



**Performance Report for Cooperative Agreement No: NA16SEC4810007  
for the Period from March 1, 2019 to August 31, 2019**

**University of Maryland Eastern Shore**

## **Living Marine Resources Cooperative Science Center**

**Paulinus Chigbu, Ph.D. (Principal Investigator & Director, LMRCS)**  
**Bradley Stevens (Co-Principal Investigator & Distinguished Research Scientist)**  
University of Maryland Eastern Shore (Lead Institution)

**Stacy Smith, Ph.D. (Co-Principal Investigator)**  
Delaware State University

**Deidre Gibson, Ph.D. (Co-Principal Investigator)**  
Hampton University

**Dionne Hoskins, Ph.D. (Co-Principal Investigator)**  
Savannah State University

**Jessica Miller, Ph.D. (Co-Principal Investigator)**  
Oregon State University

**Rosemary Jagus, Ph.D. (Co-Principal Investigator)**  
University of Maryland Center for Environmental Science, IMET

**Elizabeth Babcock, Ph.D. (Co-Principal Investigator)**  
RSMAS/University of Miami

# 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. During this period, recruitment activities focused on recruiting qualified undergraduates from existing student populations at partner institutions. We also have plans for recruitment of potential graduate students at SACNAS and AFS meetings in fall 2019.

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

The Center held the second “Literacy in NOAA mission related disciplines: A cohort experience” workshop April 1-5, 2019 at UMES. 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 Held from April 1 to 5, 2019

Day	Morning Session - 8:30 am to Noon	Professional Development Session 1:00 pm - 2:30pm	Afternoon Session 2:45 - 6pm
Monday April 1, 2019	Welcome – Dr. Paulinus Chigbu (UMES)  Grant Writing Introduction - Dr. Bradley Stevens (UMES)  Sustainable Aquaculture - Dr. Rosemary Jagus (IMET)	Cooperation and Collaboration in the Research Environment - Dr. Dionne Hoskins-Brown (SSU)	Sustainable Aquaculture - Dr. Rosemary Jagus (IMET)
Tuesday April 2, 2019	Stock Assessment – Speakers: Dr. Elizabeth Babcock (RSMAS)	Time Management/ Professional Communication – Dr. Victoria Young (SSU)	Stock Assessment - Dr. Larry Alade (NOAA)
Wednesday April 3, 2019	Ecosystems Science - Speakers/Instructors - Dr. Jessica Miller (OSU); Dr. Chris Harvey (NOAA), Dr. Brian Wells (NOAA)	Grant Writing Collaboration work period - Dr. Bradley Stevens (UMES)	Ecosystems Science - Speakers/Instructors - Dr. Jessica Miller (OSU); Dr. Chris Harvey (NOAA), Dr. Brian Wells (NOAA)
Thursday April 4, 2019	Human Dimensions – Kelly Beidenweg (OSU)	Molecular Tools for the Environmental Biologist– Dr. Rosemary Jagus (IMET)	Human Dimensions – Kelly Beidenweg (OSU)
Friday April 5, 2019	Hands on experience: Deal Island field trip	Grant writing student team presentations	

**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 LMRCS 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. Shadaesha Green (Ph.D. student, UMCES-IMET) is the second Scott B. Gudes Public Service Scholar in Marine Resource Conservation. Plans are underway for the selection of the 3<sup>rd</sup> Gudes Public Service Scholar before the end of fall 2019.

**Research Goal:**

Seven (7) collaborative research proposals were recommended for funding in 2018-2019 following TAB review; 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. Two 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; five of the lead PIs are graduate students who through the TAB process have gained experience on how to prepare proposals.

**Table 2. TAB projects funded for FY 2019**

Project #	Principal Investigator	Title	Theme
19-01	Sook Chung & A. Lawrence (UMCES-IMET)	Baseline data on environmental impacts on physiological and molecular parameters determining growth for commercially valuable decapod crustacean management	Stock Assessment Support
19-02	Shanelle Haughton (UMES)	Evaluating physiological and immune responses of snow crabs ( <i>Chionoecetes</i> sp.) to <i>Hematodinium</i> infection	Climate and Ecosystems
19-03	Amanda Pappas (DSU)	Ecological investigation of a toxic harmful algal bloom species ( <i>Dinophysis acuminata</i> ) and its potential impact to the aquaculture industry of Delaware Inland Bays	Stock Assessment Support
19-04	Rose Jagus (UMCES-IMET)	Validation of Monkfish Age and Growth Using Microconstituent Analysis of Hard parts	Stock Assessment Support
19-05	Keala Pelekai (OSU)	Evaluation of age, natal origin, and trophic history of Pacific Lamprey ( <i>Entosphenus tridentatus</i> )	Stock Assessment Support
19-06	Hillary Thalmann (OSU)	Thermal impacts on juvenile Pacific Cod ( <i>Gadus macrocephalus</i> ) foraging and growth in Gulf of Alaska nursery habitats	Stock Assessment Support
19-07	Adrienne Wilson (RSMAS)	Population structure and growth of lane snapper, a data limited species.	Healthy Habitats

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 2019. Nine students are enrolled in it.

**Ethical Conduct of Research Training for Students and Faculty:**

All center students are required at a minimum to complete online CITI Responsible Conduct of Research courses. The certificate of completion is submitted with the Student Development Form. In addition, graduate students at RSMAS, UMES, and UMCES are required to take a course in scientific ethics.

**Administration Goals:**

- a) Post-doctoral Fellow, Matt Kenworthy, was hired at SSU. He has been added to the Research Committee and SSU LMRCSC leadership.
- b) The Center conducted its monthly Executive Committee meetings, and Science Committee meetings
- c) The LMRCSC held its Science meeting on Friday, June 14, 2019 at NOAA Headquarters.
- d) The LMRCSC has continued to disseminate information on the accomplishments of the Center through presentations at scientific meetings, updating of the website and production of the summer 2019 electronic newsletter.

## 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-two (22) students have been identified/recruited as members of Cohort 2 (2017-2018) including 7 Ph.D., 7 M.S., and 8 B.S. students. Seventeen (17) students have been identified/recruited as members of Cohort 3 (2018-2019) including 3 Ph.D., 4 M.S. and 10 B.S. students. So far, nine (9) students including 2 Ph.D., 5 M.S., and 2 B.S. students have been recruited into Cohort 4. Recruitment for this period is on-going.

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

Consistent with our goal specified in the Implementation Plan, one rising sophomore from a center institution, Erianna Hammond (B.S. student, SSU) was supported in a summer internship in 2019. Those students along with all sophomore undergraduates supported by the center, and unsupported students at partner institutions have and will continue to receive guidance regarding applications to the Hollings and NOAA EPP Undergraduate Scholarships. Additionally, LMRCSC supported scientists and staff organized a 6 week summer 2019 Geoscience Bridge Program at UMES as a pipeline for recruitment of students into the Center. Seven students participated in the program after which 3 of them enrolled at UMES; one student enrolled at HU. Another student with interest in Atmospheric science enrolled at Jackson State University, one student enrolled at Florida A&M University, and another student enrolled at North Carolina A&M University.

**Scott B. Gudes Public Service Graduate Scholarship in Marine Resource Conservation:** Ms. Shadaesha Green (Ph.D. student, UMCES) is the Scott B. Gudes Public Service Scholar in Marine Resource Conservation. We will select the next Gudes Scholar in the next reporting period.

**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 April 1-5, 2019 at UMES. Students participated in a variety of activities described in Table 1. Feedback from the students and instructors will be used to improve the Cohort Experience workshop.
- b) Data Management course is being taught in Fall 2019; and
- a) Education Expert Dr. Victoria Young has planned online forums for LMRCSC students to discuss the center and ask questions about requirements and expectations. They will be held on September 10 and 25, 2019
- b) Professional Development workshops were offered by Dr. Maggie Sexton biweekly for undergraduate students, and monthly for graduate students during the academic year at UMES.
- c) PIs at HU, OSU, SSU, and UMCES report holding regular lab meetings with Center students.

#### **Research Goals:**

Seven collaborative proposals (Table 2) were funded/selected for funding 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) The Center held its monthly Executive Committee meetings during which plans to execute student development and professional activities were discussed.
- b) The LMRCSC Center Core Administration Committee met on August 29, 2019 at UMES. Accomplishments from this meeting include:
  - Introduced new administrators (Provost & Vice President for Academics, and Vice President for Finance and Administration) at UMES to the Center
  - Discussed challenges and ways that the university can help to address them
  - Discussed future university support of Center activities

#### **4. Key outcomes or other achievements:**

- a) A total of 71 students (23 in Cohort 1, 22 in Cohort 2, 17 in Cohort 3, 9 in Cohort 4) have been recruited to the Center
- b) External Evaluation of the LMRCSC by Tina Bishop and Howard Walters from the College of Exploration (COE) 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.

- 9 students enrolled in the Data Management for Scientists course that was offered in fall 2019.
- Twelve (12) students took part in NERTO internships at NOAA facilities under the supervision of NOAA scientists.

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

- LMRCSC scientists and students had 27 publications of which 2 were co-authored by students; one publication was submitted for review, and 4 theses/dissertations were produced (Tables 3a-c). They also made 50 presentations of their work at professional conferences including 29 by students (see Tables 4a and 4b).
- Graduate students gave 5-minute talks at the annual LMRCSC Science Meeting held at NOAA Headquarters in June 2019.
- At RSMAS, one PhD student participated in the ICCAT mako shark assessment

#### **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 9 students have been recruited into Cohort 4, including 2 Ph.D., 5 M.S. and 2 B.S.
- b) Begin planning for the next workshop on Literacy in NOAA related sciences for spring 2021.
- c) Work with sophomores supported during the Summer 2019, as well as other sophomores recruited during Fall 2019 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) Solicit proposals to fund through the TAB process
- 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) Plan the LMRCSC Board of Visitors (BOV) meeting for November 5, 2019 to be held at University of Miami.

## 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: The center awarded 9 degrees during the current funding period including 4 B.S., 3 M.S., and 2 Ph.D. They are listed below.**

First	Last	Degree	Partner
Nakia	Coit	B.S.	UMES
Kendra	Dorsey	B.S.	HU
Dante	Freeman	B.S.	SSU
Nefertiti	Smith	B.S.	HU
Brian	Galvez	M.S.	DSU
Andre	Price	M.S.	UMES
Rebecca	Wenker	M.S.	UMES
Jorge	Rodriguez	Ph.D.	UMES
Cara	Schweitzer	Ph.D.	UMES



### Publications in Journals:

Tables 3 and 4 contain manuscripts published during this period and those currently under review. A justification of how each manuscript is associated with the LMRCSC is included to the right of the citation.

**Table 3a. Twenty-seven (27) publications (2 student authors identified by \*) produced by the Center; LMRCSC scientists are in bold**

Publications in journals	Justification	Status
<b>Bachvaroff, T.R.</b> (2019). A precedented nuclear genetic code with all three termination codons reassigned as sense codons in the syndinean <i>Amoebophrya</i> sp. ex <i>Karlodinium veneficum</i> . PLoS One, 14(2), e0212912.	Leveraged	Published
Bond, M.E., Valentin-Albanese, J., <b>Babcock, E.A.</b> , Heithaus, M.R., Grubbs, R.D., Cerrato, R., Peterson, B.J., Pikitch, E.K. & Chapman, D.D. (2019). Top predators induce habitat shifts in prey within marine protected areas. <i>Oecologia</i> doi:10.1007/s00442-019-04421-0	Leveraged	Published
Brill, R.W., <b>Horodysky, A.Z., Place, A.R.</b> , Larkin, M.E.M. & Reimschuessel, R. (2019). Effects of dietary taurine level on visual function in European sea bass ( <i>Dicentrarchus labrax</i> ). PLoS One, 14(6), e0214347.	TAB	Published
<b>Chung, J.S.</b> , Huang, X.S., <b>Bachvaroff, T.R.</b> , <b>Lawrence*, A;</b> <b>Pitula, J.S. &amp; Jagus, R.</b> (2019). Reovirus changes transcript levels of eukaryotic translation initiation factor eIF4E family Members and eIF4E-binding protein (4E-BP) in the blue crab, <i>Callinectes sapidus</i> . <i>Journal of Shellfish Research</i> . 38:23-34.	Leveraged	Published
Cruz-Marrero, W.* , <b>Cullen, D.W.</b> , Gay, N.R. & <b>Stevens, B.G.</b> (2019). Characterizing the benthic community in Maryland's offshore wind energy areas using a towed camera sled: Developing a method to reduce the effort of image analysis and community description. PLoS ONE 14(5):e0215966.	Leveraged; LMRCSC PI	Published
Gonsior, M.; Powers, L.C.; Williams, E.; <b>Place, A.; Chen, F;</b> Ruf, A; Hertkorn, N. & Schmitt-Kopplin, P. (2019). The chemodiversity of algal dissolved organic matter from lysed <i>Microcystis aeruginosa</i> cells and its ability to form disinfection by-products during chlorination. <i>Water Research</i> . 155:300-309.	Leveraged	Published
Lennox RJ, <b>Secor, DH</b> & 29 co-authors (2019). One Hundred Pressing Questions on the Future of Global Fish Migration Science, Conservation, and Policy. <i>Frontiers in Ecology and Evolution</i> <a href="https://doi.org/10.3389/fevo.2019.00286">https://doi.org/10.3389/fevo.2019.00286</a>	Leveraged	Published
Pecher, W.T., Al Madadha, M.E., DasSarma, P., Ekulona, F., <b>Schott, E.J.</b> , Crowe, K. et al. (2019). Effects of road salt on microbial communities: Halophiles as biomarkers of road salt pollution. PLoS One, 14(9), e0221355.	Leveraged	Published
Rooker, J.R., Dance, M.A., Wells, R.J.D., Ajemian, M.J., Block, B.A., Castleton, M.R., <b>Secor, D.H.</b> et al. (2019). Population connectivity of pelagic megafauna in the Cuba-Mexico-United States triangle. <i>Sci Rep</i> , 9(1), 1663.	Leveraged	Published

