Conference, Oct. 19-23, New Orleans, LA. Sept 2018	Leveraged
Cruz K, Rittman J, Carter N, Carter K, Pressley N, Milton* I, Layton* J, Smith* N, Bonin C, Lewallen EA. (2018). Genetic Techniques for Monitoring Black Sea Bass Abundance in the Chesapeake Bay Region. 23rd Annual School of Science Research Symposium, Hampton University, Hampton, VA. April 11-12, 2018.	2 LMRCSC cohort 1, 1 cohort 2
Fenwick* I , Salcedo A, Rogers J, Leslie J, Gibson D. (2018). Save the Bay: <i>Crassostrea virginica</i> Oyster Spat Recruitment Study in Hampton River of Virginia. 9th Biennial NOAA EPP Science and Education Forum. Howard University, Washington, DC, March 18-21, 2018.	LMRCSC cohort 1
Fenwick* I , Salcedo A, Rogers J, Leslie J, Gibson D. (2018). Save the Bay: <i>Crassostrea virginica</i> Oyster Spat Recruitment Study in Hampton River of Virginia. Annual School of Science Research Symposium, Hampton University, Hampton, VA April 11-12, 2018.	LMRCSC cohort 1
Haq, S, & Bachvaroff, TR, Oyler, BL, & Place, AR (2017). Acetyl-coa carboxylases in dinoflagellates: fueling the polyketide synthase pathways. 9th U.S. Conference on Harmful Algae. Baltimore, MD. 2017.	Leveraged
Haq, S, Place, AR & Bachvaroff, TR. Oyler, BL, & Place, AR (2017) Phylogenetic analysis of acetyl CoA carboxylases in dinoflagellates. 17th ICHA Proceedings, Florianópolis, Brazil.	Leveraged
Jagus, R. , Gillespie, K.M. & Bachvaroff, T.R. (2017). Widespread distribution of Class III eIF4E family members in metazoans. EMBL Conference on Translational Control, Heidelberg, Germany.	Leveraged
Kendra Dorsey*, Richard Brill, Olivera Stojilovic, Michael H Schwarz, Thomas P Hurst and Andrij Horodysky (2018). Effect of Ocean Acidification on Auditory Neurobiology in a tropical Marine Fish 9th Biennial NOAA EPP Science and Education Forum. Howard University, Washington, DC, March 18-21, 2018.	1 LMRCSC cohort 2
King*, Brittany. (2018). Underrepresentation for racial and ethnic groups in fisheries science profession. Presented at Oregon State University for the Research Advances in Fisheries, Wildlife, and Ecology Symposium (RAFWE), April 2018 . Poster Presentation	LMRCSC Cohort 2 student

Kleponis*, N. , Mendez*, D., Heckscher, C., Smith, S. (2018). Assessing the Relative Abundance of Wintering Red-throated Loon in the Delaware Bay. Presented at the NOAA EPP meeting, Washington, D.C., April 2018.	LMRCSC Cohort 2 student
Layton* JM, Bonin CA, Pressley N, Park LK, Weitkamp LA, Lewallen EA. Genetic-based methods for assessing prey composition and feeding ecology of Pacific lampreys, 23rd Annual School of Science Research Symposium, Hampton University, Hampton, VA April 11-12, 2018.	1 LMRCSC Cohort 2 student
Layton* JM, Bonin CA, Pressley N, Park LK, Weitkamp LA, Lewallen EA (2018). Genetic-based methods for assessing prey composition and feeding ecology of Pacific lampreys, 9th Biennial NOAA EPP Science and Education Forum. Howard University, Washington, DC, March 18-21, 2018.	1 LMRCSC cohort 2
Liu, CL, Gillespie, KM, Place, AR & Jagus, R. (2017). Use of antibiotics for maintenance of axenic cultures of <i>Amphidinium carterae</i> for the analysis of translation. 9th U.S. Conference on Harmful Algae, Baltimore, MD.	Leveraged
Mayes* C, Horodysky A, Bonin CA, Fogarty M, Gibson D, Wiley S, Lewallen EA. (2018). Ecosystem Based Approaches to Modeling Fish Species Distributions in Chesapeake Bay. 23rd Annual School of Science Research Symposium, Hampton University, Hampton, VA April 11-12, 2018.	1 LMRCSC cohort 1
Milton* IA, Smith* NN, Goebel M, Krause D, Lewallen EA, Barreto F, Hoffman J, Bonin CA. (2018). Social Structure of Leopard Seal, <i>Hydrurga leptonyx</i> , at Livingston Island, Antarctica. 23rd Annual School of Science Research Symposium, Hampton University, Hampton, VA April 11-12, 2018.	2 LMRCSC Cohort 1 students
Milton* IA, Smith* NN, Goebel M, Krause D, Lewallen EA, Barreto F, Hoffman J, Bonin CA. (2018). Social Structure of Leopard Seal, <i>Hydrurga leptonyx</i> , at Livingston Island, Antarctica. 9th Biennial NOAA EPP Science and Education Forum. Howard University, Washington, DC, March 18-21, 2018.	2 LMRCSC cohort 1
Noland, K, Liu, CL, & Jagus, R. (2017). Dramatic changes in eIF4E-1a phosphorylation accompany the striking diel changes in protein synthetic rate of axenic <i>Amphidinium carterae</i> . EMBL Conference on Translational Control, Heidelberg, Germany.	Leveraged
Oyler, BL, Donald F. Smith, Saddef Haq, David R. Goodlett, Allen R. Place (2017). Primary structure elucidation of hemolytic toxins from dinoflagellates responsible for fish kills by accurate tandem mass spectrometry. 9th U.S. Conference on Harmful Algae, Baltimore, MD, Sept 6-9, 2017	Leveraged
Smith* NN, Milton* IA, Cox T , Kellar N, Trego M, Morin P, Lewallen EA, Bonin CA. Assessing the utility of microRNAs as biomarkers for marine mammal health. 23rd Annual School of Science Research Symposium, Hampton University, Hampton, VA April 11-12, 2018.	2 LMRCSC Cohort 1 students
Smith* NN, Milton* IA, Cox T, Kellar N, Trego M, Morin P, Lewallen EA, Bonin CA. Assessing the utility of microRNAs as biomarkers for marine mammal health. 9th Biennial NOAA EPP Science and Education Forum. Howard University, Washington, DC, March 18-21, 2018.	2 LMRCSC cohort 1
Williams, EP, Bachvaroff, T, Place, AR (2017). Phosphopantetheinyl transferases in dinoflagellates: toxin versus fat synthesis. 9th U.S. Conference on Harmful Algae. Baltimore, MD. 2017.	Leveraged
Coit, N.*, Pitula, J. (2018). <i>Perkinsus</i> : An Aquatic Parasite as an Alternative Model for Lipid Metabolism. 9th Biennial NOAA EPP Science and Education Forum. Howard University, Washington, DC, March 18-21, 2018.	LMRCSC Cohort 1 student

McClain*, Nylah, Richardson, Chelsea, Ishaque, Ali (2017). Creating A Dynamic Food Web of The Summer Flounder Using Fatty Acid, Stable Isotope, and Gut Content Analysis. Presented at NOAA EPP Forum, August 2017, Howard University	Cohort 1 Student
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Other Publications:

Technologies or Techniques: None

Patents: None

Inventions: None

Websites: www.umes.edu/lmrcsc

Products:

Other products	Justification
1st place AAAS Makers and Innovation award for the Multifaceted Oyster Reef prototype by HU students.	LMRCSC Cohort 1 student and other leveraged students.

III. Participants in Award Performance

There are no limits on the number of participants listed for this section; however, the Center is required to list all participants who have worked one-person month or more for the project reporting period. *NOTE: Conversion of percentage of effort to person months is as follows. To calculate person months, multiply the percentage of effort associated with the project times the number of months of the appointment. For example: 25% of a 9 month academic year appointment equals 2.25 (AY) person months (9 x 0.25= 2.25).*

For the reporting period, specific questions are listed below. For award participants, recipient must provide information for:

1. What individuals have worked on the project?
2. What organizations have been involved as partners?
3. What other collaborators have been involved?

1. What individuals have worked on the project?

First name	Last Name	Partner Institution	Most Senior Project Role	Project Hours Worked per Month
Stacy	Smith	DSU	Principal Investigator	90
Christopher	Heckscher	DSU	Participating	10
Gulni	Ozbay	DSU	Participating	3
Deidre	Gibson	HU	PI	40
Carolina	Lewallen	HU	Faculty	80
Jessica	Miller	OSU	PI	35

Elizabeth	Babcock	RSMAS	Principal Investigator	7
David	Die	RSMAS	Faculty	3.5
Rosemary	Jagus	UMCES	PI	80
J. Sook	Chung	UMCES	Mentor	40
Tsvetsan	Bachvaroff	UMCES	Bioinformatics resource	20
Russell	Hill	UMCES	Fundraiser	20
Allen	Place	UMCES	Mentor	10
Dave	Secor	UMCES	Mentor	10
Paulinus	Chigbu	UMES	Center Director and Principal Investigator	80
Margaret	Sexton	UMES	Assistant Center Director	160
Dionne	Hoskins-Brown	SSU	Principal Investigator	40
Victoria	Young	SSU	Education Expert	160
Tara	Cox	SSU	TAB PI	20
Sue	Ebanks	SSU	Faculty	10
Bradley	Stevens	UMES	Distinguished Research Scientist	160
Ida	Tilghman	UMES	Administrative Assistant	160

2. What organizations have been involved as partners?

Provide additional information such as:

1. Type of Partner Organization:
2. Name:
3. Location:
4. Partner's Contribution to the Project:

Type of partner organization	Name	Location	Partners contribution to the project
State government	DNREC	Dover, DE	Helped students collect samples
State government	NJ DEP	Galloway Township, NJ	Helped students (Brian Galvez) collect samples
State government	DNREC	Dover, DE	Helped students (Brian Galvez) collect samples
State government	MD DNR	Annapolis, MD	Helped student (Kasondra Rubalcava) collect samples
Non profit	Chesapeake Bay Foundation	Richmond, VA	Helped students with oyster restoration project
Federal	NOAA Bycatch Program	WA, DC	Grant funding
Federal	National Park Service	Assateague Nat'l. Seashore	Grant funding

Federal	MD Sea Grant	Univ. of MD	Program Development Funding
Federal	NOAA S-K Program	WA, DC	Grant funding

Have other collaborators or contacts been involved? Yes

If Yes, describe involvement and time spent.

Last name	First name	Title/Affiliation	Description of involvement
Crawford	Maurice	Associate professor, UMES	Committee member/TAB for Brian Galvez
North	Heather	Oyster tech, CBF	Helped students with oyster restoration project
Beidenweg	Kelly	Assistant Professor, OSU	Human Dimensions, mentor for Britany King
Pitula	Joe	Associate Professor, UMES	collaborator on TAB project
Secor	Dave	Professor, UMCES-CBL	collaborator on proposed TAB project
Pitula	Joe	Professor, UMES	Student co-advisor
Chung	Sook	Professor, IMET	Co-PI on Grant
Anderson	Phil	Assist. Professor, Salisbury Univ.	Committee member for N. Olsen
Bradley	Christina	Assist. Professor, Salisbury Univ.	Committee member for W. Cruz
Dickinson	Gary	The College of New Jersey	Co-PI on Grant
Horodysky	Andrij	Assoc. Professor, Hampton	Co-author on publication
Lipcius	Rom	Professor, VIMS	Co-author on publication

Have NOAA collaborators or contacts been involved? Yes

If Yes, describe involvement and time spent.

Last name	First name	Title/Affiliation	Description of involvement
Townsend	Howard	NEFSC	M.S. committee member/mentor for Brian Galvez (DSU), Laura Almodovar Acevedo (UMES)
Zamon	Jen	NWFSC	M.S. committee/mentor for Nicole Kleponis (DSU)
Wikfors	Gary	NEFSC	M.S. committee/mentor for Amanda Pappas (DSU) and Jorge Rodriguez (UMES)
Fogarty	Michael	NEFSC	NERTO advisor for Cristin Mayes (HU)
Cortes	Enric	SEFSC	Ph.D. committee member and NERTO mentor for Halie O'Farrell (RSMAS)
Walter	John	SEFSC	Collaborator
Thorson	Jim	NWFSC	Collaborator

Sharma	Rishi	NWFSC	Collaborator
van Dolah	Francis	NOS/NCCOS, Hollins Marine Lab	collaborator on dinoflagellate research
Friedland	Kevin	NMFS, NEFSC, Woods Hole	PhD committee member for Amar Hanif (IMET); Collaborator on TAB project
Leight	A.K.	NOS/NCCOS, Oxford, MD	Collaborator on TAB project
Messick	Gretchen	NOS/NCCOS, Oxford, MD	Collaborator on blue crab health and disease
Morton	Steve	NMFS, Center for Coastal Fisheries and Habitat Research	Collaborator on blue crab research
Poach	Mathew	NMFS JJ Howard Marine Sciences Lab, Sandy Hook, NJ	Collaborator on red crab research
Richards	Anne	NEFSC	Collaborator on TAB project
Rivera	Jose	NMFS Habitat Conservation Division, Puerto Rico	Collaborator on sponge research
Shank	Burton	NEFSC, Woods Hole, MA	Collaborator on Jonah crab reproductive status
Skelley	Suzanne	COL/NOS	Collaborator on TAB project
Weinberg	James	NMFS/NEFSC Resource Evaluation & Assessment Division	Ph.D. committee member for Shadaesha Green & Amanda Lawrence (IMET)
McBride	Rich	NEFSC, Woods Hole	Committee member for Andre Price (UMES)
Guida	Vince	NEFSC, Sandy Hook	Committee member for R. Wenker (UMES)
Long	Chris	AFSC, Kodiak Lab	Committee member for S. Martinez (UMES)
Shank	Burton	NEFSC, Woods Hole	Committee member for N. Olsen (UMES)
Hill	Ron	SEFSC, Galveston Lab	Committee member for W. Cruz (UMES)
John	Jacobs	NOS, Oxford Lab	NERTO mentor for D. Rosales (UMES)
Kellison	Todd	SEFSC, Beaufort Lab	Committee member for C. Schweitzer
Deshpande	Ashok	NEFSC	M.S. committee member for Davielle Drayton (SSU)
Barbaro	Jacob	SWFSC	UAS course for Shaneese Mackey (SSU)
Hill	Ron	SEFSC	Serves on an internal committee to collaborate on the use of UAS for habitat monitoring in the South Atlantic, Gulf, and Caribbean
Caldwell	Phil	SEFSC	Serves on an internal committee to collaborate on the use of UAS for habitat monitoring in the South Atlantic, Gulf, and Caribbean

Merino	Joy	SEFSC	Serves on an internal committee to collaborate on the use of UAS for habitat monitoring in the South Atlantic, Gulf, and Caribbean
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IV. Impacts of Award

What is the impact on the development of future workforce candidates for the principal discipline(s) of the award and NOAA mission-aligned support of the project?

Twenty-three (23) students have been identified/recruited to the Center as members of Cohort 1 (2016 – 2017), including 5 Ph.D., 8 M.S., and 10 B.S. Twenty-one (21) students have been recruited to Cohort 2 (2017-2018) including 8 Ph.D., 4 M.S., and 9 B.S. students. So far, Ten (10) students have been identified/recruited as members of Cohort 3 (2018-2019) including 3 Ph.D., 2 M.S. and 5 B.S. students; at least 6 of them belong to underrepresented minority groups. LMRCS activities focus on training programs that are preparing students for work on essential fish habitat, marine protected species and ecosystems. The future workforce candidates, our students, are gaining valuable experiences via the cohort experience so they will have colleagues after they graduate. Developing these relationships early will help them in the future. The NOAA mentor experience will prepare students for their first NOAA 'job' experience. Under the tutelage of a mentor, the students will develop work skills, such as co-worker interactions, proper workplace etiquette, etc.

What is the impact on other disciplines and Program Level Outputs and Outcomes aligned with the 2016 FFO?

HU: 5 student and 1 faculty from Biological Sciences are now working in the LMRCS funded genetics lab.

What is the impact on the development of candidates for the NOAA mission future workforce?

The LMRCS, through its Student Development Plan, will produce a cadre of more prepared students for careers in marine and fisheries science. The presence of the LMRCS and its support for these students in Cohort 1 has attracted other interested students to ask about NOAA careers.

DSU: Impacts of center on the future workforce can be witnessed in Delaware. Delaware State agencies have hired 1 technician and 3 former students, mostly women and minorities.

UMCES: Ammar Hanif (IMET) was awarded Knauss Fellowship and is based at NOAA/NOS/NCCOS, Silver Spring.

What is the impact of the Center activities to building institutional capacity in support of the objectives of the NOAA FY16 CSC award?

The project is helping the Center to build capacity at Center Institutions through hiring of postdoctoral fellows, new staff, and support of scientists in NOAA related science disciplines, and enhanced collaboration with NOAA scientists. Funds leveraged from external sources by Center scientists are being used to train additional students and to build infrastructure for research and

education. The Center is establishing federal guidelines as an expectation of minimal student support. These are unprecedented and are communicating a standard for what is needed to guide a student through a degree. The 2016 award supports student research to a degree that allows students to explore more sophisticated approaches with distant collaborators - something that would not be possible without the one-time \$10,000 in research support.

What is the impact of the NOAA award on the Center's data and information resources?

Nothing to report.

To whom and how is this information and the Center accomplishments communicated?

DSU: At DSU, the NOAA award accomplishments are disseminated throughout the university and to the smaller 2-year colleges in the area. This is one way of recruiting students. Also, our students work with DE and NJ state environmental departments, so the center accomplishments are shared with them.

How has the Center successfully conducted transfer of research results and new technologies in support of NOAA mission-aligned R2X?

DSU: Students and PIs attend meetings, present poster and talks, and are thereby informing others of the research results from the center.

RSMAS: Research results have been published, and presented at scientific meetings and stock assessment working groups.

UMCES: Grad student Hanif assisting NOAA-COL scientists, Leight & Skelley with microbial community analysis of the Tred Avon, Choptank River tributary, using high-throughput sequencing. Hanif is also helping NCCOS Monitoring & Assessment Branch to characterize of microplastics in Great Lake mussels (seeking training from Dr. Ashok Deshpande, Sandy Hook).

What were the societal impacts of the Center research activities? How were or are the impact results communicated to the general public.

DSU: One of the societal impacts is that more minorities are being hired in fisheries positions. The students who do research are informing others about their research activities through outreach in schools.

HU: Oyster restoration efforts are communicated to student groups and the public.

RSMAS: Center research is communicated to the public in leadership training organizations and conferences like the Institute for Georgia Environmental Leadership and the Choosing to Lead Conference as well as in non-technical regional periodicals.