Rosenberger, A., C. Zimmerman, D. Noakes, R. Taylor, E. Keeley, J. Musick, R. Phillips, <b>A. Horodysky</b> , M. Neilson, T. Ray, & J. Neilson. Salmonidae. In: Diversity of North American Freshwater Fishes: Natural History, Ecology, and Conservation, Volume II.	LMRCSC TAB recipient	Published
Roux, S, Trubl, G, Couradeau, E, Ahlgren, NA, <b>Marsan*, D, Chen, F</b> , Fuhrman, JA, & Elie-Fadrosh, EA. (2019). Optimizing <i>de novo</i> genome assembly from PCR-amplified metagenomes. Peer J, doi.org/10.7287/peerj.	Leveraged	Published
<b>Schott, E.J.</b> , Di Lella, S., <b>Bachvaroff, T.R.</b> , Amzel, L.M. & Vasta, G. R. (2019). Lacking catalase, a protistan parasite draws on its photosynthetic ancestry to complete an antioxidant repertoire with ascorbate peroxidase. BMC Evol. Biol., 19(1), 146.	Leveraged	Published
Schweitzer, C.C.* & <b>Stevens, B.G.</b> (2019). The relationship between fish abundance and benthic community structure on artificial reefs in the Mid-Atlantic Bight, and the importance of sea whip corals <i>Leptogorgia virgulata</i> . Peer J. 7:e7277.	Leveraged; LMRCSC PI	Published
Schweitzer, C.C.*, Lipcius, R.N. & <b>Stevens, B.G.</b> (2018). Impacts of a multi-trap line on benthic habitat containing emergent epifauna within the Mid-Atlantic Bight. ICES Journal of Marine Science: fsy109-fsy109.	Leveraged; LMRCSC PI	Published
<b>Secor, D.H.</b> ; Zhang, F; O'Brien, MHP. & Li, M. (2019). Ocean destratification and fish evacuation caused by a Mid-Atlantic tropical storm. ICES Journal of Marine Science. 76: 573-584.	Leveraged	Published
Sharma, R., Porch, C.E., <b>Babcock, E.A.</b> , Maunder, M.N. & Punt, A. E. (2019). Recruitment: Theory, estimation, and application in fishery stock assessment models. Fisheries Research 217: 1-4. doi: /10.1016/j.fishres.2019.03.015.	Leveraged	Published
Spitznagel, MI; Small, HJ; Lively, JA; Shields, JD; <b>Schott, E.J.</b> (2019). Investigating risk factors for mortality and reovirus infection in aquaculture production of soft-shell blue crabs ( <i>Callinectes sapidus</i> ). Aquaculture. 502:289-295.	Leveraged	Published
Tewfik, A., <b>Babcock, E.A.</b> , Appeldoorn, R.S., & Gibson, J. (2019). Declining size of adults and juvenile harvest threatens sustainability of a tropical gastropod, <i>Lobatus gigas</i> , fishery. Aquatic Conservation: Marine and Freshwater Ecosystems 2019:1-21. doi: 10.1002/aqc.3147	Leveraged	Published
Walters, T.L. <sup>1,2</sup> , Lambole, L.M. <sup>1,2</sup> , López-Figueroa, A.B. <sup>3†</sup> , Rodríguez, A. <sup>3‡</sup> , <b>Gibson, D.M.</b> <sup>3</sup> & Frischer, M.E. <sup>1*</sup> (2019). Diet and trophic interactions of a globally significant gelatinous marine zooplankter, <i>Doliolietta gegenbauri</i> (Uljanin, 1884). Molecular Ecology, 28:176–189.	LMRCSC HU PI	Published
Tizabi, D., Sosa, A., <b>Bachvaroff, T. &amp; Hill, R.T.</b> (2019). Draft genome sequences of three sponge-associated actinomycetes exhibiting antimycobacterial activity. Microbiol. Resour. Announc. 8:e00858-19.	Leveraged	Published
Walters, T.L., <b>Gibson, D.M.</b> , Frischer, M.E. (2019). Cultivation of the Marine Pelagic Tunicate <i>Doliolietta gegenbauri</i> (Uljanin 1884) for Experimental Studies. J. Vis. Exp. (150), e59832, doi:10.3791/59832	LMRCSC HU PI	Published
Wright, D.A., Mitchelmore, C., <b>Place, A.R.</b> , Williams, E.P. & Orano-Dawson. (2019). Genomic and microscopic analysis of ballast water in the Great Lakes Region. Applied Sciences, 9, 2441.	Leveraged	Published

Zan, J., Li, Z., Tianero, M.D., <b>Davis, J.*</b> , <b>Hill, R.T.</b> & Donia, M.S. (2019). A microbial factory for defensive kahalalides in a tripartite marine symbiosis. <i>Science</i> 364: eaaw6732 DOI: 10.1126/science.aaw6732	Leveraged	Published
Zhao, Z., Gonsior, M., Zhang, R., Zhan, Y., Jiao, N. & <b>Chen, F.</b> (2019). Microbial transformation of virus-induced dissolved organic matter from picocyanobacteria: coupling of bacterial diversity and DOM chemodiversity. <i>ISME Journal</i> , 13: 2551-2565.	Leveraged	Published
<b>Chigbu, P.</b> , Malinis, L., Malagon, H.* & Doctor, S. (2019). Influence of temperature on the occurrence and distribution of sand shrimp ( <i>Crangon septemspinosa</i> ) in mid-Atlantic Coastal Lagoons. <i>Journal of Crustacean Biology</i> . 39(5): 586-593.	LMRCSC UMES PI	Published
Oghenekaro, E.U.* & <b>Chigbu, P.</b> (2019). Population dynamics and life history of marine Cladocera in the Maryland Coastal Bays. <i>Journal of Coastal Research</i> . In Press.	LMRCSC UMES PI	Published
Oseji, O.F.*, Fan, C. & <b>Chigbu, P.</b> (2019). Composition and dynamics of phytoplankton in the Coastal Bays of Maryland revealed by microscopic counts and diagnostic pigments. <i>Water</i> (In Press). <a href="http://dx.doi.org/10.3390/w11020368">http://dx.doi.org/10.3390/w11020368</a> .	LMRCSC UMES PI	Published

**Table 3b. One (1) publication under review or accepted (1 student author identified by \*) was produced by the center**

Publications under review or accepted	Justification	Status
Hanif,* A., White, J., Place, A.R. & Jagus, R. (2019). Methodology for the identification of stomach contents in a filter feeding fish ( <i>Brevoortia patronus</i> ) using metabarcoding; submitted to <i>Limnology &amp; Oceanography</i>	TAB	submitted

**Table 3c: Four (4) theses/dissertations were produced by LMRCSC students**

Theses/Dissertations	Justification
Price, A. (M.S., Spring 2019). Comparing Localized Feeding Ecology of Black Sea Bass ( <i>Centropristis striata</i> ) at Natural and Artificial Reefs Using Gut Content and Stable Isotope Analyses	LMRCSC Cohort; 2 student
Rodriguez, J. (Ph.D., Spring 2019). Use of Glycan Epitopes to Characterize <i>Mytilus edulis</i> Hemocytes and Their Molecular Interactions with <i>Protoeces maculatus</i> and <i>Himasthia quinssetensis</i>	LMRCSC Cohort; 2 student
Schweitzer, C. (Ph.D., Spring 2019). The effects of Commercial Trap Fishing on Benthic Structural Habitat and Fish Abundance in the Mid-Atlantic: Case study of Black Sea Bass <i>Centropristis striata</i>	LMRCSC Cohort; 2 student
Wenker, R. (M.S., Spring 2019). Sea Whip Coral ( <i>Leptogorgia virgulata</i> ) in the Mid-Atlantic Bight: Colony Complexity, Age, and Growth.	LMRCSC Cohort; 1 student

### Conference Papers, Posters and Presentations:

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

**Table 4a. Twenty-five (25) oral presentations (11 student presenters); LMRCSC Scientists in bold**

Oral presentations at professional meetings	Justification
<b>Chung. J. Sook</b> (2019). Evolutionary and Ecological endocrinology of invertebrate carbohydrate metabolism using the blue crab, <i>Callinectes sapidus</i> as a model. 5th biannual NASCE, Gainesville, May 24-28, 2019	Leveraged
<b>Chung. J. Sook</b> (2019). Morgan State University, Patuxent Environmental and Aquatic Research Laboratory, Is Crustacean molting a growth-stress? April 18, 2019.	TAB
Denson*, L.S., <b>Babcock E.A.</b> & Walter J.F. (2019). The effect of spatial and temporal variation on larval indices used for King mackerel in the Northern Gulf of Mexico. Presented at the LMRCSC 2019 Science Meeting, NOAA HQ, Silver Spring, MD, June 2019.	TAB, Cohort 2 student
Frey*, B.A., Secor, D., Richards, A., & Jagus, R. (2019). Monkfish age validation using hardpart analysis of known-age cohorts. LMRCSC Science Meeting, NOAA HQ, Silver Spring, MD, June 2019. Lightning Talk	TAB
Galvez*, B., Townsend, H., <b>Ozbay, G. &amp; Smith, S.</b> (2019). Trophic ecology of Delaware Bay weakfish using stomach content and stable isotope analyses. Presented at the Association for Research Directors (ARD) meeting, Jacksonville, FL, March 2019, winner 1st place oral presentation.	Cohort 1
Hanif*, A. & Johnson, E. (2019). Assessing temporal changes of the microbial community in gills of invasive dreissenid mussels collected from Lake Michigan. LMRCSC Science Meeting, NOAA-HQ, Silver Spring, MD, June 2019.	NERTO
Lawrence*, A. (2019). Investigating male Jonah crab, <i>Cancer borealis</i> sexual maturity. Presented at LMRCSC Science Meeting, NOAA-HQ, Silver Spring, MD, June 2019.	TAB
Pelekai*, K.P. (2019). Evaluation of Pacific Lamprey age, natal origins, and trophic history through anatomical structures. Research Advances in Fisheries, Wildlife, and Ecology Symposium. Presentation.	Cohort 3
<b>Schott, EJ.</b> (2019). Blue crab virus genetics may help improve fishery management NOAA-LMRCSC Science Meeting. June, 2019. NOAA-HQ, Silver Spring, MD.	Leveraged
<b>Schott, EJ.</b> (2019). Presentation at the Oyster Symposium hosted by the Anne Arundel Watermen's Association and the West/Rhode Riverkeeper. Smithsonian Environmental Research Center, Edgewater, MD. March 9, 2019.	Leveraged