UMCES: Nick Hammond presents "Startup CEO Training" for interested members of the public. In collaboration with the Baltimore Underground Science Space (BUGSS) iGEM program IMET presented an evening on using biology to degrade plastics and microplastics for cleaning up our water and environment. This was followed by a screening of 'A Plastic Ocean' and a Q&A session with Dr. Michael Gonsior (UMCES-CBL), one of the featured researchers from the film. This event is open to all of IMET and the general public.

V. Changes/Challenges

If not previously reported in writing to NOAA through other mechanisms, provide the following additional information or state, "Nothing to Report", if applicable.

Changes in performance of the award objectives - approach and reason(s) for change:

Nothing to report in this time period.

Actual or anticipated problems or delays and actions or plans to resolve them:

Nothing to report.

Changes that have a significant impact on expenditures:

UMCES: Increase in student stipends.

VI. Special Award Conditions

This report section is intended to provide information on progress under each special award condition for the specific reporting period. This is not cumulative reporting.

Accomplishments (provide evidence) in implementing of:

Center Evaluation – activities completed for the Evaluation Plan that assess program progress and measures, the impact of activities related to intended education, and training, research and outcomes of the CSC.

Reports of the years 1 and 2 External Evaluations of the LMRCSC by a team from the College of Explorations (COE) are presented in Appendix I. The following describes how the LMRCSC has used recommendations from the evaluations to improve upon its programs and activities.

LMRCSC Use of Year 1 Assessment Findings in Year 2 Program Modifications: Closing the Loop on Assessment Data for Continuous Quality Improvement

A critical step in continuous quality improvement in any program is the use of assessment findings to revise the program during recurring program cycles. For purposes of the LMRCSC, the project leadership was responsive to the external assessment report and did, indeed, modify the program in the directions indicated by the evaluation team. The following summary describes these efforts at closing the loop of program implementation, assessment, and program revision.

At the end of year one, the external evaluation team submitted a written assessment report on August 15, 2017. This report was circulated to the project leadership by Dr. Paulinus Chigbu, LMRCSC Director, who then scheduled the evaluation team to meet with the project leadership on a conference call on September 19, 2017. The evaluation report was a major item on the call agenda, and provided an opportunity for the leadership team to ask clarifying questions of the evaluators, and to ask questions about data and interpretations. This, in turn, allowed the project leadership to move into year two of the project with a clear assessment of key project elements, and to use these assessment to guide planning and project revision.

The primary findings, conclusions, or recommendations that emerged in the Year 1 Assessment Report which were actionable by project leadership included (page numbers are from

the August 15 Year One Assessment Report):

1. The need for clarity of “mentoring,” “mentoring plans,” and student/advisor/faculty relationships in TAB and NERTO projects associated to the project (p.4);
2. A desire, expressed by students, for community development through an alumni association and increased, cross-center interactions with other students (p. 7);
3. A recommendation for the development of a more formalized, cohort model for project data organization and data collection (p.8);
4. A need for enhanced support structures for students to maximize the learning experience embedded in the LMRCSC programs (p.10);
5. A student-expressed need for additional development of work related skills such as proposal writing, planning research, and writing for publication, as well as clarification of the social science dimensions of the project goals (p. 11); and
6. A need for additional information from project related scientists and faculty at the partnering universities (p. 14).

The project leadership (LMRCSC Director, Assistant Director, Education Director, and Co-PIs) acted on these findings, conclusions, or recommendations during year two of the project. The year two assessment report from the external evaluation team documents that six items above were incorporated into the LMRCSC project expansion, revision, or day-to-day plans for years two and three in the following ways (note: these are enumerated in the same sequence as above for clarity):

1. The need for clarity of “mentoring,” “mentoring plans,” and student/advisor/faculty relationships in TAB and NERTO projects associated to the project (p.4) has been acted on across the second year of the project by development of explicit Handbooks for both Undergraduate and Graduate students in the LMRCSC (available upon request from project leadership) which the external evaluation team has reviewed in Summer 2018 at the end of Year 2.
2. A desire, expressed by students, for community development through an alumni interactions and increased, cross-center interactions with other students (p. 7) has been addressed by the project leadership in three primary ways. First, the project web site now includes updated biographical and contact information for Cohorts 1 and 2 (project years 1 and 2) for current and potential students to review and access. Second, in March of Year 2, the project leadership assembled the current cohorts at the UMES campus for a week of interaction, social development, and training. Among the activities reviewed and observed by the evaluation team was an opportunity for students from across the different institutions to work together for planning cooperative research projects around shared interests. Finally, a select group of current students were provided the opportunity to attend the NOAA EPP Forum in Washington DC, for further interactions across the LMRCSC and with other Center students and personnel.
3. A recommendation for the development of a more formalized, cohort model for project data organization and data collection (p.8) has been addressed through enhanced efforts by the Project Education Director, housed at Savannah State University, to revise and implement the project data tracker, implementation of an undergraduate webinar for students in current cohorts, and by improving communications structures for student tracking with the external evaluation team. The Education Director has further developed these processes, project efficiency and excellence through enhancements to the Education Team realized through monthly conference calls/meetings.
4. A need for enhanced support structures for students to maximize the learning experience embedded in the LMRCSC programs (p.10) has been realized in year two through the implementation of the face to face student workshop, and through

implementation of online student webinars. The external evaluators have observed and/or attended these workshops and have already been collecting and analyzing impact data from these, which has been summarized in a year two annual assessment report.

5. A student-expressed need for additional development of work related skills such as proposal writing, planning research, and writing for publication, as well as clarification of the social science dimensions of the project goals (p. 11) was addressed in the curricular planning and implementation for the early spring workshop at UMES in 2017. This workshop will be repeated in Spring of 2019 for Cohort 3 students and for students in Cohort two who had schedule conflicts with attending the workshop in 2017.
6. A need for additional information from project related scientists and faculty at the partnering universities (p. 14) was addressed cooperatively by the LMRCSC project leadership and the external evaluation team through development and implementation of a formal survey of project scientists and faculty members in year two. Survey data have been analyzed and formally included in the year two assessment report, reported to the project leadership in a scheduled phone conference call, and have been incorporated in select form in the revisions to the current student handbooks for the TAB and NERTO project information, which is available to both students and faculty/scientists.

It is clear that project leadership is demonstrating responsiveness to the assessment and evaluation efforts of the external evaluation team. This is observed through the accessibility of the leadership team, as the external evaluators are consistently included in team meetings and conference calls. It is also observed through objective efforts to revise the project in year two based on, as described above, clear findings, conclusions, and recommendations from the Year One Report during Year Two of the project. In years three and following, the evaluators will develop a reporting form for documentation of continuous quality improvements in the project through responses to assessment data. This reporting form will be further aligned to the key, guiding questions for the project provided by NOAA EPP, and will be summarized in the Year 3 assessment report.

Direct Student Support – Twenty-three (23) students have been identified/recruited to the Center as members of Cohort 1 (2016 – 2017), including 5 Ph.D., 8 M.S., and 10 B.S. Twenty-one (20) students have been recruited to Cohort 2 (2017-2018) including 8 Ph.D., 4 M.S., and 9 B.S. students. So far, ten (10) students have been identified/recruited as members of Cohort 3 (2018-2019) including 3 Ph.D., 2 M.S. and 5 B.S. students.

Participant Beneficiaries

Increase in the number of undergraduate and graduate students who gain NOAA mission-relevant STEM discipline-specific knowledge and skills that are the primary focus of the Center Type award (i.e. Atmospheric Sciences and Meteorology, Coastal and Marine Ecosystems, Earth System Sciences and Remote Sensing Technologies, and Living Marine Resources), enroll and complete degrees, and are prepared to enter NOAA mission-aligned STEM careers or pursue advanced education.

EPP CSC Award Postsecondary Student Cohort(s) Supported (provide for each student by name):

1. Tuition, 2. Stipend, 3. Travel, 4. NERTO, 5. One-time Research:

First	Last	Cohort #	Degree	Partner	Tuition (\$)	Stipend (\$)	Travel (\$)	NERTO (\$)	One-time Research Support (\$)	Professional development
Brian	Galvez*	1	M.S.	DSU	6,370.00	11,307.66	4,150.00	5,000.00	10,000.00	
Amanda	Pappas*	1	M.S.	DSU	5,688.00	5,653.83	270.00			
Ileana	Fenwick*	1	B.S.	HU		1,400.00				
Isaiah	Milton*	1	B.S.	HU		1,400.00				
Nefertiti	Smith*	1	B.S.	HU	4,000.00					
Cristin	Mayes*	1	M.S.	HU	5,335.00	9,000.00	7,794.00	5,000.00		
Angie	Munguia*	1	M.S.	OSU	10,500.00	6,370.00	1,450.00		4,042.00	
Darius	Sanford*	1	B.S.	SSU						
Emily	Griffin	1	M.S.	SSU						
Shadaesha	Green*	1	Ph.D.	UMCES	1,185.00	14,096.71	820.56			
Ammar	Hanif*	1	Ph.D.	UMCES			425.00	1,320.00		
Chryston	Best-Otubu*	1	B.S.	UMES	8,092.00	4,222.63				
Nakia	Coit*	1	B.S.	UMES	7,892.00	2,530.54				
Nylah	McClain*	1	B.S.	UMES	4,021.00	0.00				
India	Oliver*	1	B.S.	UMES	8,067.00	3,145.00	1,948.15			
Malisa	Smith*	1	B.S.	UMES	8,086.33	4,299.33	1,575.00			
Rebecca	Wenker	1	M.S.	UMES	5,986.00	21,023.03		1,588.95	701.93	
Stephanie	Martinez-Rivera*	1	Ph.D.	UMES	1,136.00	41,327.83	0.00	6,973.83	345.00	
Detbra	Rosales*	1	Ph.D.	UMES	3,144.00	37,323.45	2,617.94	3,538.54	5,483.00	
Kleponis	Nicole	2	M.S.	DSU	11,070.00	11,307.66	1,250.00			
Kendra	Dorsey*	2	B.S.	HU	4,000.00	2,500.00				
Janelle	Layton*	2	B.S.	HU		1,400.00				
Brittany	King*	2	Ph.D.	OSU	14,484.00	7,240.00	1,419.00			
Davielle	Drayton*	2	M.S.	SSU	947	12,600	802	1,230	3,502	
Joe	Day	2	BS	SSU	3,195	0	0	0	0	
Sena	Tay	2	BS	SSU	3,497	0	0	0	0	
Dante	Freeman	2	B.S.	SSU	8,390	4,000	3,453	0	0	
Michael	Williams	2	B.S.	SSU	12,000	0	0	0	0	
Erianna	Hammond	2	B.S.	SSU	6,000	0	0	0	0	
Amanda	Lawrence	2	Ph.D.	UMCES						

Aris-Aja	Horsey*	2	B.S.	UMES	4,021.00		1,415.47			
Desmond	Love*	2	B.S.	UMES	4,046.00					
Enid	Munoz-Ruiz*	2	M.S.	UMES	6,856.00	25,341.78	1,049.54			
Andre	Price*	2	M.S.	UMES	4,836.79	27,617.03	971.86		374.00	
Laura	Acevedo-Almodovar*	2	Ph.D.	UMES	1,906.79	23,626.63		889.33		
Jorge	Rodriguez*	2	Ph.D.	UMES	3,765.00	31,477.70	2,406.95			
Kasondra	Rubalcava*	2	Ph.D.	UMES	11,887.00	25,411.13	109.00			
Cara	Schweitzer*	2	Ph.D.	UMES	2,988.00	27,611.61	2,618.52		13,200.00	
Adrienne	Wilson	2	Ph.D.	RSMA S						
LaTreese	Denson	2	Ph.D.	RSMA S	23,400.00	19,816.00	947.00			
Colby	Boomer*	none	none	UMES		0.00				5,750.64
Khari	Crommarty*	none	none	UMES		0.00				5,750.64
DaQuan	Davis*	none	none	UMES						5,750.64

Milestones for Meeting Requirements of the Award: Presented below are timelines for students in cohort 1 to meet major award requirements. During this reporting period, NOAA mentors have been identified for most of the graduate students. The students have developed or are in the process of developing their research synopsis, and are preparing to fulfill the NERTO requirement.

First	Last	Cohort #	Degree	Partner	Cohort Experience	NERTO	Ethical Conduct of Research	Data Management Course	NOAA Mentor
Brian	Galvez*	1	M.S.	DSU	Spr. 18	Sum 18	Fall 17	Fall 17	Fall 17
Amanda	Pappas*	1	M.S.	DSU	Spr. 19	Fall 19	Fall 18	Fall 19	Fall 18
Ileana	Fenwick*	1	B.S.	HU	Fall 17	NA	Spr. 18	NA	NA
Isaiah	Milton*	1	B.S.	HU	Fall 17	NA	Spr. 18	NA	NA
Nefertiti	Smith*	1	B.S.	HU	Fall 17	NA	Fall 17	NA	NA
Cristin	Mayes*	1	M.S.	HU	Spr. 18	Sum 18	Spr. 18	Fall 17	Fall 17
Angie	Munguia*	1	M.S.	OSU	Spr. 18	Sum 17	Fall 17	Wint. 17	Fall 17
Darius	Sanford*	1	B.S.	SSU	n/a	Sum 19	NA	NA	NA
Emily	Griffin	1	M.S.	SSU	Spr. 18	Fall 17	Fall 17	Fall 17	Fall 17
Shadaesha	Green*	1	Ph.D.	UMCES	Spr. 18	Fall 18	Fall 17	Fall 17	Fall 17
Ammar	Hanif*	1	Ph.D.	UMCES	Spr. 18	Fall 18	Fall 17	Fall 17	Fall 17
Chryston	Best-Otubu*	1	B.S.	UMES	n/a	n/a	Sum. 17	n/a	n/a
Nakia	Coit*	1	B.S.	UMES	n/a	n/a	Sum. 17	n/a	n/a
Nylah	McClain*	1	B.S.	UMES	n/a	n/a	Sum. 17	n/a	n/a

India	Oliver*	1	B.S.	UMES	n/a	n/a	Sum. 17	n/a	n/a
Malisa	Smith*	1	B.S.	UMES	n/a	n/a	Spr. 18	n/a	n/a
Rebecca	Wenker	1	M.S.	UMES	Spr. 18	Fall. 18	Fall 16	Fall 17	Fall 18
Stephanie	Martinez-Rivera*	1	Ph.D.	UMES	Spr. 18	Sum 18	Fall 15	Fall 18	Fall 17
Detbra	Rosales*	1	Ph.D.	UMES	Spr. 18	Spr. 18	Fall 15	Fall 17	Fall 17
Kleponis	Nicole	2	M.S.	DSU	Spr. 19	Sum 19	Spr. 18	Fall 18	Spr. 18
Kendra	Dorsey*	2	B.S.	HU	Fall 17	NA	Spr. 18	NA	Fall 17
Janelle	Layton*	2	B.S.	HU	Fall 17	NA	Spr. 18	NA	NA
Brittany	King*	2	Ph.D.	OSU	Spr. 18	TBD	Fall 18*	TBD	TBD
Joe	Day*	2	B.S.	SSU	Spr. 18	NA	Fall 18	NA	NA
Sena	Tay	2	B.S.	SSU	Spr. 18	NA	Fall 18	NA	NA
Davielle	Drayton*	2	M.S.	SSU	Spr. 19	Sum 18	Fall 19	Fall 19	Sum 18
Dante	Freeman*	2	B.S.	SSU	Spr. 18	NA	Fall 18	NA	NA
Michael	Williams*	2	B.S.	SSU	Spr. 18	NA	Fall 18	NA	NA
Erianna	Hammond	2	B.S.	SSU	Spr. 18	NA	Fall 18	NA	NA
Amanda	Lawrence*	2	Ph.D.	UMCES	Spr. 18	Sum 19	Fall 17	Fall 18	Fall 17
Aris-Aja	Horseley*	2	B.S.	UMES	n/a	n/a	Fall 18	n/a	n/a
Desmond	Love*	2	B.S.	UMES	n/a	n/a	Fall 19	n/a	n/a
Enid	Munoz-Ruiz*	2	M.S.	UMES	Spr. 18	Sum. 18	Fall 18	Fall 18	Fall 17
Andre	Price*	2	M.S.	UMES	Spr. 18	Fall 18	Spr. 18	Fall 17	Fall 17
Laura	Acevedo-Almodovar*	2	Ph.D.	UMES	Spr. 18	Fall 17	Fall 17	Fall 17	Fall 17
Jorge	Rodriguez*	2	Ph.D.	UMES	Spr. 18	Sum. 18	Fall 17	Fall 17	Fall 17
Kasondra	Rubalcava*	2	Ph.D.	UMES	Spr. 18	Sum. 19	Fall 18	Fall 18	Spr. 18
Cara	Schweitzer*	2	Ph.D.	UMES	Spr. 18	Fall 18	Fall 17	Fall 18	Fall 17
Adrienne	Wilson*	2	Ph.D.	RSMAS	Spr 18	Sum 18	Fall 17	Fall 18	Sum 18
LaTreese	Denson*	2	Ph.D.	RSMAS	TBD	TBD	TBD	TBD	TBD
Colby	Boomer*	none	none	UMES	n/a	n/a	Sum. 18	n/a	n/a
Khari	Crommarty*	none	none	UMES	n/a	n/a	Sum. 18	n/a	n/a
DaQuan	Davis*	none	none	UMES	n/a	n/a	Sum. 18	n/a	n/a

*Underrepresented minorities

Professional Development - Award Recipient Must Report Activities Accomplished for

1. [Rising Sophomore Experiential Training Program](#). Provide activities completed for IV., B., 8.1.2 (i) 1. thru 3. (FFO pg. 39). Students must be identified by name, home academic institution, academic year and major.

Three students participated in the rising sophomore experiential training program at the LMRCS in summer 2018. These students participated in NOAA-mission aligned summer research projects and other activities designed for students in the NSF Research Experiences for Undergraduates in marine and estuarine science at UMES.

Rising Sophomore Experiential Training Program (RSETP)					
First Name	Last	Home Institution	Year	Major	Site of the RSETP
Colby	Bommer	HU	Fr.	Marine Science	UMES
Khari	Crommarty	HU	Fr.	Marine Science	UMES
DaQuan	Davis	UMES	Fr.	Environmental Science	UMES

Individual Student Development Plan. Center activities to ensure completion, monitoring and student success.

All students are required to complete the student development plan with their advisors upon recruitment into the program. These plans are currently being completed and collated.

2. Student Preparation for Success in the Career Path Relevant to the Center Award.
Provide Center activities with activity titles, participants, outcomes for Center measures of success.

Student Preparation of Success in the Career Path Relevant to the Center Award	
Student name(s)	Activity name and/or description
Nefertiti Smith	Research training in marine mammal genetics
Cristin Mayes	M.S. thesis Ecosystem modeling
Isaiah Milton	Research training in marine mammal genetics
Ileana Fenwick	Research training in oyster restoration
Kendra Dorsey	Research training in OA impacts on fish vision and hearing
Janelle Layton	Research training in marine mammal genetics
Adrienne Wilson	Presented seminar on MS thesis work at RSMAS MBE Department graduate student seminar
Halie O'Farrell	Gave LMRCSC webinar: "Evaluation of environmental conditions as predictors for mako shark CPUE using generalized linear mixed modeling and quantile regression"
Shadaesha Green	PROMISE-AGEP Summer Success Institute (SSI), Aug. 2018
Shadaesha Green	Promise thesis writing workshop
Amanda Lawrence	PROMISE-AGEP Summer Success Institute (SSI), Aug. 2018
Amanda Lawrence	Internship at NIST for quantification proteins
Ammar Hanif	LMRCSC Cohort Experience Workshop, March, 2018
Ammar Hanif	NERTO experience on microplastics in dreissenid mussels
Ammar Hanif	Increased proficiency in R and R packages such as Phyloseq & ggplot2
Ammar Hainif	Increased proficiency in python for data base management

Post-Doctoral Program -

Center Process to Recruit and Select Postdoctoral Fellows

For each Fellow provide: Approved Postdoctoral Plan including anticipated number and proposed dates for publication submissions; activities; NOAA-facility tenure; and, anticipated products in support of Center priorities for education and training

SSU: The postdoc position was mis-advertised by the SSU HR office in 2017. The applicants were reviewed, but those that were eligible did not have fisheries research skills or had graduated earlier than 2 years prior. The position has been re-advertised.

UMES: Dr. Dan Cullen has been selected for this position. He began work in March 2018. Dr. Cullen is currently serving his six month residency at NOAA NEFSC, J.J. Howard Sandy Hook Lab, New Jersey.

Pre-Publication Manuscript Submission -

Provide anticipated number and proposed dates for Center submissions for both faculty and students

	Target # of manuscripts	Proposed date of submission
DSU Faculty	3	January 2018
DSU Students	1	September 2018
HU Faculty	3	1 Fall 2018; 2 Spring 2018
HU Students	2	Fall 2018
OSU Faculty		
OSU Students		
RSMAS Faculty		
RSMAS Students	1	Fall 2018
SSU Faculty	2	Spring 2018
SSU Students	2	Spring 2018
UMCES Faculty	3	Next 6 months
UMCES Students	2	Next 6 months
UMES Faculty	2	Next 6 months
UMES Students	6	3 Fall 2018; 3 Spring 2019

Papers currently in review or in press:

Publications in journals	Justification	Status
Oseji, O.F., Fan, C., and Chigbu, P. Composition and dynamics of phytoplankton in the Coastal Bays of Maryland revealed by microscopic counts and diagnostic pigments. Estuaries and Coasts.	LMRCSC PI	In Review
Schweitzer*, C. C., A. Z. Horodysky , A. L. Price*, and B. G. Stevens. In Press. Impairment indicators for delayed mortality in black sea bass (<i>Centropristis striata</i>) bycatch in the commercial trap fishery using a condition index. Fisheries Research.	TAB	In Press

Walters, Tina L., Lauren M. Lamboley, Natalia B. López-Figueroa, Áurea Rodríguez, Deidre M. Gibson and Marc E. Frischer. Diet and trophic interactions of a globally significant gelatinous marine zooplankter, <i>Doliolietta gegenbauri</i> (Uljanin, 1884).	LMRCSC PI	In Revision
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NOAA Substantial Involvement and Collaborative Engagement

Identify NOAA mentors and collaborators, including: mentor and aligned student mentored; start date and time mentorship; time commitment; Line Office affiliation; and, project title.

Mentor	LMRCSC Student	Institution	Cohort #	Start date	Role	Time Commitment	Line Office	Project Title
Robert Allman	Adrienne Wilson	RSMAS	2	2017	NERTO mentor	3 month NERTO	NOAA SEFSC	Ageing methods for lane snapper, a data poor species
Burton Shank	Amanda Lawrence	IMET	2	18-Jan-18	Collaborator		NMFS	Male reproductive status for Jonah crab
AK Leight	Ammar Hanif	IMET	1	1-Jun-17	Collaborator		NCCOS	
Kevin Friedland	Ammar Hanif	IMET	1	1-Dec-13	Committee member and TAB collaborator		NMFS	Diet and microbiome of Atlantic menhaden
John Jacobs	Ammar Hanif	IMET	1	1-Jun-17	TAB collaborator		NCCOS	Comparing the diet and microbiome of Atlantic menhaden and Eastern oyster using DNA barcoding
AK Leight	Ammar Hanif	IMET	1	1-Jun-17	Collaborator		NCCOS	microbial community analysis of the Tred Avon, Choptank River tributary
Kevin Friedland	Ammar Hanif	IMET	1	1-Dec-13	Committee member and collaborator		NMFS	Diet and microbiome of Atlantic menhaden
Ed Johnson	Ammar Hanif	IMET	1	17-Jan-18	NERTO mentor		NCCOS	Microplastics in dreissenid mussels
Ashok Deshpande	Ammar Hanif	IMET	1	18-Jan-18	NERTO mentor		NMFS	Microplastics in dreissenid mussels
John Jacobs	Ammar Hanif	IMET	1	1-Jun-17	TAB collaborator		NCCOS	Comparing the diet and microbiome of Atlantic menhaden and Eastern oyster using DNA barcoding
Rich McBride	Andre Price	UMES	2	Sum. 18	NERTO mentor		NOAA NEFSC	Diet of Black Sea Bass
Laurie Weitkamp	Angie Munguia	OSU	1	1-Sep-17		~1.5 month/yr	NOAA NWFSC	Characterizing feeding ecology and food web linkages of yearling chinook salmon (<i>Onchorhynchus tshawytscha</i>) emigrating through the lower Columbia River and Estuary

Howard Townsend	Brian Galvez	DSU	1	17-Jan	Committee member		NOAA NEFSC	Diet analysis of Delaware Bay weakfish (<i>Cynoscion regalis</i>) using stable isotope and stomach content analyses
Tod Kellison	Cara Schweitzer	UMES	2	Fall 18	NERTO mentor		NOAA SEFSC	By-catch mortality of Black Sea Bass
Mike Fogarty	Cristin Mayes	HU	1	17-Sep	TAB collaborator, committee member	1 year	NOAA CB	The Impact of Increasing Sea Surface Temperature on Piscivore and Planktivore Species Dynamics: An Ecosystem-Based Modeling Approach
John Jacobs	Detbra Rosales	UMES	1	1/15/2018	Committee member, technical advisor		NOAA COL	Assessing the impacts of harmful algal species and <i>Vibrio</i> spp. on oysters
Patricia Rosel	Emily Griffin	SSU	1	1-Sep-17	Committee member, communicating collaborator		NOAA NMFS Lafayette	Refining stock structure of common bottlenose dolphins (<i>Tursiops truncatus</i>) through photo-identification and genetic analysis
Enric Cortes	Halie O'Farrell	RSMAS	1	2015	Committee member		NOAA SEFSC	Evaluation of the effect of size and sex-based spatial segregation on shortfin mako and bull shark fishery sustainability
Rich Brill	Kendra Dorsey	HU	2	1-May-17	Research collaborator	3 years	NOAA NEFSC	Effects of Ocean Acidification on Auditory Neurobiology in a Tropical Marine Fish
Howard Townsend	Laura Almodovar-Acevedo	UMES	2	Fall 17	Committee member		NOAA COL	Habitat suitability model for Black Sea Bass
Jen Zamon	Nicole Kleponis	DSU	2	18-Jan	Committee member		NOAA NWFSC	Red-throated loon fish diet and distribution in the Delaware Bay as an indicator of ecosystem health
Vince Guida	Rebecca Wenker	UMES	1	9/1/2016	Committee member		NOAA NEFSC	Age, Growth, and Colony Complexity of the Gorgonian Sea-Whip <i>Leptogorgia virgulata</i> in the Mid-Atlantic Bight
James Weinberg	Shadaesha Green	UMCES	1	17-Sep-16	NERTO mentor and committee member		NMFS	Size and maturity of male red crabs
James Weinberg	Shadaesha Green	IMET	1	17-Sep-16	Committee member		NMFS	Size and maturity of male red crabs
Burton Shank	Shadaesha Green	IMET	1	17-Sep-18	Collaborator		NMFS	Reproductive strategy of female deep-sea red crab

Chris Long	Stephanie Martinez Rivera	UMES	1	Fall 17	Committee member, technical advisor		NOAA	Reproductive biology of Jonah Crab
Chris Long	Stephanie Martinez Rivera	UMES	1	2/1/2014	Committee member		NOAA AFSC	Reproductive cycle, ovarian development, size at Maturity, and Fecundity of Red Deep-Sea Crabs
Ron Hall	Wilmelie Cruz	UMES		3/1/2018	Committee member			Comparison of video camera sled with diver surveys for Puerto Rico queen conch (<i>Lobatus gigas</i>)

CSC Programmatic Special Award Conditions

Recipient must provide accomplishments for Programmatic Special Award Conditions that address the education and training, scientific research and administrative functions in the award including, for example, outcomes from Advisory Board Meetings, effective management for all key personnel positions, early engagement with NOAA in performance of award, outcomes of Center meetings, integration of human dimensions in all award activities, implementing longitudinal outcomes tracking, and overall Program-level metrics for the EPP/MSI CSC postsecondary awards as a Federal STEM Education Agency-mission Future Workforce, for reporting period (NOT cumulative).

A. Provide FY16 Center award information for:

1. **Number of EPP-funded post-secondary students from underrepresented minority communities** who are trained **39** and graduated **1** in NOAA- mission sciences.
2. **Total number of EPP-funded post-secondary students** who are trained **38** and graduate **2** in NOAA-mission fields relevant to this announcement.
3. **Number of EPP-funded graduates who enter the NOAA mission workforce as hires** by NOAA **0**, NOAA contractors **0**, NOAA partners **0**, resource management agencies **0**, NGO community **0**, academia **0** or as entrepreneurs **0**.
4. **Number of EPP-funded graduates who participate in and complete NOAA agency mission-related postdoctoral level programs** **0**.
5. **Total new funds leveraged with NOAA EPP award** (including post-secondary student support) = **\$979,652**

B. Provide FY16 Center award information to demonstrate contribution to supporting CSC Desired Program level Outcomes and Outputs defined in FFO p. 7 - 10, for this reporting period.

5. CSC Desired Program Level Outcomes and Outputs

5.1 Education and Training

Outcome 1. Increased number, annually, of CSC post-secondary students, trained.

Twenty-three (23) students have been identified/recruited to the Center as members of Cohort 1 (2016 – 2017), including 5 Ph.D., 8 M.S., and 10 B.S. Twenty-one (21) students

have been recruited to Cohort 2 (2017-2018) including 8 Ph.D., 4 M.S., and 9 B.S. students. So far, ten (10) students have been identified/recruited as members of Cohort 3 (2018-2019) including 3 Ph.D., 2 M.S. and 5 B.S. students. Three undergraduate students participated in the rising sophomore experiential training program in summer 2018 at UMES.

Outputs:

(a) Increased quantitative and analytical skills – Students are acquiring quantitative and analytical skills by taking courses such as Data Management for scientists that is offered in fall 2018, and by participating in internships and REU programs.

(b) Increased competence in applying STEM to decision making, policy and management – This will be addressed by the Cohort Experience Workshop. Planning for the workshop took place during this time period. The workshop is scheduled for the first week of the next reporting period in spring 2019.

(c) Increased skills to use large data sets, geographical information systems (GIS) and statistical analysis, computer modeling, and algorithm development –An online course is offered covering Data Management in Fall 2018 and will be offered every subsequent Fall. All graduate students are required to complete the course prior to graduation.

Outcome 2. Increased number of CSC post-secondary students educated and graduated annually.

Twenty-three (23) students have been identified/recruited to the Center as members of Cohort 1 (2016 – 2017), including 5 Ph.D., 8 M.S., and 10 B.S. Twelve (21) students have been recruited to Cohort 2 (2017-2018) including 8 Ph.D., 4 M.S., and 9 B.S. students. So far, ten (10) students have been identified/recruited as members of Cohort 3 (2018-2019) including 3 Ph.D., 2 M.S. and 5 B.S. students.

(a) **Number of degrees earned annually in NOAA mission-related disciplines** – One student graduated with an M.S. during this period.

(b) **Number of students (total and URM) who participated in professional development opportunities, to include at least one on-site experiential research and training opportunity at a NOAA Lab, office, or facility with tangible training and research:** Ten students, all of whom belong to URM groups, participated in on-site experiential research and training opportunities at a NOAA Lab, office or facility during this reporting period.

Student Name	Activity/project title	NOAA personnel involved	Location
Cristin Mayes*	Ecosystem Based Approaches to Modeling Fish Species in the Middle Atlantic Bight	Mike Fogarty	NEFSC
Halie O'Farrell*	Fisheries independent data collection and harvest control rules for sharks	Enric Cortes	SEFSC Panama City
Adrienne Wilson*	Age and growth of Lane Snapper, a data poor species	Robert Allman	SEFSC Panama City
Ammar Hanif*	Comparing the diet and microbiome of Atlantic menhaden and Eastern oyster using DNA barcoding	John Jacobs	NOS/COL

Ammar Hanif*	Microbial community analysis of the Tred Avon, Choptank River tributary, using high-throughput sequencing	A.K. Leight	NOS/COL
Ammar Hanif*	Microplastics in dreissenid mussels	Ed Johnson	NCCOS
Stephanie Martinez Rivera*	Eastern Bering Sea Crab Survey training for CSC graduate student	Chris Long	NOAA AFSC, Kodiak AK
Brian Galvez*	Feeding ecology of young of the year, and first and second year class of incoming and returning weakfish from and to the Delaware Bay using stable isotope analysis	Howard Townsend	NOS/COL
Detbra Rosales*	What are the impacts okadiac acid has on oysters	John Jacobs	Cooperative Oxford Lab, Oxford, MD
Enid Munoz Ruiz*	Assessment of microplastics and polybrominated diphenyl ethers in scallops	Ashok Deshpande	Sandy Hook Lab, Sandy Hook, NJ
Jorge Rodriguez*	<i>Mytilus edulis</i> hemocytes: a study on hemocyte surface glycoconjugates and their possible role in host-pathogen interactions	Gary Wikfors & April Croxton	NOAA NEFSC, Milford CT; NOAA Headquarters
Dante Freeman*	Comparing two methods to characterize the chemical components of marine microplastics	Ashok Deshpande	NEFSC

*URM

Outcome 3. Increased CSC capacity to train and graduate students.

The grant has made it possible for 11 collaborative research projects to be funded for the period of 2018 – 2019, which will enable more Center scientists to be available to mentor and advice undergraduate and graduate students. In addition, 22 NOAA scientists have been identified to serve as mentors of the students during the NERTO program or as collaborators in the TAB funded projects. The NERTO has increased exposure to NOAA training and encouraged faculty to increase their flexibility in scheduling graduate students' field work and academic schedules.

Outputs: (a) Number of seminars, new courses, new programs, and new degrees offered to develop working skills and functional competencies to support the NOAA mission and workforce, (b) Total numbers of students supported by the LMRCSC and degrees awarded that reflect the changing demographics of the nation.

Outputs	# During this Reporting Period
Seminars	24
New courses offered	0
New programs developed	1
New degrees offered	0
# of students supported by the LMRCSC	36
Total degrees awarded	1
Degrees awarded to URMs	0

Outcome 4. Reduce the attainment gap for URM students in NOAA mission-relevant fields

The recruitment of new URM students (graduate and undergraduate students) during this reporting period is an important first step needed for preparing the students for careers in NOAA mission-relevant fields. This will ultimately help to reduce the attainment gap for the URM students in the fields.

Outputs:

(a) Increased number of URM students in student development activities that will lead them to the attainment of degrees and/or employment in NOAA mission fields = **34** URM students at the LMRCSC took part in student development activities.

(b) Increased number of URM students who select to pursue higher education in NOAA mission fields = **31** URM students at the LMRCSC are pursuing higher education in NOAA mission fields during this reporting period.

5.2 Scientific Research

Outcome 1. Increased NOAA mission-relevant research capacity at MSIs.

NOAA scientists are already collaborating with Center scientists as well as working with some of the graduate students; suitable mentors are being identified for the remaining students. The Center has a post-doctoral research associate at UMES, and is in the process of completing search for another post-doctoral position at SSU which will help increase research capacity at the Center. Additionally, research funds provided to scientists at the Center are enabling them to purchase equipment and supplies for their research in addition to Graduate Research Assistantship provided to support research endeavors.

Outputs:

(a) **Number of research collaborations with NOAA and LMRCSC faculty, staff and students:** Each of the eleven LMRCSC TAB projects has a NOAA scientist as a collaborator.

(b) **Number of NOAA scientists serving as mentors and advisors for student research:** 22 NOAA scientists and collaborators are working with the Center.

(c) **Number of intra-institutional collaborative partnerships established and maintained in support of NOAA's mission = 33**

(d) **Number of uses of NOAA data in research and tool development = 1.** Halie O'Farrell (Ph.D. student at RSMAS) is using the U.S. pelagic longline observer data for her dissertation research. In addition, Kasondra Rubalcava (Ph.D. student at UMES) is using the long term fish dataset collected by the Maryland Department of Natural Resources for her dissertation research aimed at developing an ecosystem model for the Maryland Coastal Bays.

Outcome 2. CSC-supported faculty, staff and students' research directly aligned with NOAA's mission and strategic priorities.

Eleven collaborative research projects were funded by the LMRCSC for the period of 2017 – 2018. These projects were funded after they had been reviewed by the Technical Advisory Board (TAB) based on a number of criteria one of which is their alignment with NOAA's mission and strategic priorities.

Outputs:

	# From Projects Directly Supported with FY 16 Funds	# from Leveraged Projects
# of peer reviewed publications	3	10
# of presentations	25	16
# Tools developed	12	0
Use of LMRCSC research results and tools by NOAA & other stakeholders	2	1
# of instances LMRCSC publications are cited	8	160
# of LMRCSC students, staff or faculty recognized nationally for LMRCSC research	2	8

TAB Funded Research Projects in 2017-2018

In 2017-2018, the LMRCSC funded eleven small research projects approved by the Technical Advisory Board (TAB). Some of these were continuations of projects funded in previous years. Three of these were awarded to lead investigators at UMES, one each at HU, SSU, and UMCES-IMET, and two were joint projects between UMES/UMCES-IMET, and OSU/DSU, respectively. Numerous other scientists and students at LMRCSC institutions were involved, as well as many NOAA investigators. Topics included bycatch and discard mortality, reproduction and maturity, genetic stock structure, climate change impacts, harmful algal blooms, fish migration, and trophic ecology. These projects involved a total of five PhD students, three MS students, four undergraduate students, and nine NOAA collaborators. Abstracts of the projects are presented below; more detailed reports can be found in Appendix II.