<b>Schott, E.J.</b> Crustacean contagion: a blue crab virus found in aquaculture may help us understand crab population connectivity University of Maryland Eastern Shore, School of Agricultural and Natural Sciences. April 25, 2019.	Leveraged
<b>Secor, D.H.</b> (2019). Keynote Address. Adaptation to Climate Change: Can we better equip Hudson River fishes to succeed. 2019 Hudson River Symposium, Vassar College, NY.	Leveraged
<b>Stevens, B.G.</b> (2019). Experimental Design for Biologists. Presentation for NSF-Research Experience for Undergraduates, UMES, June 10, 2019.	Leveraged
<b>Stevens, B.G.</b> (2019). Hab in the MAB: Characterizing Black Sea Bass Habitat in the Mid-Atlantic Bight. Project completion report to the Atlantic States Marine Fisheries Commission, August 6, 2019.	Leveraged
<b>Stevens, B.G.</b> (2019). Hab in the MAB: Characterizing Black Sea Bass Habitat in the Mid-Atlantic Bight. Project completion report to the Mid-Atlantic Fisheries Management Council, August 14, 2019.	Leveraged
<b>Stevens, B.G.</b> & Miller, T.J. (2019). Status and Trends of World Crab Fisheries. Presentation to Norwegian Institute of Fisheries and Aquaculture Research, June, 2019.	Leveraged
Thalmann*, H.L., <b>Miller, J.A.</b> & Laurel, B. (2019). Quantifying impacts of warm years on juvenile Pacific Cod growth and foraging patterns. Presented at Oregon State University's Research Advances in Fisheries, Wildlife, and Ecology Symposium. Corvallis, OR. April 2019. Oral Presentation.	Cohort 1
Ramirez, M.D.* , Avens, L., Goshe, L.R., Snover, M.L. & <b>Heppell, S.S.</b> (2019). Density-independent decline in Kemp's ridley somatic growth rates following the Deepwater horizon oil spill. International Symposium on Sea Turtle Biology and Conservation, Charleston, SC. Oral Presentation	LMRCSC Cohort 2 student
Rosales, D.* , <b>Ozby, G., Parveen, S.,</b> Jacobs, J. & <b>Pitula, J.S.</b> (2019). Harmful Algae Succession and Vibrio Association in the Delaware Inland Bays. AFS Tidewater Annual Meeting, Salisbury University, Feb. 2019	LMRCSC Cohort 1 student
Rubalcava, K.* & <b>Chigbu, P.</b> (2019). Influence of Environmental Factors on the Abundance and Growth of Spot ( <i>Leiostomus xanthurus</i> ), in the Maryland Coastal Bays. AFS Tidewater Chapter Meeting, Salisbury University, February 2019	LMRCSC Cohort 2 Student
Rubalcava, K.* & <b>Chigbu, P.</b> (2019). Recruitment and Density-dependent growth of Spot ( <i>Leiostomus xanthurus</i> ) in the Maryland Coastal Bays. ASLO 2019 San Juan, Puerto Rico.	LMRCSC Cohort 2 Student
Wenker, R.P. * & <b>Stevens, B.G.</b> (2019). Sea Whip coral ( <i>Leptogorgia virgulata</i> ) in the Mid-Atlantic Bight: Age, colony complexity and distribution. AFS Tidewater Annual Meeting, Salisbury University, February 2019.	LMRCSC Cohort 1 Student
Wenker, R.P. * & <b>Stevens, B.G.</b> (2019). Sea Whip coral ( <i>Leptogorgia virgulata</i> ) in the Mid-Atlantic Bight: Age, colony complexity and distribution. ASLO 2019 Aquatic Sciences Meeting. February 23-March 2. San Juan, Puerto Rico.	LMRCSC Cohort 1 Student

Das, N., Mayor, E. & <b>Chigbu, P.</b> (2019). Population dynamics of blue crabs in the Maryland Coastal Bays. ASLO, Puerto Rico, Feb. 24 to March 1, 2019.	LMRCSC PI
DaSilva, L.V., Ossai, S., <b>Chigbu, P.</b> & <b>Parveen, S.</b> (2019). Characterization of <i>Vibrio vulnificus</i> isolated from environmental and blue crab samples collected from Maryland Coastal Bays. ASLO, Puerto Rico, Feb. 24 to March 1, 2019.	LMRCSC PI

Table 4b. **Posters: 24 (\*8 student presenters)**

<b>Poster presentations at professional meetings</b>	<b>Justification</b>
Smith*, N., et al. (2019). Sea Urchin Importance in Cropping Algal Turf and Removing Sediment on Coral Reefs. Presented at the ASLO conference, San Juan, PR., Feb-Mar. 2019	Cohort 1
Smith*, N., et al. (2019). Human homolog microRNAs are found in common Bottlenose Dolphin skin tissues. Presented at the 1st Annual Caribbean Health Disparities Conference and 24th Annual School of Science Symposium April 17, 2019, Hampton, VA	Cohort 1
Fenwick*, I., et al. (2019). Assessing Oyster Recruitment and Water Parameters in the Hampton River. Presented at the 1st Annual Caribbean Health Disparities Conference and 24th Annual School of Science Symposium April 17, 2019, Hampton, VA	Cohort 1
Fenwick*, I. et al. (2019). Herbivory increases energy allocation towards reproduction in small <i>Turbinaria ornata</i> . Poster presentation at 2019 ASLO Conference, San Juan, Puerto Rico.	Cohort 1
Milton*, I., et al. (2019). Coral Reef Structural Complexity Impacts Ecosystem Functions. Presented at the ASLO conference, San Juan, PR., February 23 -March 1, 2019.	Cohort 1
Milton*, I., et al. (2019). Social Structure of Leopard Seal, <i>Hydrurga leptonyx</i> , at Livingston Island, Antarctica. Presented at the 1st Annual Caribbean Health Disparities Conference and 24th Annual School of Science Symposium April 17, 2019, Hampton, VA	Cohort 1
Thalmann*, H.L., <b>Miller, J.A.</b> & Laurel, B. (2019). Thermal effects on pre-recruit Pacific Cod phenology, early growth, and prey quality in the Gulf of Alaska. Presented at the Oregon American Fisheries Society Meeting, Bend, OR. March 2019. Poster Presentation	Cohort 1
Thalmann*, H.L., <b>Miller, J.A.</b> & Laurel, B. (2019). Thermal impacts on juvenile Pacific Cod foraging in Gulf of Alaska nursery habitats. Presented at the 25th Annual Markham Graduate Student Research Symposium, Newport, OR. June 2019. Poster Presentation.	Cohort 1
Thalmann*, H.L., <b>Miller, J.A.</b> & Laurel, B. (2019). Thermal effects on juvenile Pacific Cod phenology, growth, and foraging in Gulf of Alaska nursery habitats. Presented at the Pacific Estuarine Research Society Meeting, Anacortes, WA. April 2019. Poster Presentation.	Cohort 1
Layton*, J., et al. (2019). The feeding ecology of Pacific lampreys assessed by gut fullness and prey identification. Presented at the ASLO conference, San Juan, PR., Feb-Mar. 2019	Cohort 2

Layton*, J., et al. (2019). The feeding ecology of Pacific lampreys assessed by gut fullness and prey identification. Presented at 1st Annual Caribbean Health Disparities Conference and 24th Annual School of Science Symposium April 17, 2019, Hampton, VA	Cohort 2
Dorsey*, K., et al. (2019). Comparison of the Visual Neurobiology of Tropical and Coastal Marine Fishes Under Ocean Acidification. Presented at the ASLO conference, San Juan, PR., Feb-Mar. 2019	Cohort 2
Dorsey*, K., et al. (2019). Comparison of the Visual Neurobiology of Tropical and Coastal Marine Fishes Under Ocean Acidification. Presented at the 1st Annual Caribbean Health Disparities Conference and 24th Annual School of Science Symposium April 17, 2019, Hampton, VA	Cohort 2
Zhao, M, Behringer, D., Plough, L., Bojko, J., Kough, A., Tavares, C., <b>Schott, E.J.</b> (2019). Genetic variation of a blue crab reovirus (CsRV1) is linked to host geography and life history. Presented at the Atlantic Estuarine Research Society meeting, Woodbridge, VA. April 4, 2019	Leveraged
Arzola, N., Ross, M., <b>Schott, EJ</b> , O'Neil, J. (2019). Tracking microbial contaminants in Baltimore Harbor: Are current techniques sufficient for assessing human risk? American Society of Limnology and Oceanography. San Juan, Puerto Rico. February 26- March 1, 2019.	Leveraged
Harris, L., Dahlenburg, C., <b>Schott, E.J.</b> & Woodland, R. (2019). Jump starting scientific co-production in Baltimore: results of the 'Harbor Science' workshop. American Society of Limnology and Oceanography. San Juan, Puerto Rico. February 26- March 1, 2019	Leveraged
Medero, L. <b>Schott, EJ</b> , Zhao, M. (2019). Genetic Variation of a Blue Crab Virus as a Tool to Understand Crab Movement. American Society of Limnology and Oceanography. San Juan, Puerto Rico. February 26- March 1, 2019	Leveraged
Farmer*, M.A., <b>Pitula, J.S.</b> , North, E.W. & <b>Stevens, B.G.</b> (2019). Spatial and Temporal Distribution of <i>Crassostrea virginica</i> Spat Settlement in the Maryland Coastal Bays. University of Maryland Eastern Shore Graduate Studies Regional Research Symposium 2019, Princess Anne, MD, April 16, 2019. (10 minute oral presentation)	Leveraged
Farmer*, M. A. & <b>Stevens, B.G.</b> (2019). Where are the Baby Oysters? University of Maryland Eastern Shore Graduate Studies Regional Research Symposium 2019, Princess Anne, MD, April 16, 2019. (3 minute thesis)	Leveraged
Gibson, D. (2019). Underrepresented But Not Forgotten: The Making of a Marshall Scholar. Presented at the ASLO conference, San Juan, PR., Feb. 23-Mar 1, 2019.	LMRCSC HU PI
Young, V., Hoskins-Brown, D., Chigbu, P., Sexton, M. A., Gibson, D., Jagus, R., ... Stevens, B.G. (2019). The NOAA LMRCSC and Its Multifaceted Approaches to Facilitate Student Development and Diversity in the Marine Sciences. <i>28th Symposium on Education</i> . Presented at the American Meteorological Society 99th Annual Meeting, Phoenix, AZ.	Results of LMRCSC
Pelekai*, K.P., <b>Miller, J.</b> , Hess, J. & Porter, L. (2019). Determination of age, natal origin, and trophic history of Pacific Lamprey ( <i>Entosphenus tridentatus</i> ). Oregon Chapter of the American Fisheries Society Annual Meeting.	Cohort 3
Morales, A. & <b>Chigbu, P.</b> (2019). The community structure of soft-bottom macrobenthic fauna in dead-end canals in the Maryland Coastal Bays, USA. ASLO, Puerto Rico, Feb. 24 to March 1, 2019.	LMRCSC UMES PI

Elfadul, R., Jesien, R., Elnabawi, A., <b>Chigbu, P. &amp; Ishaque, A.</b> (2019). Analysis of emerging contaminants in Maryland Coastal Bays using <i>in vitro</i> bioassays as biological screening tools. ASLO, Puerto Rico, Feb. 24 to March 1, 2019.	LMRCSC UMES PI
---	-------------------

**Other Publications:**

Other publications	Justification
<b>Babcock, E.A.</b> , Cortes, E., & O'Farrell*, H. (2019). Updated projections for the Bayesian production model (BSP2JAGS) from the 2017 shortfin mako shark assessment. <i>ICCAT Collective Volume of Scientific Papers</i> . SCRS/2019/092	Cohort 1 student
Vaughan, N., <b>Babcock, E. A.</b> , & Courtney, D. (2019) Summary of intersessional work completed with the Decision Support Tool to evaluate 2017 conservation measures recommended by ICCAT to reduce mortality for north Atlantic shortfin mako. <i>ICCAT Collective Volume of Scientific Papers</i> . SCRS/2019/101	Leveraged

**Technologies or Techniques:** None

**Patents:** None

**Inventions:** None

**Websites:** [www.umes.edu/lmrcsc](http://www.umes.edu/lmrcsc)

**Products:** None



### 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	80
Christopher	Heckscher	DSU	Advisor	10
Gulni	Ozbay	DSU	Co-advisor	10
Dennis	McIntosh	DSU	Participating Faculty	10
Kevina	Vulinec	DSU	Co-advisor	10
Grant	Blank	DSU	Participating Faculty	15
Deidre	Gibson	HU	Principal Investigator	40
Carolina	Lewallen	HU	Faculty	80
Jessica	Miller	OSU	Principal Investigator	40
Elizabeth	Babcock	RSMAS	Principal Investigator	7
David	Die	RSMAS	Faculty	3.5
Dionne	Hoskins-Brown	SSU	Principal Investigator	40
Victoria	Young	SSU	Education Expert	160
Tara	Cox	SSU	TAB recipient Faculty	20
Sue	Ebanks	SSU	Faculty	10
Chris	Hintz	SSU	Faculty	10
Matt	Kenworthy	SSU	Postdoc	100
Rosemary	Jagus	UMCES-IMET	Principal Investigator	60
Tsetso	Bachvaroff	UMCES-IMET	Co-advisor & bioinformatics mentor on several LMRCSC	40

			graduate student projects	
Feng	Chen	UMCES-IMET	Committee member for LMRCSC graduate students	20
Sook	Chung	UMCES-IMET	Mentor for three LMRCSC graduate students	60
	Li	UMCES-IMET	Mentor for LMRCSC graduate student	40
Allen	Place	UMCES-IMET	Co-advisor for LMRCSC graduate students	5
Eric	Schott	UMCES-IMET	Mentor for LMRCSC graduate student	40
Dave	Secor	UMCES-IMET	Mentor for LMRCSC graduate student	40
Paulinus	Chigbu	UMES	Principal Investigator	80
Tanesha	Hankerson	UMES	Communications and Outreach Specialist	124
Alexander	Kessie	UMES	Coordinator for Budget and Data Management	160
Judith	Rose	UMES	Program Manager, LMRCSC	76
Cy'Anna	Scott	UMES	LMRCSC Recruiter	80
Margaret	Sexton	UMES	Assistant Director	160
Bradley	Stevens	UMES	DRS	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	NJDEP	Ocean County, NJ	Helped students collect samples
Non profit	Chesapeake Bay Foundation	Richmond, VA	Helped students with oyster restoration project

Tribal government	Columbia River Intertribal Fish Commission	Portland OR	intellectual investment, samples, collaborative research
Federal Government	NOAA NWFSC and AFSC	Newport, OR	intellectual investment, samples, collaborative research
Tribal government	Yakama Nation Fisheries (YNF):		Collaborating with YNC hatcheries to provide additional known age and origin lamprey samples.
Environmental NGO	Wildlife Conservation Society	Belize	Helped Adrienne Wilson collect lane snapper samples in Belize
State government	GADNR	Brunswick, GA	Provide nets, serve on committee
Federal Commission	Gullah Geechee Cultural Heritage Corridor Commission	Charleston, SC	Provide data, student mentoring

**Have other collaborators or contacts been involved? Yes**

If Yes, describe involvement and time spent.