Project Number: 18-01

Project Title: Underrepresentation in marine and fisheries science professions: how significant life experiences shape a diverse workforce

Project Abstract: NOAA Fisheries has a responsibility to provide the best available science for the management of living marine resources. Research has shown the value of diversified thinking and approaches in science and that diverse perspectives can improve our collective ability to solve problems. However, African American, Latino, and Native American populations face the issue of being underrepresented in marine and fisheries science professions, resulting in a workforce that does not reflect the diversity of the United States. To better understand how to recruit individuals from underrepresented communities, it is important to examine the factors that influence individuals to pursue careers in marine and fisheries science professions and identify whether any of these key factors are unique to individuals from underrepresented populations. Focusing on participants from two of NOAA Educational Partnership Programs with Minority Serving Institutions Cooperative Science Centers (CSCs), and the American Society of Limnology and Oceanography Multicultural Program (ASLOMP), this study will provide an analysis of how life experiences and identity shape career decisions of individuals pursuing careers in marine and fisheries related sciences. This study will use in-depth interviews and qualitative data analysis to analyze the effects of life experiences and identity on career decisions. The results of this study will provide foundational information for the refinement of specific hypotheses about life experience and identity, including research on the development of fisheries and marine career identities amongst youth.

Thematic Area Addressed: Assessment

Lead Scientist(s): Brittany King (OSU, PhD Student), Kelly Biedenweg, PhD (OSU)

NOAA Collaborator(s): Kevin Werner (NOAA/NWFSC)

LMRCSC Collaborator(s): Benjamin Cuker, PhD (Hampton University)

LMRCSC Research Student(s):

Start Date: 1 September 2018

End Date: 31 March 2020

Project Number: 18-02

Project Title: Baseline Data of Male Reproductive Status for Jonah Crab Management

Project Abstract: The fishery of Jonah crab (*Cancer borealis*) has been rapidly increasing in the Northeast United States since 2002. As one of the data-poor species, it still lacks in the information on age, growth or reproduction. In 2016, a Fishery Management Plan states a minimum legal size (4.75") based on limited information, despite that the life history and the size of the onset of sexual maturity are unknown and that these animals over the legal size would experience another molt to become larger. This proposal addresses to 1) establish a relationship between the size of males and reproductive status (onset of sexual maturity; physiological and functional maturity) by studying the primary male sex hormone, insulin-like androgenic gland hormone and 2) examine if the larger size of adults undergoes another molt cycle. This information is critical for setting size limits and managing crab fisheries in the Mid-Atlantic Bight.

Thematic Area Addressed: Stock Assessment Support

Lead Scientist(s): Amanda Lawrence (PhD Student, UMCES-IMET)

NOAA Collaborator(s): James Thorson (NOAA/NMFS), John Walter (NOAA/NMFS)

LMRCSC Collaborator(s): J. Sook Chung (UMCES-IMET), B. Stevens (UMES), Illarion Turko (NIST)

LMRCSC Research Student(s): Amanda Lawrence (Master Student, UMCES-IMET)

Start Date: 1 September 2018

End Date: 31 August 2019

Project Number: 18-03

Project Title: Indices of abundance for King Mackerel in the Gulf of Mexico and South Atlantic improved by incorporating spatiotemporal and environmental variability

Project Abstract: King mackerel migrate seasonally and change their distribution based on the quality of their environment causing shifts in their spawning locations from year to year. Shifts of the adult distribution also impact the larval stage as their distribution is dependent on the location of spawning, and the local oceanography. These changes in distribution affect King Mackerel larvae catchability and the trends in survey data, therefore affecting the derived indices of abundance for spawning stock biomass. The index currently does not explicitly consider the effect of spatiotemporal variation on abundance trends and changes in catchability, which are inherent to the data. We plan to quantify spatiotemporal variability using a geostatistical model and compare performance of the estimated index of abundance over time, to the current modeling method. No results have been collected yet since we are in the model development stage of the project. Population abundance trends can be misrepresented by a non-geostatistical model that does not explicitly consider changes in spatial distributions (e.g., migration or ontogenetic shifts). This misrepresentation of estimated trends has been shown to lead to incorrect and uncertain estimates of stock status in the stock assessments, which are used to set management regulations. Using a more precise index reduces the risk of management error, increasing the credibility of NOAA fisheries management council decisions.

Thematic Area Addressed: Stock Assessment Support

Lead Scientist(s): LaTrese Denson (University of Miami), Elizabeth Babcock (Univ. of Miami)

NOAA Collaborator(s): James Thorson (NOAA/NMFS), John Walter (NOAA/NMFS)

LMRCSC Collaborator(s): Dionne Hoskins - Brown (Savannah State University)
LMRCSC Research Student(s): LaTree Denson (PhD, University of Miami), Unnamed
Savannah State University Undergraduate
Start Date: 1 September 2018 **End Date:** 31 August 2019

Project Number: 18-04

Project Title: Examining ecosystem health through contaminant analysis of common bottlenose dolphins (*Tursiops truncatus*)

Project Abstract: As apex predators, common bottlenose dolphins (*Tursiops truncatus*) are an indicator species for ecosystem health. Persistent organic pollutants (POPs) accumulate in the blubber of bottlenose dolphins, making this species an indicator for ecosystem POP exposure. Spatial differences in bottlenose dolphin POP levels have been identified throughout the southeastern U.S. including the highest recorded PCB concentrations worldwide reported in estuaries around Brunswick, GA. This proposal requests funding to (1) identify baseline POP levels for the Northern Georgia Southern South Carolina Estuarine System (NGSSCES) Stock, (2) determine if the NGSSCES Stock has been exposed to the same point-source contaminants as the two other estuarine stocks in Georgia, and (3) use POP exposure as an additional tool in combination with genetics, photo-identification, and spatial analyses to assess stock structure.

Thematic Area Addressed: Healthy Habitats

Lead Scientist(s): Tara M. Cox, Savannah State University

NOAA Collaborator(s): Gina Ylitalo, NOAA, Northwest Fisheries Science Center

LMRCSC Collaborator(s): Carolina Bonin Lewallen, Hampton University

LMRCSC Research Student(s): Graduate student (SSU), Undergraduates (Hampton) [TBD]

Start Date: 1 August 2018 **End Date:** 31 July 2019

Project Number: 18-05

Project Title: Integration of habitat-specific growth variation into assessment models: a case study in the Kemp's ridley sea turtle.

Project Abstract: Spatiotemporal variation in demographic parameters can strongly influence a species' population dynamics. For example, somatic growth rates for Kemp's ridley turtles differ between juveniles that inhabit the Atlantic versus Gulf Coast, which may lead to differences in age at maturation for individuals or whole cohorts. Current Kemp's ridley population models do not include habitat-specific parameters due to lack of information. We propose to use a ~30 year dataset of somatic growth rates obtained through skeletochronology to quantify somatic growth variation and develop habitat-specific maturation schedules for Kemp's ridleys. These data will be used to parameterize an improved stage structured population model and evaluate the contribution of Atlantic turtles to population growth. Results of the growth analysis will be compared to those for other sea turtle species through a meta-analysis of sea turtle growth rate data. This project will yield an updated and improved population model for Kemp's ridley sea turtles that is expected to inform management of the species.

Thematic Area Addressed: Stock Assessment Support

Lead Scientist(s): Matthew Ramirez (Oregon State Univ.), Selina Heppell (Oregon State Univ.)

NOAA Collaborator(s): Jeffrey Moore (NOAA/NMFS), Larisa Avens (NOAA/NMFS)

LMRCSC Collaborator(s): Elizabeth Babcock (RSMAS)

LMRCSC Research Student(s): Matthew Ramirez (PhD, Oregon State University), Tamara Popovska (UG, RSMAS)

Start Date: 1 September 2018 **End Date:** 31 August 2019

Project Number: 18-06

Project Title: Assessing the Impacts of Harmful Dinoflagellates and *Vibrio* spp. On Oyster Aquaculture in the Delaware Inland Bays.

Project Abstract: The Delaware Inland Bays (DIBS) are a collection of salt marshes, saltwater creeks, and shallow open waters. Over the years, the ecological health of certain areas in the DIBs has deteriorated because of poor water quality. Historically, oyster reefs were evenly distributed in the DIBS, but oyster disease caused the population to collapse in the 1950s. In 2013, the Delaware State Legislature instructed the Delaware Department of Natural Resources and Environmental Control to create an oyster aquaculture industry. Recent studies have suggested an association between the abundance of phytoplankton and the pathogenic bacterium *Vibrio parahaemolyticus* in the DIBs. The presence of *V. parahaemolyticus* and several harmful algal bloom (HAB) species causes concerns for the proposed aquaculture sites due to environmental and human health risks associated with these organisms. We will examine the areas near proposed aquaculture sites to determine the impacts of water quality and proliferation of pathogenic bacteria on oyster aquaculture. The goals of the project are 1) To determine the community structure of harmful dinoflagellates and *Vibrio* spp. in the Delaware Inland Bays near the oyster aquaculture sites 2) To compare the seasonal succession of harmful dinoflagellates and microbial community in the water column to the community in oysters gut contents 3) To identify the impacts okadaic acid (dinoflagellate toxin) has on oysters health.

Thematic Area Addressed: Healthy Habitats

Lead Scientist(s): Detbra Rosales (University of Maryland Eastern Shore)

NOAA Collaborator(s): John Jacobs (NOAA/NCCOS)

LMRCSC Collaborator(s): Joseph Pitula (University of Maryland Eastern Shore)

LMRCSC Research Student(s): Detbra Rosales (PhD, University of Maryland Eastern Shore) and Reuel Danquah (UG, University of Maryland Eastern Shore).

Start Date: 1 April 2018

End Date: 30 April 2019

Project Number: 18-07

Project Title: Cold-water corals in the Mid-Atlantic Bight: Age, colony complexity, and growth

Project Abstract: Sea whips (*Leptogorgia virgulata*) are a common structural component of benthic habitats found in the DelMarVa region of the Mid-Atlantic Bight, and may serve as essential fish habitat for commercially valuable species. However, they are slow-growing, easily damaged, and especially vulnerable to damage by passive fishing gear. Despite their potential importance and fragility, sea whips are generally understudied in this region. We proposed to examine the age, colony complexity, growth, and regrowth after damage of sea whips from 4 sites in the DelMarVa region. Previously collected corals from two sites in 2017 showed no significant differences in the bifurcation (R_b) and tributary to source (T/S) ratios, and the R_b ratios indicate that for each branch of a given order there are approximately 3 branches in the next lower order. Age was significantly different between sites, with corals ranging between 2-9 years at one and 4-15 at the other. 24 corals were also previously tagged, and 5 damaged, in 2017. So far in the summer of 2018, 43 corals have been tagged, 28 collected, with plans to tag and collect approximately 30 more. Data provided by this project will help fill the large knowledge gap concerning coral habitats that exists in the coastal DelMarVa region, and the baseline created will be a useful reference to study changes over time. This also relates to NOAA's goal to improve our understanding of ecosystems to inform resource management decisions, especially if sea whips were to become a managed species.

Thematic Area Addressed: Stock Assessment Support

Lead Scientist(s): Rebecca Wenker (MS, University of Maryland Eastern Shore)
NOAA Collaborator(s): Vince Guida (NOAA, NMFS)
LMRCSC Collaborator(s): Bradley Stevens (University of Maryland Eastern Shore), Daniel Cullen (LMRCSC Postdoctoral Fellow, University of Maryland Eastern Shore)
LMRCSC Research Student(s): Rebecca Wenker (MS, UMES)
Start Date: 1 May 2018 **End Date:** 30 April 2019

Project Number: 18-08

Project Title: Genetic-based methods for assessing prey composition and feeding ecology of Pacific lampreys

Project Abstract: The Pacific lamprey (*Entosphenus tridentatus*) is an anadromous species that occurs throughout the Northern Pacific Ocean and is important to humans for at least two key reasons: 1) Indigenous peoples near the Columbia River have a cultural value for them as a ceremonial food item, and 2) during their marine phase, lampreys parasitize many fish species and may reduce commercial harvests (e.g., Pacific hake, walleye pollock). Although culturally important, vulnerable (freshwater modifications reduce larval habitats), and ecologically interesting (parasites can exhibit dramatic fluctuations in abundance), the basic biology of Pacific lamprey in marine waters has not been well documented. The goal of this study is to identify prey items of Pacific lampreys and characterize their feeding ecology in the Northeastern Pacific Ocean in, particularly where they overlap with commercially-targeted species (e.g., Pacific hake, shrimps).

Thematic Area Addressed: Stock Assessment Support

Lead Scientist(s): Eric Lewallen (Hampton University)
NOAA Collaborator(s): Linda Weitkamp (NOAA/NMFS); Linda Park (NOAA/NMFS)
LMRCSC Collaborator(s): Carolina Bonin Lewallen (Hampton University)
LMRCSC Research Student(s): Janelle Layton (UG, Hampton University), Patricia S Montalvo-Rodriguez (MS, Hampton University, expected to start 1 June 2019)
Start Date: 1 Sept 2018 **End Date:** 31 August 2020

Project Number: 18-10

Project Title: Feeding Ecology of Black Sea Bass Using Gut Content and Stable Isotope Analyses.

Project Abstract: Food habits of black sea bass (BSB, *Centropristis striata*) have been studied from trawl surveys in the Mid-Atlantic Bight, but no studies have compared food choices between specific habitats or locations. We sampled BSB at selected natural and artificial reefs near Ocean City, MD using hook-and-line angling to determine how habitat preferences influenced length frequencies, sex ratio, dietary preferences, and stable isotope ratios of $\delta^{12}\text{C}/\delta^{13}\text{C}$ and $\delta^{14}\text{N}/\delta^{15}\text{N}$. Stomach content analysis, and stable isotope analyses of muscle, liver, and mucus were used to determine whether diets varied significantly between sampling locations. Preliminary results indicate that crustaceans dominate diets of BSB by frequency of occurrence. Additionally, $\delta^{15}\text{N}$ in liver did not vary between three sampled sites. Sample size analysis showed that the number of preliminary samples were too small to detect differences $>0.3\text{‰}$ and a minimum sample size of 100 fish is required. This data will help to understand how BSB utilize different habitat types, and the contribution of reef habitats to BSB populations in the Mid-Atlantic Bight.

Thematic Area Addressed: Healthy Habitats

Lead Scientist(s): Dr. Brad Stevens, Andre Price (MS, UMES).
NOAA Collaborator(s): Dr. Richard McBride, NOAA NEFSC.
LMRCSC Collaborator(s): Dr. Maurice Crawford. Graduate committee member, UMES

LMRCSC Research Student(s): Andre Price (MS, UMES)
Start Date: 1 March 2018 **End Date:** 30 December 2018

Project Number: 18-11

Project Title: Assessment of Microplastics and Polybrominated Diphenyl Ethers (PBDEs) in Scallops as Possible Indicators of Plastic Pollution from the Georges Bank, Mid-Atlantic, Southern New England, and Gulf of Maine Stock Fisheries

Project Abstract: Plastic fragments, pellets, fibers and cosmetic beads less than 5 mm in size are termed as microplastics. These are emerging contaminants that in recent years have been found in tap water samples all over the world and in a vast array of aquatic organisms with the possibility of toxic effects in them. The focus of this research will seek to understand the following: (1) If there are microplastics present in the Atlantic sea scallop stock banks across the east coast of the United States. Multiple studies have implied that polybrominated diphenyl ethers (PBDEs), persistent bioaccumulative fire-retardant pollutants, in fish tissues display positive correlations with geographic plastic debris densities. (2) We will examine if this linear relationship also exists in a benthic environment using sea scallops as model organism. Briefly, micropolymer assays will be conducted using an efficient extraction method in which scallop tissues will be divided into muscle, respiratory system and gastrointestinal tract before digestion and visual quantification of microplastics. Scallop and bottom water column samples will be collected from multiple regions across Georges Bank and Mid-Atlantic Bight. Tissues will be tested for PBDEs while plastic debris will be examined in the water samples. Since sea scallops are important commercial organisms with fisheries dredging over 50 million pounds annually for seafood consumption, our research directly contributes to NOAA's goal to conserve and manage coastal and marine ecosystems and resources by providing the scientific foundation for understanding many future studies of the dangers microplastics can have on important ecological commercial species.

Thematic Area Addressed: Healthy Habitats

Lead Scientist(s): Enid C. Muñoz Ruiz (MS, University of Maryland Eastern Shore)

NOAA Collaborator(s): Ashok Deshpande (NOAA/NEFSC); Beth Sharack (NOAA/NEFSC)

LMRCSC Collaborator(s): Ali Ishaque (University of Maryland Eastern Shore)

LMRCSC Research Student(s): Enid C. Muñoz Ruiz (MS, UMES)

Start Date: 1 June 2018 **End Date:** 30 December 2019

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VII. Financial Information

1. Total NOAA funding breakout

FY 16 Award Center base funds: Indicate how funds were used for the reporting period, using award budget categories to provide detailed information for reporting period. Unobligated balances will be compared with SF 425 reporting.

Postsecondary Direct Student Support:

Tuition:	\$206,791.91
Stipend:	\$383,049.55
Travel:	\$37,492.99
NERTO:	\$25,540.65
One-time Research:	\$37,647.93
Professional Development	\$17,251.92

Total: \$707,774.95

Collaborative Research:

Eleven collaborative projects in the amount of **\$473,563.25** in direct cost were funded during this reporting period.

2. Total leverage funding breakout

Indicate funding source, type (grant or contract), amount, Center PI, project title; and, how funding contributed to the FY 16 Center award for:

Postsecondary Student Support:

Source	Type	Start date - end date	Total amount (\$)	Current 6 month period (\$)	PI	Project title	Contribution to Center
NSF	Grant	07/1/16-06/30/19	300,000	10,000	Horodysky, A.	Linking environment to form and function by quantifying the effects of ocean acidification on visual and auditory neurobiology in marine fishes	Funds are used to support Horodysky and 1 LMRCSC cohort 2 student tuition.
NSF	Grant	8/1/13-7/31/18	900,000	90,000	Cuker, B	Multicultural Diversity in the Aquatic Sciences	Funds are used to support students to ASLO conference.

Bunting Foundati on	Grant	07/01/17- TBD	40,000	27,000	R. Jagus	Support IMET Summer Internship	Funding supports IMET Summer Internship, 2018
Elkins Professio nship	Endow ment Income	02/01/18- TBD	60,000	60,000	R. Jagus	Support IMET Summer Internship	Funding supports IMET Summer Internship, 2018
NIST	Grant	9/1/2017 - 8/31/2019	112,050	48,052	J. Sook Chung	New method development for measuring low concentration of protein/peptide	Funds are used to support Amanda Lawrence for 1-year stipend, tuition, travel and research
NSF	Grant	5/1/12 - 4/30/19	627,489	3,199	J. Sook Chung	Functional Roles of a Novel Crustacean Female Sex Hormone in Sex Differentiation and Developing Secondary Sex Features of Crustaceans	Funds support PIs salary and Green research
Ratcliffe Foundati on	award	07/01/14- 06/30/20	800,000	66,667	Russell Hill/Nick Hammond	Award to cultivate the leadership and business skills necessary to bring their research into commercial markets and to provide students with an enhanced appreciation of the potential business implications of their research.	Funds support graduate student stipends while training in entrepreneurial skills
Total			2,839,539	304,918			

Collaborative Research:

Source	Type	Start date - end date	Total amount (\$)	Current 6 month period (\$)	PI	Project title	Contribution to Center
NSF	Grant	12/1/2012 - 1/31/19	686,888	65,273	R. Jagus	Translation regulation of gene expression in toxic dinoflagellates	Funds support PIs salary & intern research
NIST	Grant	1/1/16 - 9/30/2018	237,964	47,603	J. Sook Chung	Crustacean metabolomics: Identification of potential growth and reproductive indicators for aquaculture using NMR and MS approaches 53%	Funds support PIs salary
NSF	Grant	10/1/2017 - 9/30/2018	36,285	10,622	J. Sook Chung	CREST Center for the Integrated Study of Coastal Ecosystem Processes and Dynamics in the Mid-Atlantic Region	Funds support PIs salary
Sea Grant	Grant	11/1/2017 - 12/31/2018	9,370	5,802	Eric Schott	Opening the door for research on a pathogenic virus of the soft clam <i>Mya arenaria</i>	Funds support PIs salary
DPW	Grant	7/12/2016 - 7/13/2019	12,988	841	Eric Schott	DPW- Microbial Source Tracking as a Tool for Assessing and Managing Fecal Contamination through UB	Funds support PIs salary
USDA	Grant	9/1/2015 - 8/31/2018	12,513	-	Eric Schott	Testing and Application of Novel Probiotic Bacteria	Funds support PIs salary
NSF	Grant	7/1/2017 - 6/30/2020	359,437	44,593	Eric Schott	Determining how Variation in life history & connectivity drive pathogen-host dynamics	Funds support PIs salary, intern stipend and intern research
NSF	Grant	9/1/2016 - 8/31/21	5 million	500,000	P. Chigbu; M. Sexton; A. Ishaque; S. Parveen	CREST Center for the Integrated Study of Coastal Ecosystem Processes and Dynam	Funds support PIs salaries, students, research
Total			2,155,445	674,734			

Appendices

Appendix I: External Evaluations Report of the LMRCSC

Living Marine Resources Cooperative Science Center External Evaluation Report for Year 2 (2017-2018)

Background and Introduction

The Living Marine Resources Cooperative Science Center (LMRCSC) was “established in October 2001 as a cooperative agreement between NOAA’s Educational Partnership Program (EPP), and a collective of universities “to address environmental, natural resources management and STEM workforce challenges...” The mission of the Center “is to prepare a diverse student body for careers in marine and fisheries science through exemplary academic and research collaborations” (all quotes from the Project Narrative). The LMRCSC received an additional five years of funding, which began in Fall 2016. The project leadership contracted with The College of Exploration’s (TCOE) Dr. Tina Bishop, Dr. Peter Tuddenham, and Dr. Howard Walters to develop and implement an external evaluation of the project. This evaluation plan was reviewed and approved by internal project leadership, and also was submitted with the project proposal for review and approval by NOAA EPP. This current report has been written by Drs. Bishop and Walters and submitted to the Project Leadership.

Revision to Evaluation Plan

Early in year two of the currently funded project, LMRCSC leadership and external evaluators were contacted by NOAA EPP and notified of the need for a comprehensive revision to the project evaluation plan based on a new set of guiding questions and sub-questions which were provided by NOAA EPP. This revision was undertaken by Bishop and Walters and necessitated a significant use of time to coordinate the writing of the new plan, along with NOAA EPP mandated conference calls and participation on a cross-Center, cooperative evaluation strategy. Bishop and Walters, on behalf of the LMRCSC, have engaged substantively with this comprehensive strategy, assuming the lead in developing and providing a cross-Center assessment instrument for NOAA Scientist engagement that is now utilized at two of the four CSCs.

The revised CSC evaluation framework is based on a set of three over-arching questions, focused on the CSC impact on students and graduates, NOAA mission-aligned research, and CSC management and administrative processes. The guiding questions for this framework are:

- 1. How has the Center award implementation activities increased the number of students and graduates trained in the competencies and skills that align with employability and graduate studies in NOAA mission-aligned areas to advance the effectiveness and impacts of the NOAA Educational Partnership Program with Minority Serving Institutions (EPP/MSI) postsecondary NOAA mission STEM future workforce program?*
- 2. What is the evidence that the Center award implementation activities enhanced the capacity for NOAA mission-aligned research at partner institutions and other MSI’s?*
- 3. What is the evidence that the CSC management team and administrative processes enhanced the capacity of lead and partner institutions to meet the goals and objectives of the Center award in advancing the effectiveness and impacts of the NOAA EPP/MSI STEM future workforce program? □*

We note here the emphasis on *evidence claims* in these guiding questions, and in the related sub-questions in the NOAA EPP evaluation framework. This is consistent with the external evaluation planned and underway for the LMRCSC as implemented by Bishop and Walters.

Annually, the external evaluators plan to implement select data collection through a variety of methods to obtain evidence toward assertions that the project is meeting these overarching goals. Given the comprehensive span of the project, the external evaluation annually identifies and targets select stakeholders related to the project, and select programming efforts within the LMRCS C to collect evidence that supports the overarching questions and the project goals and objectives.

Year Two Data Collection and Evaluation Focus

For year two of the external evaluation, evidence collection focused on current graduate students, NOAA Scientists who are working with these students or with the LMRCS C in a support position, and project management team members. Programmatically, the evaluation effort focused on the Spring 2018 student workshop held at the University of Maryland—Eastern Shore campus. This program was selected for focused review during this project year as it represented a nexus of effort and involvement by all of the stakeholder groups mentioned above, and represented a cross-cutting initiative that encompassed all of the overarching, guiding questions described above. The evidence summaries in the following narrative are organized in the order of the three guiding questions above.

Evaluation Activities in Year Two

- Monthly management phone calls;
- Phone calls with other CSC evaluators and NOAA EPP;
- Evaluation plan revision at NOAA EPP request;
- NOAA Scientist Survey;
- Cross-CSC version of NOAA Scientist Survey;
- LMRCS C Administration and Staff Survey;
- All three evaluation team members attended the March workshop;
- Prepared initial data slides for Dr. Chigbu for NOAA EPP Forum;
- Graduate Student Post-Workshop Survey; and
- Informal interviews with LMRCS C co-PIs, staff members, graduate students, and NOAA scientists.

Impact on Students

The first of a sequence of student workshops for the LMRCS C was implemented March 5-9, 2018, at the University of Maryland—Eastern Shore campus. Students from 6 of the campuses/institutions represented in the LMRCS C effort attended the intensive workshop, which was specifically designed to enhance employability skills and knowledge and understanding of NOAA mission-critical science content. Students were able to meet and participate in discussions with NOAA scientists, project faculty, and project co-PIs, as well as with each other. The conversations and work projects undertaken during the workshop were designed to build and strengthen relationships among the students from across the LMRCS C participating institutions in order to build the *cohort* aspect of the project. The external evaluators attended the workshop to observe firsthand and independently of the project management the impact of the workshop toward meeting project goals. In addition, the external evaluators used the week to interact with and talk with NOAA scientists, project faculty, administrative staff, students, and project managers to ascertain the involvement of each of these stakeholder communities with the LMRCS C. Finally, the evaluators used the opportunity of the workshop to administer a post-workshop survey to the students to collect feedback on a variety of project goals and objectives.

The student survey included twenty-one items to capture background demographic information from the students, as well as student perceptions of the value and impact of the workshop and the broader LMRCS C effort on their progress through school, their understanding of NOAA as a potential employer, NOAA's mission-critical scientific concerns, and other issues

related to college or graduate school progress. Fifteen of the student participants at the workshop volunteered to complete the survey in its entirety, which was collected confidentially and separate from LMRCSO management involvement. All of the student respondents were graduate students at the MS or PhD level (6 and 9 respectively). All of the students are matriculating in areas strongly related to NOAA mission-critical science. Eleven of the respondents were able to provide the name of a specific, NOAA scientist with whom they are currently working—which is a very strong indicator that the LMRCSO is directly linking graduate students and NOAA scientists. This is evidence which supports project performance in both the first and second focus areas of the NOAA EPP question framework cited above. (Note: the NOAA scientists who were surveyed separately, reported below, provide independently confirmed support for these students' survey responses, demonstrating the reliability of these data as evidence for support.)

Fourteen of the respondents perceived that the workshop fully met their expectations, with the only negative perceptions related to the intensity and duration of the workshop. All of the respondents perceived as important and beneficial the workshop's focus on building relationships between and among the student cohort, between students and project faculty and NOAA scientists, and for building content awareness of the key science areas. A correlation matrix calculated for the item rating scale indicates that the relationship building activities were the highest rated workshop components (14 and 11 respondents respectively rating these at the highest positive level). The second highest rated cluster of responses pertained to the career and work-skill development components of the workshop (career opportunities and pathways, interviewing skills and networking) which were rated at the highest levels by 11 and 9 respondents respectively.

Items ten through fourteen on the survey solicited responses about impact on the students regarding the NOAA LMRCSO goals and objectives, and student understanding of NOAA's mission science, as well as impact on academic and career goals. Twelve of the fifteen respondents Strongly Agreed or Agreed that the workshop increased their understanding of the LMRCSO goals and objectives. Thirteen of the fifteen respondents Strongly Agreed or Agreed that the workshop increased their understanding of NOAA's mission science. Direct observations of the workshop classes by the external evaluators suggests these are reasonable impacts based on the classes offered during the week and that these are credible data as evidence of goal attainment. Interestingly, in the narrative response section related to the workshop information, eleven of the respondents indicated that the career information and job skills information were the most helpful information that they received. Again, this was directly observed by the external evaluators and suggests strong evidence to support the NOAA EPP guiding question regarding employment skills as noted earlier in the report. Clearly, the LMRCSO takes seriously its responsibility to provide employment and employability skills training to its cohorts of students and has built this into a workshop that is perceived by the students themselves to be important.

Finally, eleven of the respondents provided narrative descriptions of the impact of the workshop on their ability to set and meet academic goals. Select responses to this item that are typical of student responses include:

- *The workshop gave me a better understanding of this field, now I know which path to focus on;*
- *It helped me solidify the direction in which I want to take my research;*
- *It refreshed my knowledge of stock assessment and remind me to consider human dimensions;*
- *It helped me to think about career options;*
- *It helped me to realize what options are out there, and that there are more options aside from being a PI, because sometimes that is all people make it seem like there is out there;*
- *It opened my eyes to the various jobs I can get after receiving my degree.*

Items fifteen and sixteen solicited responses related to students working as a cohort across

the LMRCSC institutions. Clearly, the workshop was designed to create these relationships and this “cohort identity” among students, and included sessions that built on team collaboration. Nevertheless, four of the respondents were able to describe planned efforts to collaborate with student-colleagues across institutional lines. It was clear, further, that these collaborations emerged from and were the result of the sessions implemented during this workshop. Students were asked to describe the impact of the workshop on fostering collaborations with students or faculty from other institutions. Select, typical responses included:

- *We are in the same area for a few days so it allowed us to become more comfortable with each other. The group project facilitated conversation outside of the classroom. We were able to foster friendship when we ate together and the discussions in the workshops allowed us to find out more things we had in common.*
- *I learned about what other students are doing and we have different expertise that would be helpful on a larger project.*
- *I was able to meet other LMRCSC students and form new relationships to discuss research issues, projects, and goals.*
- *I was able to get contact information and expand networking.*

Item seventeen solicited feedback from students on the opportunity to obtain support and mentoring from NOAA scientists at the workshop. The responses were limited, as there were actually few NOAA personnel scheduled on the workshop agenda. Students noted only one NOAA scientist presented to them and was available at the workshop. Clearly, as indicated in the earlier item where they described working with these scientists on projects, these students are working with numerous NOAA scientists. Nevertheless, it may be that LMRCSC leadership should consider whether involving more of these NOAA personnel in the workshop would be advantageous (or not).

Item eighteen solicited feedback from students on the workshop’s benefits to them. Interesting, all fifteen of the respondents described meeting other students and networking as the primary benefit of the workshop experience. This is a very strong and unified response, provided independently, that suggests the workshop design and focus was successful and intentional in accomplishing this. The evaluators observed numerous classes at the workshop that encouraged networking and discussion between and among the students in different working groups. These approaches to team and network-building certainly support eventual team and network approaches on the job (NOAA EPP guiding question area one from above).

Finally, survey items nineteen through twenty-one were incorporated to allow formative input to the LMRCSC leadership team for planning future student events. Students were asked for ideas for sessions that would strengthen the workshop, topics on which they would like additional resources, and any challenges they encountered with the workshop. As anticipated, the topic and idea items produced a range of content suggestions that seem related to the span of topics and degree areas in which the students are interested and are conducting their research or formal academic studies. With respect to the challenges, clearly the students were somewhat stressed with the intensity of the workshop—which is not necessarily a negative aspect and may in fact be considered, ultimately, a positive benefit to the students. It does seem that the timing of the workshop, during an academic semester, was something that challenged the students. Numerous students indicated that they were continuing to have to work on academic material related to their courses at their home institutions while the workshop was ongoing, and producing its own additional workload.

In summary, the student responses to the post-workshop survey are credibly related to the observations of the workshop that the evaluation team recorded themselves. The workshop was highly content-focused, with numerous sessions on NOAA’s mission science. The workshop incorporated intentional focus on job skills, career building and networking skills, and career pathway information. Students clearly enjoyed these sessions—as observed by the evaluators

and as described in the survey. This workshop, as observed by the evaluators and described by the students, is evidence that the LMRCS is substantially addressing NOAA EPP's concerns for preparing students for career entry and success with the job and career skills required.

In addition to these observations of the workshop, the evaluators also recorded their impressions as participant observers at the workshop. These included: that there should be a more comprehensive overview of NOAA EPP and the LMRCS presented at the beginning of the workshop to highlight the important mission issues, goals and objectives of these organizations. Additionally, the importance of the *cohort* model in the project could be better defined and conveyed. In some uses, *cohort* is used as a term to signify the movement of federal funds to particular groups of students, and not as a cohesive, social and professional community. Third, the workshop planners could have included greater representation of NOAA scientists, even through distance connections. Fourth, the use of the phrase *human dimensions* during the workshop was never defined clearly to the students, who seemed confused at times about the use of that label. Fifth, given the location of the workshop, a field trip to a nearby NOAA laboratory, or a field location to an important ecosystem would have added to the experiential value of the workshop. And finally, some additional structured, social activities to build the cohort might be considered in the future.

Enhancements to NOAA Research

To collect evidence related to the LMRCS “enhancing the capacity for NOAA mission-aligned research at partner institutions and other MSI’s” (NOAA EPP guiding question two from above). The external evaluators designed and implemented a survey for NOAA scientists who are connected to the LMRCS through work with graduate students at the MSI partners on the project, or through other support avenues. Ten scientists completed the survey. These respondents were asked to identify their NOAA line office and location, which included:

- Sandy Hook, NJ
- NMFS, SEFSC
- NOS Oxford Laboratory
- NOAA—Office of the Chief Financial Officer, Silver Spring, MD
- NMFS, NEFSC, JJ Howard Laboratory, Highlands, NJ
- NMFS ST
- Northeast Fisheries Science Center
- NMFS, Science and Technology, Oxford, MD
- NMFS AFSC, Newport, OR
- NWFSC, Newport, OR

Of these responding scientists, five indicate that they provide direct instruction of students in coursework related to the project. The course content areas include: fish disease and general environmental science, economics, fish physiology, and ecosystem modeling. The scientists also provided a list of their own primary research interests:

- Chemistry in fisheries research;
- Population dynamics and stock assessment;
- Ecological forecasting and shellfish sanitation;
- Economics of natural resources;
- Fisheries habitat and habitat modeling;
- Environmental physiology of fishes;
- Ecosystem modeling;
- Climate and habitat effects on commercial fisheries; and
- Pacific Salmon and lamprey estuarine and marine ecology.

A key set of questions in the survey (items 6-13) were related to the involvement of these

NOAA personnel in the LMRCSC, and ways which the CSC meets the needs of these scientists. It is noted that the NOAA scientists in this case are serving as proxies for NOAA research interests and concerns as reflected in the NOAA EPP guiding question two above. In response to question 6 regarding the pathways through which the NOAA scientists connected to the CSC, the scientists replied:

- *The previous NEFSC Director contacted me regarding mentoring a FAMU doctoral student;*
- *Through a student who got funding;*
- *Colleagues at UMES and mutual research interests;*
- *I was a student with the LMRCSC;*
- *Running multi-day habitat cruises with LMRCSC student groups;*
- *Technical monitor for the LMRCSC;*
- *Through a colleague at Hampton University;*
- *Many years ago, Paulinus Chigbu invited some scientists at the Cooperative Oxford Lab to meet with him;*
- *I advise and assist students at Oregon State University; and*
- *I was approached by others and interacting with the Oregon State University person.*

Items seven through twelve explored a variety of demographic issues related to scientist participation in the CSC. The scientists were asked to describe their primary role with the LMRCSC, through a checkbox response item that allowed space for narrative entry of data. The responses are overlapping and allow for multiple roles and responses by individual scientists. Six of the ten serve as advisors to the LMRCSC. Three serve as advisors or directors of student research. Five engage on a collaborative project with the LMRCSC. Four teach courses, sections of courses, or sections of webinars and workshops for the LMRCSC. One serves as a technical monitor of the project. Of these scientists, only one is in the first year of work with LMRCSC. Three have been involved from 1-5 years; two from 6-10 years; and four from 11-15 years. In the coming year, these individual NOAA scientists will:

- Teach entire courses (1 person)
- Teach sections of courses (2 people)
- Teach part or all of a workshop (4 people)
- Conduct research connected to LMRCSC (3 people)
- Mentor or advise students from MSIs (8 people)
- Supervise student internships (4 people) or
- Provide specimens for research projects (1 person).