Last name	First name	Title/Affiliation	Description of involvement
Coyne	Kathy	DE Seagrass head/Prof. Univ. of DE	Helping student with DNA analysis/lab space
North	Heather	Oyster tech, CBF	Helped students with oyster restoration project
Lampman	Ralph	Yakama Nation	Working with Pelekai on thesis research
Alber	Merryl	Dir. UGAMI	Research mentor
Cai	Wei-Jun	Professor, Univ. Delaware	Research mentor

**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
Zamon	Jen	NWFSC	M.S. committee member
Wikfors	Gary	NEFSC	M.S. committee member
Forgerty	Michael	NEFSC	NERTO advisor
Weitkamp	Laurie	NWFSC	NOAA TAB collaborator; committee member for Peleki
Moore	Jeffery	SWFSC	NERTO mentor for M. Ramirez
Avens	Larisa	NEFSC	Committee member for M. Ramirez
Laurel	Ben	AFSC	Committee member for Thalmann
Werner	Kevin	NWFSC	Committee member for King
Allman	Robert	SEFSC	Ph.D. committee member and NERTO mentor for Adrienne Wilson
Cortes	Enric	SEFSC	Ph.D. committee member and NERTO mentor for Halie O'Farrell
Walter	John	SEFSC	Ph.D. Committee member for LaTreese Denson
Thorson	James	AFSC	NERTO mentor for LaTreese Denson
Sharma	Rishi	NWFSC	Collaborator
Deshpande	Ashok	Res. Chemist, NEFSC	M.S. thesis committee member of Davielle Drayton
Werner	Cisco	Dir. of Scientific Programs and Chief Science Advisor, NMFS; LMRCS Technical Monitor	Provided guidance on research development at SSU
Hill	Ron	Acting Branch Chief, SEFSC	Serves on an internal committee to collaborate of the use of UAS for habitat monitoring in the South Atlantic, Gulf, and Caribbean
Caldwell	Phil	GIS Technician, SEFSC	Serves on an internal committee to collaborate of the use of UAS for habitat monitoring in the South Atlantic, Gulf, and Caribbean
Merino	Joy	SEFSC	Serves on an internal committee on the use of UAS for habitat monitoring in the South Atlantic, Gulf, and Caribbean

## 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-two (22) students have been identified/recruited as members of Cohort 2 (2017-2018) including 7 Ph.D., 7 M.S., and 8 B.S. students. Seventeen (17) students have been identified/recruited as members of Cohort 3 (2018-2019) including 3 Ph.D., 4 M.S. and 10 B.S. students. So far, nine (9) students including 2 Ph.D., 5 M.S., and 2 B.S. students have been recruited into Cohort 4. At least 8 of them belong to underrepresented minority groups. LMRCSC 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 prepares students for their first NOAA 'job' experience. Under the tutelage of a mentor, the students 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?**

- DSU: Training undergraduate students from other disciplines can be challenging initially because of lack of knowledge. Nevertheless, some students have switched majors to marine and fisheries sciences.
- HU: 3 students and 1 faculty from Biological Sciences are now working in the LMRCSC funded genetics lab. Two M.S. students have been recruited through the Biology Department to work with Marine and Environmental Science faculty.

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

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

### **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 LMRCSC 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?**

The NOAA award has enabled the LMRCSC to acquire fisheries and environmental data from research activities that have been or are being used for publications and presentations at professional meetings. Additionally, data on student enrollment, graduation and participation in professional development activities are being collected and are being used together with results from the assessments and evaluations of the Center by LMRCSC external evaluators to improve on the Center's performance, and to determine the extent to which the Center is accomplishing its goals and objectives.

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

Research results have been published, and presented at scientific meetings and stock assessment working groups. Additionally, LMRCSC research and education outcomes are communicated to NOAA and the public in general through the Center's electronic newsletters, the latest of which was produced in summer 2019.

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

RSMAS: Research results have been published, and presented at scientific meetings and stock assessment working groups. Ph.D. student L. Denson mentored a Savannah State University student.

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

HU: LMRCSC students are engaged in outreach activities at K-12 schools and at Community and City wide organizations.

RSMAS: RSMAS PhD students participated in outreach activities for elementary and high school students, and in the RSMAS diversity committee.

## **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:**

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

SSU: Progress by one freshman at SSU has been delayed because his grade point average has dropped below the minimum requirement. Mentoring has been extended to him and he has sought tutorial.

#### **Changes that have a significant impact on expenditures:**

RSMAS Ph.D. student Anya Byrd (cohort 3) has transferred to UMCES-IMET. We have accepted M.S. student, Juan Cervera with the remaining Cohort 3 funds.

## 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.**

The report of the year 3 External Evaluations of the LMRCSC conducted during this reporting period by a team from the College of Explorations (COE) is presented in Appendix I.

**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-two (22) students have been identified/recruited as members of Cohort 2 (2017-2018) including 7 Ph.D., 7 M.S., and 8 B.S. students. Seventeen (17) students have been identified/recruited as members of Cohort 3 (2018-2019) including 3 Ph.D., 4 M.S. and 10 B.S. students. So far, nine (9) students including 2 Ph.D., 5 M.S., and 2 B.S. students have been recruited into Cohort 4. Recruitment for this period is on-going.

### 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
Ileana	Fenwich*	1	B.S.	HU		\$3,750				
Isaiah	Milton*	1	B.S.	HU		\$3,750				
Nefertiti	Smith*	1	B.S.	HU	\$5,000					
Nakia	Coit*	1	B.S.	UMES	\$4,151	\$1,353	\$0	\$0	\$0	\$0

Nylah	McClain*	1	B.S.	UMES	\$0	\$1,263	\$0	\$0	\$0	\$0
India	Oliver*	1	B.S.	UMES	\$0	\$0	\$0	\$0	\$0	\$0
Chryston	Best Otubu*	1	B.S.	UMES	\$5,371	\$5,870	\$1,211	\$0	\$0	\$0
Brian	Galvez*	1	M.S.	DSU	\$1,635	\$4,038	\$2,903			
Amanda	Pappas*	1	M.S.	DSU	\$4,867	\$11,308	\$3,500			\$145
Cristin	Mayes*	1	M.S.	HU	\$5,471	\$6,000				
Angie	Munguia*	1	M.S.	OSU						
Hillary	Thalmann	1	M.S.	OSU	\$6,110	\$14,682				\$1,570
Emily	Griffin	1	M.S.	SSU	\$50	\$0	\$0	\$0	\$0	
Rebecca	Wenker	1	M.S.	UMES	\$186	\$11,277	\$0	\$0	\$1,130	\$0
Halie	O'Farrell*	1	Ph.D.	RSMAS			\$3,554			
Shadaesha	Green*	1	Ph.D.	UMCES	\$1,185	\$14,391	\$321	\$1,899	\$2,016	
Ammar	Hanif*	1	Ph.D.	UMCES	\$1,185	\$6,283		\$1,107	\$2,000	
Stephanie	Martinez-Rivera*	1	Ph.D.	UMES	\$0	\$3,668	\$0	\$0	\$0	\$0
Detbra	Rosales*	1	Ph.D.	UMES	\$0	\$1,915	\$0	\$0	\$0	\$0
Kendra	Dorsey*	2	B.S.	HU	\$5,000					
Janelle	Layton*	2	B.S.	HU		\$3,750				
Alexandria	Ambrose*	2	B.S.	SSU			\$6,187			
Dante	Freeman*	2	B.S.	SSU	\$0	\$0	\$0			
Erianna	Hammond*	2	B.S.	SSU	\$6,000	\$0	\$0			
Michael	Williams	2	B.S.	SSU	\$0	\$0	\$0			
Aris-Aja	Horseley*	2	B.S.	UMES	\$3,050	\$1,212	\$0	\$0	\$0	\$0
DaQuan	Davis*	2	B.S.	UMES	\$4,151	\$2,727	\$0	\$0	\$0	\$0
Joe	Day*	2	BS	SSU	\$6,822	\$0	\$0			
Sena	Tay*	2	BS	SSU	\$3,001	\$0	\$4,527			
Kleponis	Nicole	2	M.S.	DSU	\$4,045	\$11,308	\$1,391	\$3,499		\$709
Davielle	Drayton*	2	M.S.	SSU	\$1,339	\$10,500	\$602	\$0	\$1,539	\$482
Amanda	Lawrence*	2	M.S.	UMCES	\$2,151	\$18,256		\$5,000	\$4,398	
Andre	Price*	2	M.S.	UMES	\$0	\$1,252	\$352	\$0	\$3,766	\$0
Enid	Munoz-Ruiz*	2	M.S.	UMES	\$4,320	\$18,999	\$3,870	\$2,907	\$0	\$0
Jorge	Rodriguez*	2	M.S.	UMES	\$835	\$17,195	\$0	\$258	\$0	\$0
Brittany	King*	2	Ph.D.	OSU		\$16,956	\$2,974			
Matthew	Ramirez*	2	Ph.D.	OSU	\$6,110	\$16,548		\$7,167		\$1,635
LaTreese	Denson*	2	Ph.D.	RSMAS	\$12,180	\$7,431	\$1,426			\$874
Adrienne	Wilson*	2	Ph.D.	RSMAS	\$12,180	\$22,398	\$811			
Laura	Almodovar-Acevedo*	2	Ph.D.	UMES	\$0	\$0	\$0	\$0	\$0	\$0
Cara	Schweitzer*	2	Ph.D.	UMES	\$105	\$15,117	\$0	\$736	\$1,095	\$0
Kasondra	Rubalcava*	2	Ph.D.	UMES	\$6,733	\$18,491	\$3,187	\$3,848	\$0	\$0
Kiani	Simmons*	3	B.S.	DSU		\$970				
Kathryn	Cruz*	3	B.S.	HU		\$3,750				
Ambrose	Alexandria*	3	B.S.	SSU	\$11,901	\$0	\$0			
Semaj	Fielding*	3	B.S.	UMES	\$0	\$350	\$0	\$0	\$0	\$0
Rhyan	Knight*	3	B.S.	UMES	\$4,151	\$899	\$0	\$0	\$0	\$0
Eunice	Sanvee*	3	B.S.	DSU		\$2,150				



Teemer	Barry*	3	B.S.	UMES	\$4,151	\$689	\$0	\$0	\$0	\$0
Tyler	Washington*	3	B.S.	UMES	\$0	\$0	\$0	\$0	\$0	\$0
Keala	Pelekai*	3	M.S.	OSU	\$6,110	\$14,682	\$1,032			\$2,052
Juan	Cervera*	3	M.S.	RSMAS		\$2,143				
Shaneese	Mackey*	3	M.S.	SSU	\$4,089	\$12,700	\$1,060	\$5,999	\$465	\$721
Benjamin	Frey*	3	M.S.	UMCES	\$6,596	\$14,236				\$847
Anya	Byrd*	3	Ph.D.	RSMAS	\$3,920	\$9,908				\$802
Wilmelie	Cruz-Marrero*	3	Ph.D.	UMES	\$730	\$15,923	\$402	\$3,093	\$0	\$0
Shanelle	Haughton*	3	Ph.D.	UMES	\$6,244	\$12,457	\$0	\$1,632	\$0	\$0
Marci-Ann	Smith*	none	B.S.	UMES	\$0	\$0	\$0	\$0	\$0	\$404
Khari	Crommarty*	RSTP	B.S.	UMES	\$0	\$0	\$0	\$0	\$0	\$0
Colby	Boomer*	RSTP	B.S.	UMES	\$0	\$0	\$0	\$0	\$0	\$0

*\*Underrepresented minorities; RSTP – Rising Sophomore Training Program participant*

**Milestones for Meeting Requirements of the Award:** Presented below are timelines for students 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 proposals, and are preparing to fulfill the NERTO requirement.

First	Last	Cohort #	Degree	Partner	Cohort Experience	NERTO	Ethical Conduct of Research Training	Data Management Course	NOAA Mentor
Ileana	Fenwich*	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
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
Chryston	Best Otubu*	1	B.S.	UMES	n/a	n/a	Sum 17	n/a	n/a
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
Cristin	Mayes*	1	M.S.	HU	Spring 18	Sum 18	Spr. 18	Fall 17	Y
Angie	Munguia*	1	M.S.	OSU	Mar-19	TBD	Wint. 17	2017	Y
Hillary	Thalmann	1	M.S.	OSU	Spr. 18	Sum 17	Fall 2018		Y
Emily	Griffin	1	M.S.	SSU					Y
Rebecca	Wenker	1	M.S.	UMES	Spr. 18	Fall 18	Fall 17	Fall 17	Y
Halie	O'Farrell*	1	Ph.D.	RSMAS	Spr. 18	Sum 18	Fall 16	Fall 17	Fall 16
Shadaesha	Green*	1	Ph.D.	UMCES	Spr. 18	Sum 19	Fall 17	Fall 17	Y
Ammar	Hanif*	1	Ph.D.	UMCES	Spr. 18	Fall 18	Fall 17	Fall 17	Y
Stephanie	Martinez-Rivera*	1	Ph.D.	UMES	Spr. 18	Sum 18	Spr. 14	Fall 17	Y
Detbra	Rosales*	1	Ph.D.	UMES	Spr. 18	Sum 18	Fall 17	Fall 17	Y
Kendra	Dorsey*	2	B.S.	HU	Fall 17	NA	Spr. 18	NA	Y

Janelle	Layton*	2	B.S.	HU	Fall 17	NA	Spr. 18	NA	NA
Alexandria	Ambrose*	2	B.S.	SSU	n/a	n/a	n/a	n/a	n/a
Dante	Freeman*	2	B.S.	SSU	n/a	n/a	n/a	n/a	n/a
Erianna	Hammond*	2	B.S.	SSU	n/a	n/a	Fall 18	n/a	n/a
Michael	Williams	2	B.S.	SSU	n/a	n/a	Fall 18	n/a	n/a
Aris-Aja	Horseay*	2	B.S.	UMES	n/a	n/a	Spr. 19	n/a	n/a
DaQuan	Davis*	2	B.S.	UMES	n/a	n/a	Sum 18	n/a	n/a
Joe	Day*	2	BS	SSU	n/a	n/a	n/a	n/a	n/a
Sena	Tay*	2	BS	SSU	n/a	n/a	n/a	n/a	n/a
Kleponis	Nicole	2	M.S.	DSU	Spr. 19	Sum 19	Spr. 18	Fall 18	Spr. 18
Davielle	Drayton*	2	M.S.	SSU	Spr. 19	Sum 18	Fall 19	Sum 18	n/a
Amanda	Lawrence*	2	M.S.	UMCES	Spr. 18	Sum 19	Fall 18	Fall 17	Y
Andre	Price*	2	M.S.	UMES	Spr. 18	Fall 18	Fall 17	Fall 17	Y
Enid	Munoz-Ruiz*	2	M.S.	UMES	Spr. 18	Fall 18	Spr. 18	Fall 18	Y
Jorge	Rodriguez*	2	M.S.	UMES	Spr. 18	Fall 18	Spr. 18	Fall 17	Y
Brittany	King*	2	Ph.D.	OSU	Mar-19	TBD	Fall 18		Y
Matthew	Ramirez*	2	Ph.D.	OSU	Spr. 18	TBD	Spr. 17	2018	Y
LaTreese	Denson*	2	Ph.D.	RSMAS	Spr. 19	Fall 18	Fall 15	Fall 18	Sum 18
Adrienne	Wilson*	2	Ph.D.	RSMAS	Spr. 18	Sum 18	Fall 17	Fall 18	Sum 18
Laura	Almodovar-Acevedo*	2	Ph.D.	UMES	Spr. 18	Sum 17	Spr. 18	Fall 17	Y
Cara	Schweitzer*	2	Ph.D.	UMES	Spr. 18	Wint. 19	Spr. 18	Fall 18	Y
Kasondra	Rubalcava*	2	Ph.D.	UMES	Spr. 18	Sum 19	Fall 18	Fall 18	Y
Kiani	Simmons*	3	B.S.	DSU	n/a	n/a	Spr. 19	n/a	n/a
Kathryn	Cruz	3	B.S.	HU	Fall 18	NA	Spr. 19	NA	NA
Ambrose	Alexandria	3	B.S.	SSU	n/a	n/a	n/a	Sum 19	n/a
Semaj	Fielding*	3	B.S.	UMES	n/a	n/a	Spr. 19	n/a	n/a
Rhyan	Knight*	3	B.S.	UMES	n/a	n/a	Spr. 19	n/a	n/a
Eunice	Sanvee*	3	B.S.	DSU	n/a	n/a		n/a	n/a
Teemer	Barry*	3	B.S.	UMES	n/a	n/a	Fall 18	n/a	n/a
Tyler	Washington*	3	B.S.	UMES	n/a	n/a	Sum 18	n/a	n/a
Keala	Pelekai*	3	M.S.	OSU	Spr. 18	Fall 18	Fall 18		Y
Juan	Cervera*	3	M.S.	RSMAS	Spr 20	Sum 20	Fall 20	Fall 20	Fall 20
Shaneese	Mackey*	3	M.S.	SSU	Spr. 19	Sum 19	Fall 18	Fall 19	Spr. 19
Benjamin	Frey*	3	M.S.	UMCES	Spr. 19	Spr. 19	Fall 19	Fall 19	Y
Anya	Byrd*	3	Ph.D.	RSMAS	Spr. 19	Sum 20	Fall 18	Fall 20	Fall 20
Wilmelie	Cruz-Marrero*	3	Ph.D.	UMES	Spr. 19	Sum 19	Fall 18	Fall 19	Y
Shanelle	Haughton*	3	Ph.D.	UMES	Spr. 19	Sum 19	Spr. 19	Fall 19	Y
Marci-Ann	Smith*	none	B.S.	UMES	n/a	n/a	Fall 18	n/a	n/a
Khari	Crommarty*	RSTP	B.S.	UMES	n/a	n/a	Sum 18	n/a	n/a
Colby	Boomer*	RSTP	B.S.	UMES	n/a	n/a	Sum 18	n/a	n/a

\*Underrepresented minorities; RSTP – Rising Sophomore Training Program participant

**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.

Erianna Hammond, a B.S. student from SSU participated in the Rising Sophomore Experiential Training Program this summer. She conducted her research at the Pacific Marine Mammals Center, but received mentorship from Drs. Hoskins and Sexton. She participated in the UMES REU Communications Workshop and presented her research at the UMES REU Symposium.

Additionally, LMRCSC supported scientists and staff organized a 6 week summer 2019 Geoscience Bridge Program at UMES as a pipeline for recruitment of students into the Center. Seven students participated in the program after which 3 of them enrolled at UMES; one student enrolled at HU. Another student with interest in Atmospheric science enrolled at Jackson State University, one student enrolled at Florida A&M University, and another student enrolled at North Carolina A&M University. Two of the students who enrolled at UMES LMRCSC after completing the Geoscience Program last year: Semaj Fielding and Teemer Barry will be submitting applications for both the Hollings Scholarship Program and the NOAA EPP Undergraduate Scholarship Program.

**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.

<b>Student name(s)</b>	<b>Activity name and/or description</b>
Brian Galvez	Agricultural Research Directors conference talk and winner 1st place oral competition
Brian Galvez	Boat training and captaining
Nicole Kleponis	Engagement with OSU faculty/salmon project
Amanda Pappas	Working with Univ. of Delaware faculty for PCR training
Amanda Pappas	Taxonomic Identification of HAB at the Bigelow National Center
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 Ocean Acidification impacts on fish vision and hearing
Janelle Layton	Research training in marine fisheries genetics
Kathryn Cruz	Research training in marine fisheries genetics

Matt Ramirez	2015–2019, Member, Graduate Student Advisory Council, OSU Graduate School
Matt Ramirez	2014–2019, Program Coordinator, OSU Fisheries and Wildlife Mentorship Program. <a href="https://tinyurl.com/osufwmentorship">https://tinyurl.com/osufwmentorship</a> .
Hillary Thalmann	2019-, Program Coordinator, OSU Fisheries and Wildlife Mentorship Program. <a href="https://tinyurl.com/osufwmentorship">https://tinyurl.com/osufwmentorship</a> .
Brittany King 2019	Underrepresentation of ethnic and racial groups in marine and fisheries science professions. Presented at NOAA LMRCSC Annual Science Meeting.
Brittany King	Fisheries and Wildlife Graduate Student Association, Communications officer July 2018 - July 2019
Brittany King	OSU Graduate Student Advisory Council, Member, September 2018- Present
Adrienne Wilson	Traveled to Belize to collect lane snapper samples.
LaTreese Denson	Mentored Savannah State University undergraduate intern Alexandria Ambrose for summer internship on statistical modeling of fish distributions.
Halie O'Farrell	Contributed to the ICCAT mako shark assessment in June 2019
Alexandria Ambrose	Did summer internship at RSMAS working with PhD Student, LaTreese Denson
Adrienne Wilson	Adrienne Wilson wrote a TAB proposal and received funding for her dissertation work
Benjamin Frey	Training in fish diet analysis, otolith extraction, seining practices, fish identification, use of R software and increased proficiency in statistical approaches to time series analyses, linear regression models, ANOVA, probability distributions. Took courses in Fishery Science & Management, Ecological Systems, Advanced Population Dynamics & Assessment, Environmental Statistics I and II. Took LMRCSC Cohort Workshop. Planned NERTO experience with Dr. Anne Richards, NEFSC, Woods Hole, MA
Shadaesha Green	Completed NERTO experience with Dr. Bruce Vogt, NOAA Chesapeake Bay Office, to compile fish survey and habitat data to quantify and map striped bass spawning and nursery areas in the Chesapeake Bay. Developed comprehensive RFP for Chesapeake Bay Office funding to remedy gaps in knowledge. Took Chesapeake Bay Program: Introduction to Story Maps and Chesapeake Bay Program Lunch and Learn Writing Tips
Ammar Hanif	Increased proficiency in R programming language and various R packages such as Phyloseq and ggplot2. Increased proficiency in python for data science. Trained URM undergraduate intern and URM high school student. Took NOAA CoastWatch/OceanWatch Satellite Training Course, College Park.
Amanda Lawrence	During NERTO experience she learnt to use PreSens software for OXY-10 SMA multichannel respirometer, as well as becoming proficient in calibrating and running the OXY-10 SMA respirometer to measure oxygen consumption

### 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

UMES: In February 2019, Dr. Cullen completed his six months' residency at NOAA NEFSC, J.J. Howard Sandy Hook Lab, New Jersey. He is currently analyzing data and preparing manuscripts for publication in journals.

SSU: The SSU Post-Doctoral Fellow position has been filled by Dr. Matt Kenworthy. He is

currently developing a research plan and a TAB proposal.