The scientists were also queried for input on the role of the LMRCSC in supporting their own professional growth and development (item 12) and their work with students (item 13). The responses included:

- *Students bring energy and fresh ideas to contribute to research questions interesting to NOAA;*
- *Tutoring and mentoring students should be a part of a scientist's activity portfolio;*
- *Provides student mentoring opportunities and expands research portfolio;*
- *Provides opportunity to interact with students, serve on graduate committees, and learn from them;*
- *Broadens teaching background, helping develop students;*
- *It allows me to interact with and mentor undergraduates from Hampton University;*
- *My daily work is focused on ecosystem modeling. Working with students enables me to be more involved with the data collection and analysis needed for model building;*
- *Facilitates engagement with students and university collaborators; and*
- *Gets my name on peer reviewed papers.*

Items fourteen through seventeen invited the scientists to discuss career pipeline issues related to NOAA Fisheries, issues related to early careers of scientists and career preparation (speaking into the NOAA EPP guiding questions one above), and additional support that might emerge between the CSC, the NOAA scientists, and the students. With respect to the career pipeline issues, which the CSC should consider moving forward, as it attempts to respond to NOAA EPP guidance, scientists respond:

- *Science in general is becoming more quantitative and so prospective NOAA recruits should have a strong foundation in math, statistics, and computing, without forgetting biology;*
- *Increased emphasis on statistics and big data, and an earlier exposure to both research and policy;*
- *[support for] technical writing skills and public speaking;*
- *Computer modeling, GIS, and electrical/mechanical engineering—more and more we are getting away from traditional biology and into electronic technology;*
- *A technical writing course;*
- *Allowing students to work directly on research with NOAA scientists;*
- *Students should have strong quantitative reasoning skills;*
- *Ensure that students have sufficient data analysis experience; and*
- *Students need experience working on real projects, generating and analyzing real data, and thinking critically.*

From the perspective of additional support for the NOAA scientists from CSC (again, looking at the scientists as proxy for NOAA mission science under the NOAA EPP guiding questions two), scientists responded:

- *Provide a database of NOAA resources to students;*
- *More emphasis on aligning student research with current projects and needs in NOAA laboratories. Ask for NOAA scientist involvement before the student already has a specific project. We do not have the flexibility to allocate time and resources to things that do not further our own programs;*
- *Better coordination between CSC and NOAA scientists;*
- *More contact between CSC faculty and NOAA scientists so that we can increase the likelihood of interaction and catching the interest of students;*
- *Minimize barriers and paperwork associated with working with students;*
- *Facilitate travel to partner institutions;*
- *Fund supplies to help with student projects and travel funding for me to visit folks I'm collaborating with to allow face time.*

And finally, scientists were asked to “look out 5-10 years and consider the most significant challenges to ocean, marine, aquatic, and fisheries science careers” as an attempt to garner NOAA scientist input on the CSC goals to impact the career pipeline by supporting, training, and preparing students (NOAA EPP guiding question one above). Aside from the near unanimous response of constraints to funding, other items that emerged in the responses included:

- *The ideal scientist will have to have a very diverse skill set to address the exponentially increasing amount of information and data that are, and will, become available and the likely relative reduction of government positions;*
- *Cross-disciplinary thinking: the problems fisheries face more and more involve a host of interacting issues, including ecological, economic, social, and political, in addition to pure fisheries science. Young people need to be cross-trained to be aware of the complexity of fisheries issues;*
- *In the short term, funding will likely be a challenge and job opportunities will be limited. In the longer term, scientists will rely more and more on technology. Students need good*

base-level skills with computers, programming, etc. They will also need to be able to learn new computer and technological skills quickly.

- *Students will need advanced modeling skills and critical thinking about climate change.*

Items eighteen and nineteen ask the scientists to consider issues related to the students such as research experiences and internships, and mentoring. With a view of the benefits and opportunities for students, select typical responses from scientists included a solid focus on the real world of the NOAA laboratory experience, as distinct from simulations and problem solving in traditional academic settings. Typical responses included:

- *The students are mentored by NOAA scientists in a professional environment. The day-to-day challenges and troubleshooting experience may not be available in the protected academic setting.*
- *Students need to see “real world” situations to help them decide whether the subject of their research and internships are really what they want to pursue;*
- *Students get practical experiences in how science is done day-to-day;*
- *Real life experience with research planning and data analysis.*

And in describing their own mentoring of these students, the scientists almost uniformly consider themselves mentors of these CSC students which they work or have worked with. The scientists use language typically associated with mentoring, i.e. working with, showing, advising, demonstrating, helping them understand, serving as a role model, conveying my enthusiasm, helping them identify career pathways. There is clearly a commitment from these NOAA scientists to extend their own impact to a next generation of NOAA scientists, and to do this through their work with the LMRCSC. These data are certainly evidence that the LMRCSC is meeting the focus areas of the NOAA EPP guiding questions one and two above.

To provide formative data to the LMRCSC leadership, a series of questions were provided to the NOAA scientists to obtain “forward leaning” information to support the project in each of the focus areas illustrated in the NOAA EPP three guiding questions above. Item twenty asked about additional opportunities or challenges to consider moving forward. The constructive responses to this item are included entirely as:

- *Microplastics, application of chemical fingerprints in understanding foraging ecology, habitat use, and migration;*
- *The opportunity to more tightly align student projects with NOAA research. It appears the EPP is heading this way with required internships;*
- *Better connecting the CSC faculty with NOAA scientists, again to better align research and education projects between academia and NOAA;*
- *Getting a wide range of good projects to be submitted and considered for funding;*
- *Ensuring students have viable career opportunities as they transition out of the program.*

Item twenty-one asked respondents to describe “collaborative research projects you have completed or begun in the past year with other faculty or scientists involved with a CSC...and to include names of these individuals.” Seven of the respondents were able to provide these descriptions and multiple names of faculty, scientists, or students engaged in this research. The specificity of the responses demonstrates the rich substance of the LMRCSC, NOAA scientist interactions, as well as the involvement of the students. This represents an important body of evidence that supports the focus of each of the NOAA EPP guiding questions above: students are being supported in their career pipeline development; NOAA science is being supported through these interactive research experiences; and the LMRCSC administrative and management capacity is being extended and successfully carried out through the leveraged work efforts of all of these individuals.

Item twenty-two asks the responding NOAA scientists to describe any barriers to success

that they have encountered. The feedback from this item will be provided as formative information to the LMRCSC leadership for discussion and consideration. While the responses are limited, the clear points for consideration that emerge in this set of responses include: paperwork and bureaucratic requirements to working with students, faculty, and publication issues; the necessity of greater organization and time considerations with the institutions of higher learning so that there is lead time to develop working projects with the students; and, finally, limitations to budgets that constrain collaboration, for example travel funds that may allow face time between NOAA scientists, project faculty and students.

Nevertheless, items twenty-three through twenty-five indicate that there is evidence of collaborative research work between the NOAA scientists and the CSC through completed, planned, or currently functioning research studies; through scientist participation in LMRCSC sponsored science meetings for presentations; and through an active engagement of NOAA scientists by and with LMRCSC leadership, faculty, and students.

A final section of responses seeks to identify or create evidence of skill and content development for students through the LMRCSC, again using the NOAA scientists as a proxy for a NOAA perspective on student development. In item twenty-six, 100% of scientists Strongly Agree or Agree that “the LMRCSC technical competencies that are enhanced among students are skills required by NOAA’s mission-aligned future workforce.” Item twenty-seven summarizes evidence that the LMRCSC students are increasing their abilities for analytics and modeling, and large data-set skills, as observed by the scientists. Key quotations included: *The students are working new and diverse projects that are relevant to the NOAA Mission. The CSC actively pursues opportunities to obtain training in quantitative skills. The students that I have worked with recently seem to have stronger quantitative skills, e.g. using the R-software for data analysis, population and ecosystem modeling.*

And finally, item twenty-eight solicited descriptions of LMRCSC implemented activities that enhanced the understanding of social science integration competencies among CSC students and faculty. This item did not produce extended or detailed responses from NOAA scientists, and this issue will be considered formatively in presentation to the LMRCSC leadership moving forward.

LMRCSC Administrative Processes

Based on the NOAA EPP guiding question three above, which was circulated to the evaluation team in November 2017, a brief survey was developed and administered to the administrative team for the LMRCSC to begin the process of collecting and summarizing supportive evidence to respond to this query. Based on evaluator observations, it seems clear that the LMRCSC acts on its commitment to realizing the management structure described in the grant proposal. As is typical with complex organizations, there are periodic vacancies and delays in filling these vacancies due to organizational issues, posting and interview processes. Nevertheless, it is evident that LMRCSC functions in the manner it is described in its documentation.

Three team members with 100% work time devoted to the center, and one individual with 81% work time responded to the survey. These individuals described the commitment to the project partners to address project goals, and to improve performance in this area:

- *The LMRCSC has helped the partners with some direction on new program requirements, however, there is more the center can do to increase the communication about center goals and requirements to partner institutions;*
- *It is our responsibility to make sure our partners stay within the NOAA EPP’s financial guidelines. This has been a real challenge on the new grant with NOAA changing the rules constantly and not giving clear, written instructions;*
- *By clearly articulating those goals and by communicating at least monthly to discuss challenges and solutions to meeting those goals.*

Similarly, staff members can describe ways through which the center helps its partners

address NOAA mission priorities:

- *The center has provided guidance about NOAA mission priorities on an individual and case by case basis. A consolidation of troubleshooting measures may help partners who have not encountered barriers to meeting NOAA mission priorities and educate new personnel to streamline processes related to NOAA mission.*
- *Through collaborating for the mission of NOAA and educating scientists for the enhancement of present and future NOAA goals.*

Nevertheless, staff members can also identify challenges that exist for the center moving forward, a critical task to overall improvement in any organization:

- *Current challenges are related to students in the center transitioning from the original funding to the new grant. Many are near completion for their degrees. As these students matriculate out of the program, these challenges should diminish. Another challenge is the selection of fellows as the center bears more responsibility for student success in relation to funding. Fellows should be deserving students but support systems for successful degree completion will need to be documented with the partners and center.*
- *It is a continuing and difficult challenge to manage the Center funds to meet all of the NOAA requirements. What we proposed and they accepted, is not what they are now requiring of us. Whether or not we will be able to meet the 50% student funding requirement is a question because of all of the funding restrictions that are now being imposed on us.*
- *The largest challenge at the moment is allowable usage of the One Time Research Funds. Based on our current understanding of what we are allowed to spend those funds on (external training), that funding is misaligned with our students' needs (research related travel, supplies, analysis, equipment usage time, etc.).*

Finally, staff were asked to describe their perceptions of the benefits of the project to students who engage with the Center:

- *Students are networked to other fellows, faculty and NOAA mentors they might not have access to.*
- *They know we are there for them, that we will fight to do what is right for them and help them to accomplish their goals.*
- *An opportunity to obtain a degree in marine sciences while being provided a stipend and tuition payment which allows them to perform at a higher, non-stressed rate.*
- *The biggest benefit for graduate students is the guarantee of funding for a long period. For undergraduates, benefits include research experience, academic mentorship beyond what is offered by the department, assistance in securing paid summer internships. Both groups also benefit from additional administrative support as they navigate complicated institutional policies.*

It is clear, from these responses, and from direct observations by the external evaluation team, that the LMRCSC leadership and staff team takes its commitments to the project seriously. There is evidence that the team members have a high awareness of contractual responsibilities, explore through direction communication with NOAA EPP leadership any questions or concerns and to clarify contractual language when necessary. The external evaluation team further monitors project communication among the PIs by participating in the monthly conference meetings and through review of meeting agenda and minutes. These all serve as evidence as required by the NOAA EPP guiding question framework at the beginning of this report, that the administrative and management goals and objectives are being realized and are functional in the manner described in the grant proposal. The staff members, as evidenced in survey responses, are sensitive to compliance issues, but are dedicated and visionary in responding to students, to

faculty, to NOAA scientists. They are aware of NOAA mission science and career pipeline goals, and build these into programming for students, as further evidenced in the training sessions and materials cataloged from the spring 2018 student workshop.

Summary and Conclusions

In year two of the project external evaluation, the evaluation team invested significant time in the redesign of the evaluation goals and objectives to follow the newly released guiding question framework provided by NOAA EPP. In addition, NOAA EPP organized the external evaluators into a loosely associated “team” of evaluators, under the leadership of Dr. Mark Howse, who serves as the lead evaluator for the CCME in Florida. The LMRCSC evaluators (Walters and Bishop) engaged in the collaborative team process by participating in phone calls, numerous email communications, and, as noted above, by contributing a survey for NOAA scientists to the broader team effort. It is noted that this additional time and effort has been absorbed into the evaluation contract for this year. This collaboration seems positive, and linked to eventual structural refinements and enhancements to NOAA EPP more broadly, and to the individual Centers as they comprise a collective effort by NOAA EPP toward strengthening the pipeline of minority students into NOAA employment, and to facilitate the realization of NOAA mission science.

The evaluation team further invested time and effort in a systematic collection of impact and feedback data from students, from NOAA scientists, and from LMRCSC staff members. This feedback was collected through surveys, through direct observation of center programming by the external evaluators, and through interviews and dialogue with scientists, faculty, co-PIs, the Project Director, key staff members, the Project Education Director, and graduate and undergraduate students. The formal response data summarized from a variety of these stakeholders above indicates there is a preponderance of evidence that the LMRCSC is functioning effectively and efficiently to meet its goals and objectives in support of NOAA EPP. The project leadership is implementing numerous project activities that strengthen student knowledge and skills for eventual career success and career entry. Projects involve NOAA mission science in a variety of ways, to include courses, workshops, student and faculty research, student mentoring, and student/faculty/NOAA scientist engagements around research questions of interest to NOAA.

The student workshop in Spring 2018 was substantive, and evoked highly positive reactions from each stakeholder group. LMRCSC leadership has determined that this success warrants a repetition of the workshop in 2019 and plans are ongoing to realize that objective.

Moving into year three of the project in Fall 2018, the external evaluation will continue its cooperative efforts with the NOAA EPP broader evaluation community as requested, and will further continue the planned LMRCSC external evaluation by engagement with students, faculty, NOAA scientists, and project staff and leadership. Evidence to date is strongly supportive of a determination that the LMRCSC is successful, forward thinking, and likely to fully meet its ambitious goals and objectives.

Finally, the evaluation team will begin a focused exploration of the impacts of student mentoring across the LMRCSC during year three. This effort will incorporate data collection from the NERTO projects and the TAB projects, from both cooperating NOAA scientists, university faculty, and graduate students themselves. This effort will capture and synthesize data to address formally the NOAA EPP guiding questions one and two, with respect to student supports and the implementation of NOAA mission science, and question three with respect to the LMRCSC programmatic, structural, and administrative processes associated to the NERTO and TAB projects.

Appendix II: TAB Funded Research Projects in 2016-2017

Project Number: 18-01

Project Title: Underrepresentation in marine and fisheries science professions: how significant life experiences shape a diverse workforce

Project Abstract: NOAA Fisheries has a responsibility to provide the best available science for the management of living marine resources. Research has shown the value of diversified thinking and approaches in science and that diverse perspectives can improve our collective ability to solve problems. However, African American, Latino, and Native American populations face the issue of being underrepresented in marine and fisheries science professions, resulting in a workforce that does not reflect the diversity of the United States. To better understand how to recruit individuals from underrepresented communities, it is important to examine the factors that influence individuals to pursue careers in marine and fisheries science professions and identify whether any of these key factors are unique to individuals from underrepresented populations. Focusing on participants from two of NOAA Educational Partnership Programs with Minority Serving Institutions Cooperative Science Centers (CSCs), and the American Society of Limnology and Oceanography Multicultural Program (ASLOMP), this study will provide an analysis of how life experiences and identity shape career decisions of individuals pursuing careers in marine and fisheries related sciences. This study will use in-depth interviews and qualitative data analysis to analyze the effects of life experiences and identity on career decisions. The results of this study will provide foundational information for the refinement of specific hypotheses about life experience and identity, including research on the development of fisheries and marine career identities amongst youth.

Thematic Area Addressed: Assessment

Lead Scientist(s): Brittany King (OSU, PhD Student), Kelly Biedenweg, PhD (OSU)

NOAA Collaborator(s): Kevin Werner (NOAA/NWFSC)

LMRCSC Collaborator(s): Benjamin Cuker, PhD (Hampton University)

LMRCSC Research Student(s):

Start Date: 1 September 2018

End Date: 31 March 2020

Scientific Merit: As of today, we have not yet received our TAB funding. We expect to receive it in the next few weeks. We are still in the process of finalizing the sampling populations for the project. Brittany has talked with Dr. Cuker about using ASLOMP participants in the sample pool and he has agreed to share contact information for recent participants. Brittany has reached out to Dr. Chigbu for LMRCSC participants and has yet to reach out CCME. After the sample populations are finalized, we plan to submit the project to Oregon State University's Institutional Review Board and to start collecting data in early November, once the project approval is finalized.

Products:

King, Brittany. 2018. Underrepresentation of racial and ethnic groups in marine and fisheries science professions. Presented proposal at International Symposium on Society and Resource Management. Snow Bird, UT. June 19, 2018

Relevance: NOAA has acknowledged that in order to continue to meet its mission, a commitment to strengthening diversity and inclusion is critical. As a part of their strategic plan, multiple NMFS science centers have highlighted the importance of diversity and the need to recruit highly skilled and motivated employment candidates that reflect the diversity of the nation as one of their goals. This project will contribute to science by examining the drivers that influence individuals from underrepresented communities' pursuing fisheries science careers and contribute

to NOAA by providing a better understanding of how to recruit and retain individuals from underrepresented communities.

Broader Impacts: This project explores a social science and human dimensions aspect of marine and fisheries science that is often overlooked. It aligns well with LMRCSC missions to prepare a diverse student body for careers in marine and fisheries sciences through exemplary academic and research collaborations, by examining drivers that influence a diverse marine/fisheries science workforce. The project provides the LMRCSC student researcher, Brittany King, the opportunity to integrate social science research into the LMRCSC program to help better understand underrepresentation in marine and fisheries science professions. The results of this study will be used to inform other components of Brittany's dissertation research that test more specific hypotheses about life experience and identity, including research on the development of career identities amongst youth.