**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	1	Nov-19
DSU Students	2	Oct-19
HU Faculty	6	Spring 2020
HU Students		
OSU Faculty		
OSU Students		
RSMAS Faculty	2	Oct-19
RSMAS Students	3	Jul-20
SSU Faculty	2	Dec-19
SSU Students	1	Dec-19
UMCES Faculty		
UMCES students		
UMES Faculty	3	Dec. 2019
UMES Students	4	Fall 2019

**Papers currently in review or in press: \*Students. LMRCSC scientists in bold**

Publications in journals	Justification	Status
<b>Stevens, B.G.</b> , and T.J. Miller. in press. Crab Fisheries. G. A. Lovrich, and M. Thiel, editors. The Natural History of the Crustacea, Vol. 9, volume 9. Oxford University Press.	<b>Leveraged</b>	<b>In press</b>
Hanif,* A, White, J, Place, AR, & <b>Jagus, R.</b> Methodology for the identification of stomach contents in a filter feeding fish ( <i>Brevoortia patronus</i> ) using metabarcoding; submitted to Limnology & Oceanography Methods.	<b>TAB</b>	<b>submitted</b>

## 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	LMRCSC Institution	Cohort #	Start date	Role	Time Commitment	Line Office	Project Title
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
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
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	Jan-17	Committee member	3 months	NOAA NEFSC	Trophic ecology of Atlantic Weakfish in the Delaware Bay using stomach content and stable isotope analyses
Gary Wikfors	Amanda Pappas	DSU	1	Jun-18	Collaborator/Committee member	3 months	NOAA NEFSC	Ecology of a toxic harmful algal bloom species ( <i>Dinophysis acuminata</i> ) in the Delaware Inland Bays
Jen Zamon	Nicole Kleponis	DSU	2	Jan-18	Committee member	3 months	NOAA NWFSC	Assessing the relative abundance of the wintering red-throated loon in the Delaware Bay
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
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
Laurie Weitkamp	Angie Munguia	SSU	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
Laurie Weitkamp	Janelle Layton	HU	2	1-Sep-18	TAB collaborator	2 yrs	NOAA NWFSC	The feeding ecology of Pacific lampreys assessed by gut fullness and prey identification
Larisa Avens	Matt Ramirez	OSU	2	1-Sep-18	committee member		NOAA NEFSC	Influence of trophic ecology, habitat use, and population density on Kemp's ridley sea turtles ( <i>Caretta caretta</i> )
Jeffrey Moore	Matt Ramirez	OSI	2	1-Sep-18	NERTO mentor		SWFSC	Integration of habitat-specific growth variation in assessment models: a case study in the Kemp's ridley sea turtle
Laurie Weitkamp	Angie Munguia	OSU	1	1-Sep-17	NERTO mentor & committee member	~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
Ben Laurel	Hillary Thalmann	OSU	1	9/1/2018	committee member		AFSC	Thermal impacts on juvenile Pacific Cod ( <i>Gadus macrocephalus</i> ) foraging and growth in Gulf of Alaska nursery habitats
Kevin Werner	Brittany King	OSU	2	9/1/2017	committee member		NOAA NWFSC	Underrepresentation of ethnic and racial groups in marine and fisheries science professions.
Enric Cortes	Halie O'Farrell	RSMAS	1	2015	Committee member, NERTO mentor	3 month NERTO	NOAA SEFSC	Evaluation of the effect of size and sex-based spatial segregation on shortfin mako and bull shark fishery sustainability
Robert Allman	Adrienne Wilson	RSMAS	2	2017	NERTO mentor	3 month NERTO	NOAA SEFSC	Ageing methods for lane snapper, a data poor species
James Thorson	LaTreeese Denson	RSMAS	2	2017	NERTO mentor	3 month NERTO	NOAA AFSC	Environmental influences on indices of abundance for King Mackerel in the Gulf of Mexico examined through spatiotemporal geostatistical models
John Walter	LaTreeese Denson	RSMAS	2	2017	Committee member	committee member	NOAA SEFSC	The effect of spatial and temporal environmental variation on stock assessment inputs and management decisions with a focus on King mackerel in the US Gulf of Mexico

Ron Hill	Shaneese Mackey	SSU	3	5/26/19	Committee member, communicating collaborator	~4 months (including NERTO)	NOAA SEFSC	
Ashok Deshpande	Davielle Drayton	SSU	2	01/01/18	Committee member, communicating collaborator	~4 months (including NERTO)	NOAA NEFSC	Evaluation of microplastic consumption by the eastern oyster, <i>Crassostrea virginica</i> , in Savannah GA
Anne Richards	Benjamin Frey	UMCES-IMET	3	Sep-18	TAB collaborator & NERTO mentor		NMFS	Monkfish Age Validation Using Hardpart Analysis of Known-age Cohorts
Burton Shank	Shadaesha Green	UMCES-IMET	1	09/01/16	collaborator		NMFS	Reproductive strategy of female deep-sea red crab
James Weinberg	Shadaesha Green	UMCES-IMET	1	09/01/16	committee member		NMFS	Reproductive strategy of female deep-sea red crab
Bruce Vogt	Shadaesha Green	UMCES-IMET	1	1/19/19	NERTO mentor		NCCOS	Striped Bass Habitat Indicator for the Chesapeake Bay
Kevin Friedland	Ammar Hanif	UMCES-IMET	1	Fall 2018	committee member		NMFS	Assessing temporal changes of the microbial community in gills of invasive dreissenid mussels collected from Lake Michigan
John Jacobs	Ammar Hanif	UMCES-IMET	1	Fall 2018	TAB collaborator		NCCOS	Diet and microbiota of Eastern oyster
Ed Johnson	Ammar Hanif	UMCES-IMET	1	1/30/18	NERTO mentor		NCCOS	Diet and microbiota of dreissenid mussels
Burton Shank	Amanda Lawrence	UMCES-IMET	2	9/1/17	committee member		NMFS	Size and maturity of male red crabs
Paul McElhany	Amanda Lawrence	UMCES-IMET	2	10/1/18	NERTO mentor		NMFS	Effect of CO2 on the physiology of Dungeness crab
Ashok Deshpande	Enid Munoz Ruiz	UMES	2	9/1/17	NOAA/NERTO mentor		NOAA, NMFS	Assessment of Microplastics and dPolybrominated Diphenyl Ethers (PBDEs) in Scallops as Possible Indicators of Plastic Pollutions.
Vince Guida	Rebecca Wenker	UMES	1	8/1/17	NOAA/NERTO mentor		NOAA, NMFS	Development of alternative search strategy for assessing densities of clumped distribution species within a comprehensive image database.



April Croxton	Jorge Rodriguez	UMES	2	1/1/15	NOAA/NERTO mentor	NOAA, OAR	Seperation by density gradient centrifugation of blue mussel hemocytes; Flow cytometry analysis of fluorescently-labeled lectin stained blue mussel hemocytes; Trypsinization of cell surface glycoconjugates of blue mussel hemocytes; Observation of <i>in-situ</i> glycan-based molecular interactions between blue mussel hemocytes and its parasitic trematodes.
Gary Wikfors	Jorge Rodriguez	UMES	2	1/1/15	NOAA/NERTO mentor	NOAA, NMFS	<i>Mytilus edulis</i> hemocytes: Studies on hemocyte glycoconjugates and their possible role in host-pathogen interactions
Sheekela Baker-Yeboah	India Oliver	UMES	1	9/1/16	NOAA mentor	NOAA EPP/MSI	Exploring Ocean Optical Properties using Satellite and in situ Data.
Howard Townsend	Kasondra Rubalcava	UMES	2	9/1/17	NOAA mentor	NOAA, NMFS	Spot fish recruitment and density-dependent growth in the Maryland Coastal Bays.
Mike Burton	Cara Schweitzer	UMES	2	9/1/18	NOAA/NERTO mentor	NOAA SEFSC	The effectiveness of an alternative whole video-reading protocol on detecting the presence of sharks.
Todd Kellison	Cara Schweitzer	UMES	2		NOAA mentor	NMFS	Mortality of Black Sea Bass discarded by the commercial fishery

### 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 **41** and graduated **8** in NOAA- mission sciences.
2. **Total number of EPP-funded post-secondary students** who are trained **47** and graduate **9** 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 **2**,

- NGO community **0**, academia **1** or as entrepreneurs **0**.
4. **Number of EPP-funded graduates who participate in and complete NOAA agency mission-related postdoctoral level programs 1.**
  5. **Total new funds leveraged with NOAA EPP award** (including post-secondary student support) = **\$1,618,009**

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-two (22) students have been identified/recruited as members of Cohort 2 (2017-2018) including 7 Ph.D., 7 M.S., and 8 B.S. students. Seventeen (17) students have been identified/recruited as members of Cohort 3 (2018-2019) including 3 Ph.D., 4 M.S. and 10 B.S. students. So far, nine (9) students including 2 Ph.D., 5 M.S., and 2 B.S. students have been recruited into Cohort 4.

#### **Outputs:**

(a) Increased quantitative and analytical skills – Students are acquiring quantitative and analytical skills by taking courses such as Data Management for scientists that was offered at the Center in fall 2018, and by participating in internships and REU programs. LMRCSC students have also taken courses at their various institutions, such as Environmental Statistics I and II to enhance quantitative and analytical skills and to fulfill requirements for their degrees.

(b) Increased competence in applying STEM to decision making, policy and management. This was addressed by the Cohort Experience Workshop that took place April 1-5, 2019. The schedule of events is presented above in Table 1.

Increased skills to use large data sets, geographical information systems (GIS) and statistical analysis, computer modeling, and algorithm development – An online course was 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. Twenty-two (22) students have been identified/recruited as members of Cohort 2 (2017-2018) including 7 Ph.D., 7 M.S., and 8 B.S. students. Seventeen (17) students have been identified/recruited as members of Cohort 3 (2018-2019) including 3 Ph.D., 4 M.S. and 10 B.S. students. Nine (9) students including 2 Ph.D., 5 M.S., and 2 B.S. students have been recruited into Cohort 4.

- (a) **Number of degrees earned annually in NOAA mission-related disciplines** – Nine (9) students graduated this period including 2 Ph.D., 3 M.S., and 4 B.S. students.
- (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:** Twelve (12) students took part in NERTO internships at NOAA facilities under the supervision of NOAA scientists.

<b>Student Engagement with NOAA: Experience at NOAA Facilities</b>			
Student Name	Activity/project title	NOAA personnel involved	Location
Nicole Kleponis	Seabird lavage/salmon	Zamon	Oregon
Amanda Pappas	<i>Dinophysis</i> growth	Wikfors	NOAA Milford Lab, Connecticut
Halie O'Farrell	Fisheries independent data collection and harvest control rules for sharks	Enric Cortes	SEFSC Panama City, FL
Adrienne Wilson	Age and growth of Lane Snapper, a data poor species	Robert Allman	SEFSC Panama City, FL
LaTreese Denson	Environmental influences on indices of abundance for King Mackerel in the Gulf of Mexico examined through spatiotemporal geostatistical models	James Thorson	AFSC Seattle
Benjamin Frey	Monkfish Age Validation Using Hardpart Analysis of Known-age Cohorts	Anne Richards	NEFSC, Woods Hole, MA
Shadaesha Green	Striped Bass Habitat Indicator for the Chesapeake Bay	Bruce Vogt	NOAA Chesapeake Bay Office, Annapolis, MD
Ammar Hanif	Diet and microbiota of dreissenid mussels	Ed Johnson	NOAA Headquarters, Silver Spring, MD
Amanda Lawrence	Effect of CO <sub>2</sub> on the physiology of Dungeness crab	Paul McElhany	NWFSC, Mukilteo, WA
Wilmelie Cruz-Marrero	Caribbean conch survey	Ron Hill	SEFSC Galveston, TX
Shanelle Haughton	Understanding <i>Hematodinium</i> sp. in Alaskan crabs: new hosts, improved detection and health effects in a changing ocean	Pamela Jenson	AFSC Seattle, WA
Kasondra Rubalcava	Development of a Maryland Coastal Bays Ecosystem Model to Assess the Influence of Climatic Factors on Biomass Distributions of Fish and Macroinvertebrates, Food Web Linkages and Community Structure	Howard Townsend	Oxford, MD

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

The grant has made it possible for 7 collaborative research projects to be funded/selected for funding during the period of 2018 – 2019, which will enable more Center scientists to be available to mentor and advise undergraduate and graduate students. In addition, 28 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 LMRCS and degrees awarded that reflect the changing demographics of the nation.

<u>Outputs</u>	<u># During this Reporting Period</u>
Seminars	20
New courses offered	0
New programs developed	1
New degrees offered	0
# of students supported by the LMRCS	47
Total degrees awarded	9
Degrees awarded to URM	8

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

The recruitment of new URM (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 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 = **16** URM at the LMRCS took part in student development activities.