Project Number: 18-02

Project Title: Baseline Data of Male Reproductive Status for Jonah Crab Management

Project Abstract: The fishery of Jonah crab (*Cancer borealis*) has been rapidly increasing in the Northeast United States since 2002. As one of the data-poor species, it still lacks in the information on age, growth or reproduction. In 2016, a Fishery Management Plan states a minimum legal size (4.75") based on limited information, despite that the life history and the size of the onset of sexual maturity are unknown and that these animals over the legal size would experience another molt to become larger. This proposal addresses to 1) establish a relationship between the size of males and reproductive status (onset of sexual maturity; physiological and functional maturity) by studying the primary male sex hormone, insulin-like androgenic gland hormone and 2) examine if the larger size of adults undergoes another molt cycle. This information is critical for setting size limits and managing crab fisheries in the Mid-Atlantic Bight.

Thematic Area Addressed: Stock Assessment Support

Lead Scientist(s): Amanda Lawrence (PhD Student, UMCES-IMET)

NOAA Collaborator(s): James Thorson (NOAA/NMFS), John Walter (NOAA/NMFS)

LMRCSC Collaborator(s): J. Sook Chung (UMCES-IMET), B. Stevens (UMES), Illarion Turko (NIST)

LMRCSC Research Student(s): Amanda Lawrence (Master Student, UMCES-IMET)

Start Date: 1 September 2018

End Date: 31 August 2019

Scientific Merit: Amanda completed an NIST Fellowship during May to August 2018, during which she learned techniques to absolutely quantify protein concentrations based on an internal standard method utilizing quantification concatemers (QconCAT). She learned the basics of QconCAT design and became familiarized with tools that assist in the design process including ExPASy. She learned protein purification techniques including whole gel elution and column separation and utilized these approaches to purify QconCATs. The main purpose of this work was to quantify QconCATs to be used as an internal standard for the biological samples which they represent.

Skills acquired included SDS-PAGE, FPLC, Protein purification, column separation, and whole gel elution

Products:

Methods of Expressing, Purifying & Quantification. Oral presentation at the Summer Undergraduate Research Fellowship Colloquium, Gaithersburg, MD, August 7, 2018.

Isolating an Insulin-like androgenic gland (IAG) hormone from the male red deep-sea crab,

Chaceon quinquegens. Oral presentation at the 148th American Fisheries Society Conference, Atlantic City, NJ, August 20, 2018.

Relevance: This training will help to establish an assay tool that is required for the TAB project involving measuring male hormone levels to determine functional and physiological maturity.

Broader Impacts: The NIST summer internship (Summer 2018) was mandated by NIST as Amanda was a recipient of a NIST-fellowship. This internship in Dr. Turko provided a rare training opportunity for Amanda to learn cutting edge analytical tools. It has also enabled us to establish an inter-institutional collaboration between the laboratories of Dr. Turko and Dr. Chung.

Project Number: 18-03

Project Title: Indices of abundance for King Mackerel in the Gulf of Mexico and South Atlantic improved by incorporating spatiotemporal and environmental variability

Project Abstract: King mackerel migrate seasonally and change their distribution based on the quality of their environment causing shifts in their spawning locations from year to year. Shifts of the adult distribution also impact the larval stage as their distribution is dependent on the location of spawning, and the local oceanography. These changes in distribution affect King Mackerel larvae catchability and the trends in survey data, therefore affecting the derived indices of abundance for spawning stock biomass. The index currently does not explicitly consider the effect of spatiotemporal variation on abundance trends and changes in catchability, which are inherent to the data. We plan to quantify spatiotemporal variability using a geostatistical model and compare performance of the estimated index of abundance over time, to the current modeling method. No results have been collected yet since we are in the model development stage of the project. Population abundance trends can be misrepresented by a non-geostatistical model that does not explicitly consider changes in spatial distributions (e.g., migration or ontogenetic shifts). This misrepresentation of estimated trends has been shown to lead to incorrect and uncertain estimates of stock status in the stock assessments, which are used to set management regulations. Using a more precise index reduces the risk of management error, increasing the credibility of NOAA fisheries management council decisions.

Thematic Area Addressed: Stock Assessment Support

Lead Scientist(s): LaTreese Denson (University of Miami), Elizabeth Babcock (University of Miami)

NOAA Collaborator(s): James Thorson (NOAA/NMFS), John Walter (NOAA/NMFS)

LMRCSC Collaborator(s): Dionne Hoskins - Brown (Savannah State University)

LMRCSC Research Student(s): LaTreese Denson (PhD, University of Miami), Unnamed Savannah State University Undergraduate

Start Date: 1 September 2018

End Date: 31 August 2019

Scientific Merit: As of today, mid-September 2018, LaTreese has just begun her NERTO and we are discussing options for how the linear models for the larval index will be built. LaTreese Denson, PhD student is currently in Seattle Washington working with James Thorson to learn how to use his recently created R package VAST. Using this package will facilitate LaTreese's development of the spatiotemporal larval index.

Products:

Denson, L., Babcock, E. and, Thorson J. (2018). The effect of spatial and temporal variation on larval indices used for King mackerel in the northern Gulf of Mexico. Will be presented at the ICES Annual Science Conference, Hamburg, Germany. September 24-27, 2018

Relevance: Overall, this project contributes to NOAA's Fisheries operations by improving the understanding of the GoM and South Atlantic ecosystems and its effects on important living

marine resources such as King mackerel, to inform management decisions. This advancement is particularly important to implement ecosystem-based fisheries management. Explicitly accounting for how this stock will be affected by ecosystem changes allows for management that more readily adapts to ecosystem dynamics and is trusted by its stakeholders.

Broader Impacts: Through the process of this project the graduate student (LaTreese Denson) is given an opportunity to work alongside NOAA employees during her NERTO, to gain valuable quantitative skills and to connect to a new professional network and explore future employment opportunities. The project offers these same benefits to an undergraduate student, while also fostering collaborative research between Savannah State University and the University of Miami, through an undergraduate summer internship position at the University of Miami.

Project Number: 18-04

Project Title: Examining ecosystem health through contaminant analysis of common bottlenose dolphins (*Tursiops truncatus*)

Project Abstract: As apex predators, common bottlenose dolphins (*Tursiops truncatus*) are an indicator species for ecosystem health. Persistent organic pollutants (POPs) accumulate in the blubber of bottlenose dolphins, making this species an indicator for ecosystem POP exposure. Spatial differences in bottlenose dolphin POP levels have been identified throughout the southeastern U.S. including the highest recorded PCB concentrations worldwide reported in estuaries around Brunswick, GA. This proposal requests funding to (1) identify baseline POP levels for the Northern Georgia Southern South Carolina Estuarine System (NGSSCES) Stock, (2) determine if the NGSSCES Stock has been exposed to the same point-source contaminants as the two other estuarine stocks in Georgia, and (3) use POP exposure as an additional tool in combination with genetics, photo-identification, and spatial analyses to assess stock structure.

Thematic Area Addressed: Healthy Habitats

Lead Scientist(s): Tara M. Cox, Savannah State University

NOAA Collaborator(s): Gina Ylitalo, NOAA, Northwest Fisheries Science Center

LMRCSC Collaborator(s): Carolina Bonin Lewallen, Hampton University

LMRCSC Research Student(s): Graduate student (SSU), Undergraduates (Hampton) [TBD]

Start Date: 1 August 2018

End Date: 31 July 2019

Scientific Merit: This project started one month ago, so there are no results to report to date. Preliminary plans have been made, biopsy sampling dates scheduled (February and March 2019), and sampling design initiated. Previous samples (n=20) from 20 male common bottlenose dolphins were analyzed by G. Ylitalo and found to have the lowest mean concentrations of PCBs (31.1 µg/g) compared to 14 other locations in the Southeastern U.S. (Kucklick et al. 2011). Additional samples of females with known reproductive histories will be collected in winter 2019. All samples will be analyzed for contaminants in G. Ylitalo's lab in summer 2019.

Products: There are no products to report to date.

Relevance: This project directly addresses several of NOAA's research priorities and thematic areas. This project contributes to NOAA's mandate to manage protected resources by examining habitat health as well as stock assessment. The proposal covers two research themes of the Living Marine Resources Cooperative Science Center: Healthy Habitats: Relationships with Populations and Assessment: Support and Information. This research will contribute to the Southeast Fisheries Science Center's efforts to "describe and assess the role of habitat in supporting healthy marine ecosystems and populations of exploited and protected species" and "monitor and assess fisheries and marine ecosystems, including populations of exploited and protected species, their habitats, and the associated human communities that rely on marine resources" (NOAA 2013). Monitoring protected species, such as common bottlenose dolphins, is

part of the “core” activities that the SEFSC must continue even when budgets are minimal. Assigning marine mammals to stocks is necessary for effective management of these protected species. The three estuarine system stocks in Georgia (Northern Georgia/Southern South Carolina Estuarine System Stock, Central Georgia Estuarine System Stock, and Southern Georgia Estuarine Stock) are all considered strategic stocks under the Marine Mammal Protection Act (Hayes et al. 2017).

Broader Impacts: This study also addresses the need for more technical training for students and increased representation of women and minorities in marine science. The under-represented students will learn concepts of marine ecology, marine mammal biology and management, and spatial ecology while gaining skills in photo-identification, contaminant analyses, and GIS. In addition to these methodological skills, students will learn critical science communication skills through dissemination of the study’s results and writing a manuscript for a peer-reviewed journal.

Literature Cited

- Hayes, S.A., E. Josephson, K. Maze-Foley, and P. Rosel, eds. 2017. U.S. and Gulf of Mexico marine mammal stock assessments – 2016. NOAA Technical Memorandum NMFS-NE-241. 282pp.
- Kucklick J., L. Schwacke, R. Wells, A. Hohn, A. Guichard, J. Yordy, L. Hansen, E. Zolman, R. Wilon, J. Litz, D. Nowacek, T. Rowles, R. Pugh, B. Balmer, C. Sinclair, and P. Rosel. 2011. Bottlenose dolphins as indicators of persistent organic pollutants in waters along the US East and Gulf of Mexico coasts. *Environ Sci Technol* 45(10): 4270-4277.
- National Oceanic and Atmospheric Administration. 2013. Southeast Fisheries Science Center Science Plan 2013-2018. National Oceanic and Atmospheric Administration, Sept. 2013, 25 pp. Web. 7 January 2018.

Project Number: 18-05

Project Title: Integration of habitat-specific growth variation into assessment models: a case study in the Kemp’s ridley sea turtle.

Project Abstract: Spatiotemporal variation in demographic parameters can strongly influence a species’ population dynamics. For example, somatic growth rates for Kemp’s ridley turtles differ between juveniles that inhabit the Atlantic versus Gulf Coast, which may lead to differences in age at maturation for individuals or whole cohorts. Current Kemp’s ridley population models do not include habitat-specific parameters due to lack of information. We propose to use a ~30 year dataset of somatic growth rates obtained through skeletochronology to quantify somatic growth variation and develop habitat-specific maturation schedules for Kemp’s ridleys. These data will be used to parameterize an improved stage structured population model and evaluate the contribution of Atlantic turtles to population growth. Results of the growth analysis will be compared to those for other sea turtle species through a meta-analysis of sea turtle growth rate data. This project will yield an updated and improved population model for Kemp’s ridley sea turtles that is expected to inform management of the species.

Thematic Area Addressed: Stock Assessment Support

Lead Scientist(s): Matthew Ramirez (Oregon State University), Selina Heppell (Oregon State University)

NOAA Collaborator(s): Jeffrey Moore (NOAA/NMFS), Larisa Avens (NOAA/NMFS)

LMRCSC Collaborator(s): Elizabeth Babcock (RSMAS)

LMRCSC Research Student(s): Matthew Ramirez (PhD, Oregon State University), Tamara Popovska (UG, RSMAS)

Start Date: 1 September 2018

End Date: 31 August 2019

Scientific Merit: As this project is just starting, we have primarily been developing the research plan. Over the summer Dr. Babcock identified an undergraduate student at RSMAS, Tamara

Popovska, to assist with the project on a volunteer basis. Tamara has started a literature review of sea turtle growth rate data. These data will be used by Matthew Ramirez, the Ph.D. LMRCS research student, to inform population model development. Matthew will travel to La Jolla, CA, in October to begin his NERTO with Dr. Moore at the NOAA Southwest Fisheries Science Center. Matthew will work with Dr. Moore to develop and updated stage structured population model for Kemp's ridley sea turtles.

Products: None during this reporting period.

Relevance: We expect our results will support NOAA's mission "to conserve and manage coastal and marine ecosystems and resources" by achieving the following objectives: (1) update an assessment model for the endangered Kemp's ridley sea turtle to inform and improve management efforts, (2) evaluate the contribution of Atlantic Kemp's ridley sea turtles to overall species population dynamics, and (3) evaluate alternative hypotheses for the recent reduction in the recovery rate for the species.

Broader Impacts: This study addresses the need for more quantitative training for students and increased representation of minority students in fisheries science. Both Matthew and Tamara will learn a variety of quantitative methods used for population and statistical modeling. This study will also provide Matthew an opportunity to collaborate with NOAA scientists from multiple science centers.

Project Number: 18-06

Project Title: Assessing the Impacts of Harmful Dinoflagellates and *Vibrio* spp. On Oyster Aquaculture in The Delaware Inland Bays.

Project Abstract: The Delaware Inland Bays (DIBS) are a collection of salt marshes, saltwater creeks, and shallow open waters. Over the years, the ecological health of certain areas in the DIBs has deteriorated because of poor water quality. Historically, oyster reefs were evenly distributed in the DIBS, but oyster disease caused the population to collapse in the 1950s. In 2013, the Delaware State Legislature instructed the Delaware Department of Natural Resources and Environmental Control to create an oyster aquaculture industry. Recent studies have suggested an association between the abundance of phytoplankton and the pathogenic bacterium *Vibrio parahaemolyticus* in the DIBs. The presence of *V. parahaemolyticus* and several harmful algal bloom (HAB) species causes concerns for the proposed aquaculture sites due to environmental and human health risks associated with these organisms. We will examine the areas near proposed aquaculture sites to determine the impacts of water quality and proliferation of pathogenic bacteria on oyster aquaculture. The goals of the project are 1) To determine the community structure of harmful dinoflagellates and *Vibrio* spp. in the Delaware Inland Bays near the oyster aquaculture sites 2) To compare the seasonal succession of harmful dinoflagellates and microbial community in the water column to the community in oysters gut contents 3) To identify the impacts okadaic acid (dinoflagellate toxin) has on oysters health.

Thematic Area Addressed: Healthy Habitats

Lead Scientist(s): Detbra Rosales (University of Maryland Eastern Shore)

NOAA Collaborator(s): John Jacobs (NOAA/NCCOS)

LMRCSC Collaborator(s): Joseph Pitula (University of Maryland Eastern Shore)

LMRCSC Research Student(s): Detbra Rosales (PhD, University of Maryland Eastern Shore) and Reuel Danquah (UG, University of Maryland Eastern Shore).

Start Date: 1 April 2018

End Date: 30 April 2019

Scientific Merit: From April-September 2018 we have collected water and oyster samples from the Delaware Inland bays. We have worked with John Jacobs to identify the impacts okadaic acid has on oyster health. Detbra Rosales, our Ph.D. LMRCS research assistant, has processed

water and oyster samples for the identification and enumeration of harmful algae and pathogenic *Vibrio* spp. She was able to identify the presence of many harmful algal species such as *Karlodinium veneficum*, *Dinophysis* spp., *Heterosigma akashiwo* and *Chattonella subsalsa* in the DIBs. *V. parahaemolyticus* and *V. vulnificus* were also detected in both environmental samples and *C. virginica*. She has also exposed oysters to Okadaic acid and *V. parahaemolyticus* to understand the influence of okadaic acid on gene expression and bacterial susceptibility. As of now okadaic acid has no effect on *V. parahaemolyticus* growth within oysters, however an additional experiment is needed to confirm results. We are currently in the process of extracting RNA from oysters that were exposed to okadaic acid and running RT-QPCR for Hsp 70 (Heat shock protein 70), CP450 (metabolize xenobiotic compounds), and GADPH (house-keeping gene) to understand the impacts of okadaic acid on oyster health. Reuel Danquah, our LMRCSC undergraduate research assistant, has been testing 2018 oysters and water samples for the presence of bacteria and Dinoflagellates. These samples will then be sent out for metagenomics to determine the eukaryotic and microbial community in the Delaware inland Bays. Reuel has also created a *Vibrio* spp. library to help us determine the *Vibrio* spp. community within oysters in the Delaware inland bays.

Products:

Rosales, D., Parveen S., Ozbay, G., Jacobs, J., and Pitula, J., (2018). Harmful Algal Succession and *Vibrio* spp. detection in the Delaware Inland Bays. AERS at 70 Bridging Past & Future April 2018 Ignite Oral presentation.

Relevance: Oysters are harvested for human consumption, and studies have shown that dinoflagellates can increase bacterial loads in oysters. Therefore, understanding the relationship between the factors that promote both HAB development and bacterial proliferation is imperative. We expect that our results will support NOAA's long-term goal of "healthy habitats" by 1) Evaluating the community structure of harmful dinoflagellates and *Vibrio* spp. in the Delaware Inland Bays; 2) Comparing the seasonal succession of harmful dinoflagellates and microbial community in the water to the community in oysters gut contents; and, 3) Determining the impacts of okadaic acid on oyster health.

Broader Impacts: A major component of completing our project is to provide both our Graduate (Detbra) and Undergraduate (Reuel) students with an opportunity to collaborate with NOAA mentors, UMES and DSU faculty, Delaware Department of Natural Resources Environmental Control, and stakeholders. With our findings we will be able to better inform local government, stakeholders, and scientists on how we, as a community, can decrease factors that lead to the presence of HABs and the impacts these blooms are having on oyster's health. We expect Detbra Rosales to complete her Ph.D. degree May 2018. We also expect Reuel to gain research experience that motivates him to pursue a graduate degree in marine science. Reuel is expected to complete his undergraduate degree in Biology on December 2018. Currently, Reuel has applied to the LSAMP program at UMES and will be applying to the MEES program Fall 2019 semester.

Project Number: 18-07

Project Title: Cold-water corals in the Mid-Atlantic Bight: Age, colony complexity, and growth

Project Abstract: Sea whips (*Leptogorgia virgulata*) are a common structural component of benthic habitats found in the DelMarVa region of the Mid-Atlantic Bight, and may serve as essential fish habitat for commercially valuable species. However, they are slow-growing, easily damaged, and especially vulnerable to damage by passive fishing gear. Despite their potential importance and fragility, sea whips are generally understudied in this region. We proposed to examine the age, colony complexity, growth, and regrowth after damage of sea whips from 4 sites in the DelMarVa region. Previously collected corals from two sites in 2017 showed no significant differences in the bifurcation (R_b) and tributary to source (T/S) ratios, and the R_b ratios indicate that

for each branch of a given order there are approximately 3 branches in the next lower order. Age was significantly different between sites, with corals ranging between 2-9 years at one and 4-15 at the other. 24 corals were also previously tagged, and 5 damaged, in 2017. So far in the summer of 2018, 43 corals have been tagged, 28 collected, with plans to tag and collect approximately 30 more. Data provided by this project will help fill the large knowledge gap concerning coral habitats that exists in the coastal DelMarVa region, and the baseline created will be a useful reference to study changes over time. This also relates to NOAA's goal to improve our understanding of ecosystems to inform resource management decisions, especially if sea whips were to become a managed species.

Thematic Area Addressed: Stock Assessment Support

Lead Scientist(s): Rebecca Wenker (MS, University of Maryland Eastern Shore)

NOAA Collaborator(s): Vince Guida (NOAA, NMFS)

LMRCSC Collaborator(s): Bradley Stevens (University of Maryland Eastern Shore), Daniel Cullen (LMRCSC Postdoctoral Fellow, University of Maryland Eastern Shore)

LMRCSC Research Student(s): Rebecca Wenker (MS, UMES)

Start Date: 1 May 2018

End Date: 30 April 2019

Scientific Merit: As of mid-September 2018, we have been able to tag and measure an additional 43 corals to those we tagged in 2017. By the end of the month, we plan to return to the Memorial Barge site to re-measure the corals we tagged and damaged there in 2017, to determine their growth over that period. We have also collected 28 corals from a new site, the Sussex wreck, offshore of Ocean City, MD. These corals are currently being analyzed for their colony complexity and age. By the end of September, we will have collected about 30 more corals from a new site which will undergo the same analysis. Rebecca plans to work with Dr. Vince Guida at the NOAA Northeast Fisheries Science Center J.J. Howard Laboratory in Sandy Hook, New Jersey, beginning in October 2018, for her NERTO, where she will review a large database of existing acoustic, visual image, and trawl survey data maintained by the J.J. Howard Laboratory Image Analysis Group. Information will be examined for the distribution of hard-bottom habitats in the Mid-Atlantic Bight and presence of sea whips, which will help us define locations where sea whips occur.

Products:

Wenker, R. and B. Stevens. 2018. Cold-water corals in the Mid-Atlantic Bight: Age, colony complexity, and growth. Presented at the 148th Annual Meeting of the American Fisheries Society, Atlantic City, NJ. August 19-23, 2018. Poster.

Relevance: Data provided by this project will help fill the large knowledge gap concerning coral habitats that exists in the coastal DelMarVa region. While Alcyonacean corals are not Federally managed species, they may be critical components of essential fish habitat for black sea bass (*Centropristis striata*), tautog (*Tautoga onitis*), and lobster (*Homarus americanus*). Increasing our knowledge about their growth and resilience could benefit the managed species they already support. This aligns with NOAA's goal of assessing and defining the essential characteristics of marine habitats, understanding the potential impacts of fishing on sensitive coral habitats, and improving long-term sustainability of fisheries. Additionally, at present the distribution and extent of nearshore hard-bottom habitat is poorly documented, which prohibits the ability to characterize and map important fish habitat. Such information will be highly useful to help define and manage essential fish habitat that cannot be sampled with fish trawls. Socio-economic benefits include knowledge of the biology of habitats that support fisheries, and impacts of habitat damage on the economies/communities that depend on them. Results of this study should result in at least one peer-reviewed publication, and will help develop a baseline of information about Alcyonacean corals in this region.

Broader Impacts: This project will facilitate direct interaction and collaboration between students from the University of Maryland Eastern Shore, scientists (NOAA mentor and UMES faculty), and industry collaborators (dive boat operators). This work will also serve as the basis for Rebecca Wenker's Master's Thesis, which she will defend no later than Spring 2019. Ultimately, this project will also result in at least one peer-reviewed publication, and the development of maps and a potential model predicting the distribution of alcyonacean corals in the Mid-Atlantic region.

Project Number: 18-08

Project Title: Genetic-based methods for assessing prey composition and feeding ecology of Pacific lampreys

Project Abstract: The Pacific lamprey (*Entosphenus tridentatus*) is an anadromous species that occurs throughout the Northern Pacific Ocean and is important to humans for at least two key reasons: 1) Indigenous peoples near the Columbia River have a cultural value for them as a ceremonial food item, and 2) during their marine phase, lampreys parasitize many fish species and may reduce commercial harvests (e.g., Pacific hake, walleye pollock). Although culturally important, vulnerable (freshwater modifications reduce larval habitats), and ecologically interesting (parasites can exhibit dramatic fluctuations in abundance), the basic biology of Pacific lamprey in marine waters has not been well documented. The goal of this study is to identify prey items of Pacific lampreys and characterize their feeding ecology in the Northeastern Pacific Ocean in, particularly where they overlap with commercially-targeted species (e.g., Pacific hake, shrimps).

Thematic Area Addressed: Stock Assessment Support

Lead Scientist(s): Eric Lewallen (Hampton University)

NOAA Collaborator(s): Linda Weitkamp (NOAA/NMFS); Linda Park (NOAA/NMFS)

LMRCSC Collaborator(s): Carolina Bonin Lewallen (Hampton University)

LMRCSC Research Student(s): Janelle Layton (UG, Hampton University), Patricia S Montalvo-Rodriguez (MS, Hampton University, expected to start 1 June 2019)

Start Date: 1 Sept 2018

End Date: 31 August 2020

Scientific Merit: The Pacific lamprey (*Entosphenus tridentatus*) is an ancient (>100 million years), parasitic species with a complex anadromous life cycle. Reproductive adults migrate into freshwater during spring months, and spawn a year later. The larvae develop in freshwater and are consumed by a variety of predators including fishes inhabiting coastal tributaries (Renaud 1997; Cochran 2009). After developing in freshwater, young Pacific lampreys migrate to sea where they spend 3-4 years feeding primarily on fishes, before re-entering freshwater to spawn (Beamish, 1980; Beamish and Levings, 1991). Surprisingly, very little is known about the Pacific lamprey feeding ecology; including diet composition and prey preferences (Murauskas et al. 2013). Although lamprey parasitism has been known to fishermen and indigenous communities for centuries, its impact on commercial fisheries has never been formally assessed. This information is a crucial component to accurate modeling of ecosystem-based fishery management in the North Pacific Ocean. In addition to their ecological impacts on North Pacific Ocean fisheries, Pacific lampreys have unique cultural value to humans. Indigenous tribes of the mid-Columbia River Plateau traditionally harvest these animals, which formulate an important cultural identification icon (Close et al., 2002). Indigenous peoples were the first to highlight Pacific lamprey conservation issues that were later corroborated by risk assessment analyses (Wang & Schaller, 2015). Due to their value in indigenous cultures across the Pacific Northwest and critical ecological role in marine ecosystems, the conservation and management of Pacific lampreys has received special attention from the U.S. Fish & Wildlife Service, which established the Pacific Lamprey Conservation Initiative. This initiative includes the participation of multiple stake-holders who are signatory parties for the Pacific Lamprey Conservation Agreement in effect since 2012. Pacific lampreys are commonly caught in marine waters during fishery-independent surveys conducted by NOAA

Fisheries' Northwest and Alaska Fisheries Science Centers and by commercial fisheries that NOAA Fisheries regulates. However, it is unclear how lamprey's role as parasitic predators affects marine ecosystems. NOAA researchers also regularly catch Pacific and Western River (*Lampetra ayresii*) lampreys in the Columbia River estuary, including the collection of lamprey-wounded fish specimens. Documented fish species with lamprey wounds include: non-native American shad (*Alosa sapidissima*), sub-yearling Chinook salmon (*Oncorhynchus tshawytscha*), shiner perch (*Cymatogaster aggregata*), and Pacific herring (*Clupea pallasii*; Weitkamp et al., 2015). However, the species or types (i.e., pelagic vs. demersal) of fish parasitized by lamprey in marine waters, or their impacts to commercial species is poorly known. Our goal is to use genetic methods to investigate prey items from the gut contents of Pacific lampreys collected in marine habitats, providing a complete characterization of their diets and feeding ecology.

To date, we have obtained >250 Pacific lamprey specimens from NWFSC collaborator Dr. Weitkamp, 20 of which have been mailed to Hampton University for dissection, gut fullness measurement and genetic analysis. Basic dissection equipment have been purchased (e.g., scale, calipers, dissecting scissors) to begin dissections. Preliminary data indicate comparatively high gut fullness indices among juvenile lampreys collected as bycatch alongside the Pacific Hake fishery.

Products: Publications or presentations at regional, national, or international meetings?

Layton JM, Bonin CA, Pressley N, Park LK, Weitkamp LA, Lewallen EA. Genetic-based methods for assessing prey composition and feeding ecology of Pacific lampreys. 23rd Annual School of Science Research Symposium, Hampton University, Hampton, VA April 11-12, 2018.

Layton JM, Bonin CA, Pressley N, Park LK, Weitkamp LA, Lewallen EA. Genetic-based methods for assessing prey composition and feeding ecology of Pacific lampreys, 9th Biennial NOAA EPP Science and Education Forum. Howard University, Washington, DC, March 18-21, 2018.

Relevance: As stated in the RFP for this funding mechanism: "The LMRCSC will conduct research that supports stock assessment of fish, invertebrates, and marine mammals, by describing and understanding population abundance, migration and distribution patterns, predator-prey relationships, habitat use, age structure, growth, mortality, reproductive biology and behavior, and responses to environmental variability." We will specifically provide fundamental data for the direct assessment of Pacific lampreys by analyzing predator-prey relationships and habitat use, as well as distribution patterns. As a research program, we have the ability to perform large-scale training in laboratory-based genetics, gut content analysis, and forensics for students at Hampton University. In addition, we will provide students with opportunities for field-based research during ongoing lamprey collection efforts.

Broader Impacts: During the first year of this project we will finalize specimen collections and sample processing (e.g., voucher preservation, gut dissection, and gut content preservation). The master's student included (Patricia S Montalvo-Rodriguez) is expected to join the research team in June of 2019, and will carry out genetic analyses. Ms. Montalvo-Rodriguez will complete a 3 month internship at the NOAA Northwest Fisheries Science Center. The second year of this project will be focused on collecting any remaining data, analysis of genetic and geospatial data, preparation of manuscripts, and presenting the results of our work at a national fisheries research conference (e.g., AFS). The master's student will be expected to graduate in May 2021 from the Department of Marine and Environmental Science at Hampton University.

Project Number: 18-10

Project Title: Feeding Ecology of Black Sea Bass Using Gut Content and Stable Isotope Analyses.

Project Abstract: Food habits of black sea bass (BSB, *Centropristis striata*) have been studied from trawl surveys in the Mid-Atlantic Bight, but no studies have compared food choices between specific habitats or locations. We sampled BSB at selected natural and artificial reefs near Ocean City, MD using hook-and-line angling to determine how habitat preferences influenced length frequencies, sex ratio, dietary preferences, and stable isotope ratios of $\delta^{12}\text{C}/\delta^{13}\text{C}$ and $\delta^{14}\text{N}/\delta^{15}\text{N}$. Stomach content analysis, and stable isotope analyses of muscle, liver, and mucus were used to determine whether diets varied significantly between sampling locations. Preliminary results indicate that crustaceans dominate diets of BSB by frequency of occurrence. Additionally, $\delta^{15}\text{N}$ in liver did not vary between three sampled sites. Sample size analysis showed that the number of preliminary samples were too small to detect differences $>0.3\text{‰}$ and a minimum sample size of 100 fish is required. This data will help to understand how BSB utilize different habitat types, and the contribution of reef habitats to BSB populations in the Mid-Atlantic Bight.

Thematic Area Addressed: Healthy Habitats

Lead Scientist(s): Dr. Brad Stevens, Andre Price (MS, UMES).

NOAA Collaborator(s): Dr. Richard McBride, NOAA NEFSC.

LMRCSC Collaborator(s): Dr. Maurice Crawford. Graduate committee member, UMES

LMRCSC Research Student(s): Andre Price (MS, UMES)

Start Date: 1 March 2018

End Date: 30 December 2018

Scientific Merit: Preliminary results of stomach analysis revealed crustaceans as the primary prey item of Black Sea Bass in frequency and weight. A power analysis of liver and muscle delta values from 2016 revealed that a minimum of 100 tissues per site were required to detect a difference of 0.3 per mil. No significant differences were shown in $\delta^{15}\text{N}$ in liver samples amongst sites. Approximately 400 fish were caught in 2017 to meet this requirement and were subsequently destroyed in a lab accident. This year (2018) a total of 300 Black Sea Bass were caught in the resampling effort. Liver, muscle, and mucus samples from this year are still out for analysis; results should arrive by the end of September, 2018. Andre is currently completing his NERTO at the NEFSC in Woods Hole, MA, where he is completing analysis of stomach samples and otoliths.

Products: Publications or presentations at regional, national, or international meetings?

Andre L. Price, Cara Schweitzer, Bradley G. Stevens. Comparing Localized Feeding Ecology of Black Sea Bass (*Centropristis striata*) at Selected Reefs Using Gut Content and Stable Isotope Analyses. National Oceanographic and Atmospheric Administration Educational Partnership Program (NOAA EPP) Education and Science Forum 2018. Washington, DC.

Relevance: This research is relevant to NOAA Fisheries' goal to maintain healthy oceans and habitats as well as sustainable fisheries. Specifically, this research will provide local age data from two reef locations in the Ocean City, Maryland area. These reefs are not directly sampled by NOAA trawl surveys due to site bathymetry; this project will provide size, sex, and age (in 2018) of fish directly sampled from the reef sites. In addition, this work may help detect differences in diet between natural and artificial habitats, and whether those diets change with ontogeny, sex, or location.

Broader Impacts: The broader impacts of this project included direct and regular engagement with commercial fishermen, as well as with undergraduate students supported by NOAA's LMRCSC. Two undergraduate students supported by the NSF REU program worked directly with Andre and received training on dermal mucus sampling. Andre will also complete his NERTO internship during the months of September through December, with an expected graduation date of December 2018. It is our goal that the NERTO internship will help build on necessary skills that are required for federal employment.

Project Number: 18-11

Project Title: Assessment of Microplastics and Polybrominated Diphenyl Ethers (PBDEs) in Scallops as Possible Indicators of Plastic Pollution from the Georges Bank, Mid-Atlantic, Southern New England, and Gulf of Maine Stock Fisheries

Project Abstract: Plastic fragments, pellets, fibers and cosmetic beads less than 5 mm in size are termed as microplastics. These are emerging contaminants that in recent years have been found in tap water samples all over the world and in a vast array of aquatic organisms with the possibility of toxic effects in them. The focus of this research will seek to understand the following: (1) If there are microplastics present in the Atlantic sea scallop stock banks across the east coast of the United States. Multiple studies have implied that polybrominated diphenyl ethers (PBDEs), persistent bioaccumulative fire-retardant pollutants, in fish tissues display positive correlations with geographic plastic debris densities. (2) We will examine if this linear relationship also exists in a benthic environment using sea scallops as model organism. Briefly, micropolymer assays will be conducted using an efficient extraction method in which scallop tissues will be divided into muscle, respiratory system and gastrointestinal tract before digestion and visual quantification of microplastics. Scallop and bottom water column samples will be collected from multiple regions across Georges Bank and Mid-Atlantic Bight. Tissues will be tested for PBDEs while plastic debris will be examined in the water samples. Since sea scallops are important commercial organisms with fisheries dredging over 50 million pounds annually for seafood consumption, our research directly contributes to NOAA's goal to conserve and manage coastal and marine ecosystems and resources by providing the scientific foundation for understanding many future studies of the dangers microplastics can have on important ecological commercial species.

Thematic Area Addressed: Healthy Habitats

Lead Scientist(s): Enid C. Muñoz Ruiz (MS, University of Maryland Eastern Shore)

NOAA Collaborator(s): Ashok Deshpande (NOAA/NEFSC); Beth Sharack (NOAA/NEFSC)

LMRCSC Collaborator(s): Ali Ishaque (University of Maryland Eastern Shore)

LMRCSC Research Student(s): Enid C. Muñoz Ruiz (MS, UMES)

Start Date: 1 June 2018

End Date: 30 December 2019

Scientific Merit: As of mid-September 2018, scallop and bottom water column samples were dredged and the starting materials needed to accomplish the PBDE goal have been purchased. The Atlantic sea scallops were collected in the Mid-Atlantic Bight and Georges Bank through the NOAA NEFSC Ecosystems Survey Branch aboard the Hugh R. Sharp from May 16-June 18, 2018. A total of 483 sea scallops were dredged along with 8 water samples; scallop ages range from 2-6-year olds. PBDE extractions are very complex and thus, most of the time this summer has been spent conversing with experts to perfect the method and establish the ideal parameters in order to perform the analysis. Experts who have been consulted are Dr. Peter Straub (Stockton University) for a collaboration using a scientific freeze-dryer; Dr. Wade McGillis (Lamont-Doherty earth Observatory – Columbia University) for a collaboration to use their particle counter coupled with a Raman spectrometer; Dr. Suresh Seethapathy (Thermo Fisher Scientist) to clarify questions for about the best ion source and necessary part numbers that need to be purchased for the Thermo Scientific Trace 1310 Gas Chromatograph – TSQ 8000 Evo Triple Quadrupole Mass Spectrometer and Dr. Scott Gallagher (Woods Hole Oceanographic Institution) for questions on microplastic polymer identification. In addition, next week we will meet with Dr. Stephen Lahotay (US Department of Agriculture) for modifications and improvements to the QUECHERS extraction method. Extractions should begin within the next month.

Products: None to date.

Relevance: NOAA's mission is to "provide vital services for the nation: productive and sustainable fisheries, safe sources of seafood, the recovery and conservation of protected resources, and healthy ecosystems—all backed by a sound science and an ecosystem-based approach to the

management". This research supports NOAA's Fisheries mission, because it looks into the effects that these emerging contaminants with the potential to carry toxicants can have on organisms and ecosystems. Specifically, the outcomes are to: (1) Determine if Atlantic sea scallops, a very important commercial species, are contaminated with microplastics, (2) if plastics are present, determine if they would be potentially available for trophic transfer or consumption by humans, (3) determine if weathering of plastics causes PBDEs to leach from them and bioaccumulate in the fatty tissues of sea scallops, and (3) estimate PBDE concentrations, potential human carcinogens, in Atlantic sea scallops.

Broader Impacts: With this extensive and arduous research, we hope that Enid Muñoz-Ruiz will obtain the experience, knowledge and requirements to fulfill her Master's degree in Aquatic Toxicology at the University of Maryland Eastern Shore and furthermore, open many doors in her career. The course work, field and research experience, in addition, with the many meetings and collaborations will instill in her a sense of networking and interdisciplinary approach in the scientific community when it comes to developing ideas for projects she pursues in the future. Enid is considering expanding this project as a doctoral fellow.