(b) Increased number of URM students who select to pursue higher education in NOAA mission fields = **47** URM at the LMRCS 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 two post-doctoral research associates, one at UMES, and another at SSU which have helped to 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 seven (7) LMRCSC TAB projects has a NOAA scientist as a collaborator.
- (b) **Number of NOAA scientists serving as mentors and advisors for student research:** 28 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 = 14**
- (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.**

Seven (7) collaborative research projects were funded by the LMRCSC for the period of 2018 – 2019. 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:**

	<u># from Projects Directly Supported with FY 16 Funds</u>	<u># from Leveraged Projects</u>
# of peer reviewed publications	4	23
# of presentations	25	24
# Tools developed	0	0
Use of LMRCSC research results and tools by NOAA & other stakeholders	0	0
# of instances LMRCSC publications are cited	153	304
# of LMRCSC students, staff or faculty recognized nationally for LMRCSC research	3	4

## LMRCSC TAB-funded Projects

In 2018-2019, the LMRCSC funded seven small research projects approved by the Technical Advisory Board (TAB). An additional seven projects were continued from the previous year's funding. Abstracts of the projects are presented below; more detailed reports can be found in Appendix II.

### TAB Project Abstracts for September 2019

Abstracts of the following TAB-supported projects are included in this report.

Project #	Principal Investigator	Title	Theme
19-01	Sook Chung & A. Lawrence (UMCES-IMET)	Baseline data on environmental impacts on physiological and molecular parameters determining growth for commercially valuable decapod crustacean management	Stock Assessment Support
19-02	Shanelle Haughton (UMES)	Evaluating physiological and immune responses of snow crabs ( <i>Chionoecetes</i> sp.) to <i>Hematodinium</i> infection	Climate and Ecosystems
19-03	Amanda Pappas (DSU)	Ecological investigation of a toxic harmful algal bloom species ( <i>Dinophysis acuminata</i> ) and its potential impact to the aquaculture industry of Delaware Inland Bays	Stock Assessment Support
19-04	Rose Jagus (UMCES-IMET)	Validation of Monkfish Age and Growth Using Microconstituent Analysis of Hard parts	Stock Assessment Support
19-05	Keala Pelekai (OSU)	Evaluation of age, natal origin, and trophic history of Pacific Lamprey ( <i>Entosphenus tridentatus</i> )	Stock Assessment Support
19-06	Hillary Thalmann (OSU)	Thermal impacts on juvenile Pacific Cod ( <i>Gadus macrocephalus</i> ) foraging and growth in Gulf of Alaska nursery habitats	Stock Assessment Support
19-07	Adrienne Wilson (RSMAS)	Population structure and growth of lane snapper, a data limited species.	Healthy Habitats
18-01	Brittany King, Ph.D. student, OSU	Underrepresentation in marine and fisheries science professions: how significant life experiences shape a diverse workforce	Stock Assessment Support
18-02	S. Chung, IMET	Baseline Data of Male Reproductive Status for Jonah Crab Management	Stock Assessment Support
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	Stock Assessment Support
18-04	Tara Cox (SSU)	Examining ecosystem health through contaminant analysis of common bottlenose dolphins ( <i>Tursiops truncatus</i> )	Stock Assessment Support
18-05	Matthew Ramirez, OSU	Integration of habitat-specific growth variation into assessment models: a case study in the Kemp's ridley sea turtle	Stock Assessment Support
18-08	Eric Lewallen, HU	Genetic-based methods for assessing prey composition and feeding ecology of Pacific lampreys	Stock Assessment Support
18-11	Enid Munoz, M.S. student, UMES	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	Healthy Habitats

## **TAB Project Abstracts**

**Project Number:** 18-01

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

**Thematic Research Area:** Fishery Socio-Economics

**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. This study focusses on the underrepresentation of racial and ethnic groups in marine and fisheries related science professions and aims to provide an analysis of how life experiences and identity shape marine and fisheries science related career decisions of individuals across different racial and ethnic groups and career levels (undergraduates, graduates and professionals). This study uses in-depth interviews and a qualitative data analysis approach to analyze the effects of life experiences and identity on career decisions. To date, we've conducted 24 in-depth semi-structured interviews with participants across different racial and ethnic groups and career levels (undergraduate student, graduate student, professional). Data obtained from these interviews has yet to be analyzed.

**Principal Investigator:** Brittany King, Oregon State University

**Co-PI:** Kelly Beidenweg, Oregon State University

**NOAA Partner:** Kevin Werner, NWFSC: Northwest Fishery Science Center

**Other Partner:**

**Students:** Brittany King (PhD, OSU)

**Keywords:** Fisheries; Social science; Underrepresentation

**Start Date:** 9/1/2018

**End Date:** 3/31/2020

**Project Number:** 18-03

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

**Thematic Research Area:** Stock Assessment Support

**Abstract:** The assessment of King mackerel in the Gulf of Mexico uses an index for estimating spawning stock biomass; this index is developed using a statistical model that is parameterized by fitting to larval count data from annual plankton surveys. The model used to make the index does not explicitly consider spatiotemporal variation, which is inherent to the larval count data or environmental variability which can also influence local population density. Biomass trends can be misrepresented by a 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 which help to achieve NOAA's sustainable fisheries goals. King mackerel spatial distributions vary over time as adults migrate seasonally and change their distribution based on the quality of their environment. Migrations cause shifts in their spawning locations from year to year, and this then impacts the larval stage as their distribution is dependent on the location of spawning, and the local oceanography. We have used geostatistical models to answer the following question: Will accounting for spatiotemporal variation reduce the uncertainty in the estimates of the index, or indicate new biomass trends? We have also used non-spatial general additive models to determine environmental factors that have a significant impact on King Mackerel density. Current results indicate that incorporating

spatiotemporal variability produces different trends in abundance. Results also suggest that time of day, chlorophyll, sea surface temperature, and depth impact larval mackerel density and should be considered in a geostatistical model to develop a more ecosystem based index of abundance. Further analysis should be conducted to validate these findings.

**Principal Investigator:** LaTrese Denson, University of Miami - Rosenstiel School of Marine and Atmospheric Science

**Co-PI:** Elizabeth Babcock, University of Miami - Rosenstiel School of Marine and Atmospheric Science

**NOAA Partner:** John Walter, SEFSC: Southeast Fishery Science Center

**Other Partner:** Dionne Hoskins-Brown, hoskins@savannahstate.edu

**Students:** LaTrese Denson (PhD, RSMAS); Alexandria Ambrose (Undergraduate, RSMAS)

**Keywords:** Fisheries; Marine Biology; Population dynamics; larval surveys, spatiotemporal modeling, biomass indices, King mackerel, Gulf of Mexico

**Start Date:** 9/12/2018

**End Date:** 8/31/2019

**Project Number:** 18-04

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

**Thematic Research Area:** Healthy Habitats

**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 project aims 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. A total of 60 genetic samples and 51 POP samples were collected in February and March 2019. The genetic samples were sexed by Dr. Patty Rosel at a NOAA lab. The POP samples were analyzed by LMRCSC student Sena Tay in summer 2019 in G. Ylitalo's lab at the Northwest Fisheries Science Center. Specifically, Tay analyzed POP concentrations in 34 adult male bottlenose dolphins. Tay et al. manuscript is currently in preparation with G. Ylitalo and members of her lab.

**Principal Investigator:** Tara M. Cox, Savannah State University

**Co-PI:** Carolina Bonin Lewallen, Hampton University

**NOAA Partner:** Gina Ylitalo, NWFSC: Northwest Fishery Science Center

**Other Partner:**

**Students:** Sena Tay (Undergraduate, SSU)

**Keywords:** Protected Species

**Start Date:** 8/1/2018

**End Date:** 7/31/2019

**Project Number:** 18-05

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

**Thematic Research Area:** Stock Assessment Support



**Abstract:** Spatiotemporal variation in demographic parameters can strongly influence a species' population dynamics but is generally not included in sea turtle population due in part to lack of sufficient data. For example, Kemp's ridley sea turtles that inhabit the U.S. Atlantic Coast grow slower than conspecifics that inhabit the U.S. Gulf of Mexico (GoM) Coast, which may lead to differences in age at maturation for individuals or whole cohorts. To evaluate the influence of this variation on Kemp's ridley population dynamics, we are developing an improved age-structured population model that incorporates habitat-specific vital rate estimates (growth, survival). Using a ~30 year dataset of somatic growth rates obtained through skeletochronology, we have developed habitat-specific (Atlantic, GoM) maturation schedules for this species. In addition, ongoing analyses are using 20 years of stranding length frequency data collected through the Sea Turtle Stranding and Salvage Network to estimate habitat-specific survival rates that will be included in the model. Ongoing analyses will examine model sensitivity to changes in stage-and habitat-specific model parameters. This project will help answer critical questions about the contribution of somatic growth variation, habitat use, and Atlantic turtles, which have been excluded from all existing population models, to Kemp's ridley population dynamics.

**Principal Investigator:** Matthew Ramirez, Oregon State University

**Co-PI:** Selina Heppell, Oregon State University

**NOAA Partner:** Jeffrey Moore, SWFSC: Southwest Fishery Science Center

**Other Partner:** Elizabeth Babcock, RSMAS

**Students:** Matthew Ramirez (PhD, OSU); Tamara Popovska (Undergraduate, OSU)

**Keywords:** Marine Biology; Protected Species; Population dynamics

**Start Date:** 9/1/2018

**End Date:** 8/31/2019

**Project Number:** 18-08

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

**Thematic Research Area:** Stock Assessment Support

**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).

**Principal Investigator:** Eric A. Lewallen, Hampton University

**Co-PI:** Carolina Bonin Lewallen, Hampton University

**NOAA Partner:** Laurie Weitkamp, NWFSC: Northwest Fishery Science Center

**Other Partner:** Linda Park, NWFSC: Northwest Fishery Science Center

**Students:** Josette McClean (MS, Hampton U); Janelle Layton (Undergraduate, Hampton U)

**Keywords:** Bycatch; Fisheries; Marine Biology; Population dynamics; Ecosystems

**Start Date:** 4/1/2019

**End Date:** 8/31/2021

**Project Number:** 18-11

**Title:** Assessment of Microplastics in *Placopecten magellanicus* as Possible Indicators of Plastic Pollution from the Georges Bank, Mid-Atlantic Stock Fisheries

**Thematic Research Area:** Healthy Habitats

**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 is 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 and what kind of polymers compose the microplastics that pollute scallops. 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. A subsample of microplastics will be analyzed with Raman spectroscopy to characterize plastic composition. 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 an ecologically and commercially important species.

**Principal Investigator:** Enid Munoz Ruiz, University of Maryland Eastern Shore

**Co-PI:** Ali Ishaque, University of Maryland Eastern Shore (UMES)

**NOAA Partner:** Ashok Deshpande, NEFSC: Northeast Fishery Science Center

**Other Partner:**

**Students:** Enid Munoz Ruiz (MS, UMES)

**Keywords:** Fisheries; Ecosystems; Toxicology, pollution, microplastics

**Start Date:** 6/1/2017

**End Date:** 5/30/2019

**Project Number:** 19-01

**Title:** Baseline data on environmental impacts on physiological and molecular parameters determining growth for commercially valuable decapod crustacean management

**Thematic Research Area:** Stock Assessment Support

**Abstract:** The crustacean fishery in the US has been challenged due to drastically reduced landing for several decades, including the blue crab (*Callinectes sapidus*) industry in the Chesapeake Bay. Crustacean growth is hormonally regulated while environmental conditions as stress factors often have adverse effects on growth. The vast genetic diversity of *C. sapidus* is reflected in size variation and differential growth rates. This proposal seeks to measure physiological and molecular parameters that define stress impacts on the growth of animals with differential growth rates. Ultimately, the current project seeks to generate a model that will be applied to all commercially important decapod crustaceans for growth prediction under normal and stressful conditions in natural habitats.

**Principal Investigator:** J. Sook Chung, University of Maryland Center for Environmental Science

**Co-PI:** Elizabeth A. Babcock, University of Miami - Rosenstiel School of Marine and Atmospheric Science

**NOAA Partner:** Paul McElhany, NWFSC: Northwest Fishery Science Center

**Other Partner:** None

**Students:** Anya Byrd (PhD, UMCES-IMET); Adjele Wilson (Undergraduate, UMES)  
**Keywords:** Marine Biology; Population dynamics  
**Start Date:** 9/2/2019      **End Date:** 9/1/2020

**Project Number:** 19-02

**Title:** Evaluating physiological and immune responses of snow crabs (*Chionoecetes* sp.) to *Hematodinium* infection

**Thematic Research Area:** Stock Assessment Support

**Project Description:** *Hematodinium* is a parasitic dinoflagellate parasite that causes bitter crab disease in infected crustaceans. Tanner crabs (*Chionoecetes bairdi*) and snow crabs (*Chionoecetes opilio*) are important fished crustaceans from the Bering Sea commonly sold collectively as snow crabs. These populations are at risk due to the high prevalence of *Hematodinium* sp. *Hematodinium* has been studied and detected worldwide, but questions remain about the parasite's life cycle and specifically how it infects the host and evades host immune destruction. *Hematodinium* may affect regulation of metabolic gene expression in infected crabs, based upon observed changes in biochemical composition. This study will determine how *Hematodinium* affects the regulation of these genes by identifying metabolic genes perturbed by infection, through analysis of mRNA transcriptomes from the hepatopancreas. In addition, we will analyze the host immune response through analysis of transcriptomes from hemocytes of infected crabs.

**Principal Investigator:** Shanelle Haughton, UMES: University of Maryland Eastern Shore (UMES)

**Co-PI:** Dr. Joseph Pitula, UMES: University of Maryland Eastern Shore (UMES)

**NOAA Partner:** Dr. Pamela Jenson, AFSC: Alaska Fishery Science Center

**Other Partner:**

**Students:** Shanelle Haughton (PhD, UMES); Reuel Danquah (MS, UMES)

**Keywords:** Fisheries; Marine Biology; Climate Change

**Start Date:** 7/10/2019      **End Date:** 5/31/2020

**Project Number:** 19-03

**Title:** Ecological investigation of a toxic harmful algal bloom species (*Dinophysis acuminata*) and its potential impact to the aquaculture industry of Delaware Inland Bays

**Thematic Research Area:** Healthy Habitats

**Project Description:** The rise of a new aquaculture industry in the Delaware Inland Bays will require the development of management practices. To protect environmental and human health the monitoring of HABs species is necessary. Dinoflagellates can form a resting cyst life stage that allows them to remain viable in the sediments after a bloom has passed and may act as the inoculum to future blooms when environmental conditions become ideal (Lewis et al. 1999). This project will investigate the presence of cysts in the sediments of Rehoboth Bay specific to the dinoflagellate genus, *Dinophysis*. This genus is known to produce okadaic acid, diarrhetic shellfish toxins (DST) and pectenotoxins (PTXs) (Reguera 2012). These toxins cause Diarrhetic Shellfish Poisoning (DSP) in humans even when cell densities of *Dinophysis* sp. are low (<103 cells·L<sup>-1</sup>) and have been responsible for harvesting closures at aquaculture sites in Northern Japan, Chile, and Europe (Reguera et al. 2014). Developing methods to monitor cyst abundance within the sediments during winter months may assist in the prediction of future bloom patterns.

**Principal Investigator:** Amanda Pappas, DSU: Delaware State University

**Co-PI:** Gulnihal Ozbay, DSU: Delaware State University

**NOAA Partner:** Gary Wikfors, NEFSC: Northeast Fishery Science Center

**Other Partner:**

**Students:** Detbra Rosales (PhD, UMCES); Amanda Williams (MS, Other); Raymond Andrews (Undergraduate, DSU)

**Keywords:** Aquaculture; Plankton; HABs

**Start Date:** 3/1/2019                      **End Date:** 2/29/2020

**Project Number:** 19-04

**Title:** Validation of Monkfish Age and Growth Using Microconstituent Analysis of Hardparts

**Thematic Research Area:** Stock Assessment Support

**Project Description:** We are developing and validating a novel aging method for monkfish, *Lophius americanus*, to support stock assessment. The length modes for the strong 2015 year class (YC) have been clearly delineated through successive seasonal surveys, thus effectively providing monkfish of known age. Our collaborator, Dr. Anne Richards, a stock assessment expert for monkfish at the NEFSC Fisheries Biology Program has collected monthly samples of this YC from 6-mo old fish. The objective of this study is to analyze seasonal cycles of hardpart microconstituents (Ca, P, and Sr) from this YC at ages 0-3 y to compare with optical zonation methods. The patterns observed in the known age fish will provide a key to interpreting optical zonation patterns in fish of unknown age, filling a major gap in the data needed for quantitative assessment of monkfish and leading to improved scientific advice to fishery managers. The project is providing training at UMCES-CBL and NEFSC, Woods Hole, of a minority master's student.

**Principal Investigator:** Rosemary Jagus, UMCES: University of Maryland Center for Environmental Science

**Co-PI:** David Secor, UMCES: University of Maryland Center for Environmental Science

**NOAA Partner:** Anne Richards, NEFSC: Northeast Fishery Science Center

**Other Partner:**

**Students:** Benjamin Frey (MS, UMCES)

**Keywords:** Fisheries; Population dynamics

**Start Date:** 9/1/2019                      **End Date:** 8/31/2020

**Project Number:** 19-05

**Title:** Evaluation of age, natal origin, and trophic history of Pacific Lamprey (*Entosphenus tridentatus*)

**Thematic Research Area:** Stock Assessment Support

**Abstract:** The Pacific Lamprey (*Entosphenus tridentatus*) is an anadromous species native to the North Pacific Ocean. In the last 50 years, it has experienced declines in abundance within the Columbia River Basin, USA. More information on the biology and ecology of this species is needed for conservation and management. Anatomical structures have been widely used in fisheries science for biological inference yet remain relatively unexplored in Pacific Lamprey. The goal of this proposal is to broaden our understanding of lamprey by evaluating the efficacy of different structures for determining age, natal origin, and trophic position. These objectives will be achieved using lamprey statoliths and eye lenses taken from known age and origin specimens.

**Principal Investigator:** Keala Pelekai, Oregon State University  
**Co-PI:** Jessica Miller, Oregon State University  
**NOAA Partner:** Laurie Weitkamp, NWFSC: Northwest Fishery Science Center  
**Other Partner:** Eric Lewallen, Hampton University  
**Students:** Keala Pelekai (MS, OSU)  
**Keywords:** Fisheries; Protected Species; Population dynamics; Ecosystems  
**Start Date:** 6/1/2019                      **End Date:** 4/1/2021

**Project Number:** 19-06

**Title:** Thermal impacts on juvenile Pacific Cod (*Gadus macrocephalus*) foraging and growth in Gulf of Alaska nursery habitats

**Thematic Research Area:** Climate and Ecosystems

**Abstract:** The Gulf of Alaska is influenced by thermal variation including climatic phenomena and marine heat waves such as the warm 'Blob' of 2013-2016. Warming events are expected to impact age-0 Pacific Cod (*Gadus macrocephalus*) during summer growth in coastal nurseries and can influence patterns of foraging, selective mortality, and overwinter survival. Understanding thermal impacts on juvenile Cod is especially relevant given their largescale declines in adult abundance following the 'Blob'. I will examine juvenile Cod in Kodiak Island nurseries between 2006 and 2019 during representative warm and cold years in order to describe variability in hatch phenology, nursery growth, diet composition, and trophic position using otolith increment, stomach content, and stable isotope analysis. Expected results will inform Cod recruitment patterns in the face of climate change and contribute to nursery management during future warming.

**Principal Investigator:** Hillary Thalmann, Oregon State University  
**Co-PI:** Jessica Miller, Oregon State University  
**NOAA Partner:** Ben Laurel, AFSC: Alaska Fishery Science Center  
**Other Partner:** Bradley Stevens, UMES  
**Students:** Hillary Thalmann (MS, OSU); TBN summer intern in 2020 (Undergraduate, OSU)  
**Keywords:** Fisheries; Protected Species; Population dynamics; Ecosystems; Habitats; Thermal variability  
**Start Date:** 9/1/2018                      **End Date:** 6/30/2021

INTENTIONAL BLANK PAGE

**NOTE: INSERT BLANK PAGE BEFORE NEXT SECTION OF REPORT**

## 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:	\$170,030
Stipend:	\$364,294
Travel:	\$39,111
NERTO:	\$37,146
One-time Research:	\$16,409
<u>Professional Development:</u>	<u>\$10,241</u>
<b>Total:</b>	<b>\$637,431</b>

**Collaborative Research:**

Seven (7) collaborative projects were funded during this reporting period totaling **\$233,538** in direct funds.

### 2. Total leveraged 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	6/1/18	5/30/21	\$300,000	\$50,000	Chigbu, P.	Research Experience for Undergraduates	Provided support for some students during the summer; salary support for LMRCS faculty during the summer
NSF	Grant	7/1/16	6/30/19	\$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 LMRCS cohort 2 student tuition.
NSF	Grant	8/1/13	7/31/18	\$900,000	\$180,000	Cuker, B	Multicultural Diversity in the Aquatic Sciences	Funds are used to support students to attend ASLO conference.

NSF GRF	Fellowship	9/1/20	8/31/23	\$108,000	na	Hillary Thalmann		Provides stipend and tuition for H. Thalmann
NSF NRT	Fellowship	9/1/19	8/31/20	\$36,000	na	Hillary Thalmann	Risk and Uncertainty Quantification in Marine Science	Provides stipend and tuition for H. Thalmann
NPRB Fellowship	Fellowship	9/1/20	8/31/23	\$25,000	na	Hillary Thalmann	Thermal impacts on GOA Pacific Cod nursery residence	Provides research and travel support for H. Thalmann
Univ. of Miami Institute for Advanced Study of the Americas (UMIA) 2019 UMIA Field Research Grant	Travel	Summer 2019		\$2,000	\$2,000	Adrienne Wilson	Population structure and growth of lane snapper, a data limited species	Cohort 2 PhD student Adrienne Wilson got experience with grant-writing, and was able to collect lane snapper samples in Belize for her dissertation work
CIMAS	Grant	9/1/19	8/1/18	\$49,198	\$0	Elizabeth Babcock	Evaluation of Management Strategies for Fisheries Ecosystems, additional funds	Funding will help support at least one PhD student from LMRCS
NSF I-USE GEOPATH S-IMPACT Award	Continuing award	8/1/18	7/31/19	\$177,512	not reported	Sue Ebanks	GP-IMPACT: Expanding HBCU Pathways for Geoscience Education	
Bunting Foundation	award	1/1/19	TBD	\$65,000	\$0	Rosemary Jagus	Support IMET Summer Internship	Funding supports IMET Summer Internship, 2019
Anonymous donor	award	1/1/19	TBD	\$20,000		Rosemary Jagus	Support IMET Summer Internship	Funding supports IMET Summer Internship, 2019
NIST	Grant	9/1/17	8/31/19	\$112,050	\$6,792	J. Sook Chung	New method development for measuring low concentration of protein/peptide	Funds were used to support Amanda Lawrence for stipend, tuition, travel and research
NSF	REU supplement	3/1/19	6/30/20	\$15,000		Eric Schott	Determining how variation in life history & connectivity drive pathogen-host dynamics	Supplemental funds for summer intern
Ratcliffe Foundation	Award	7/1/14	6/30/20	\$1,000,000	\$131,148	Russell Hill/Nina Lamba	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
NSF	Grant	5/31/18	5/31/20		\$500,000	Freeman Hrabowski; Co-PI Dr. Moses Kairo and Dr. Joe Pitula	LSAMP Bridge to Doctorate	Funds are used to recruit students to the LMRCS and other UMES graduate programs
National Park Service	Grant	9/15/18	5/30/19	\$32,242	\$8,061	Bradley Stevens	Oyster Spat Settlement	Funds used to support MS student, Maddie Farmer and



								partial salary for Brad Stevens
MD Sea Grant	Grant	9/15/18	5/30/19	\$10,000	\$0	Bradley Stevens	Oyster Spat Settlement	Funds used to support MS student, Maddie Farmer

**Total=\$888,001 for the reporting period**

**Collaborative Research:**

Source	Type	Start date	end date	Total amount	Current 6 month period	PI	Project title	Contribution to Center
NSF	Grant	2/1/15	1/31/18	\$200,000	\$30,000	Gibson, D.	Cryptic Diet of the Doliolid...	Funds are used to support Research Associate and LMRCSC graduate Alexandria Salcedo.
NSF	Grant	10/1/16	9/30/21	\$5,000,000	\$500,000	Chigbu, P.	CREST Center for the Integrated Study of Coastal Ecosystem Processes and Dynamics	Provided summer salary support for some LMRCSC faculty
USDA	Grant	2017	2020	\$500,000	\$83,000	Parveen, S.	<i>Shewanella</i> Species as Potential Emerging Pathogens in Oysters and Seawater from Apalachicola, Chesapeake and Maryland Coastal Bays	Provides summer salary for LMRCSC faculty
North Pacific Research Board	Grant	1/1/20	12/31/22	\$257,000	na	Jessica Miller	Thermal effects on spawn timing and early growth of Gulf of Alaska Pacific Cod: Implications for survival & recruitment	Funds will support research started by H Thalmann and provides salary support for Miller
NOAA NMFS	MOU	1/1/00	continuing	\$100,000	\$50,000	Dionne Hoskins	NOAA CMER	Support a NMFS FTE for a CMER program
Ocean Leadership	Grant	12/1/18	6/30/19	\$10,000	\$10,000	Dionne Hoskins, Victoria Young	NOSB Regional Site	Produce the GA-SC NOSB competition
NSF	Grant	5/1/12	4/30/19	\$627,489	\$22,236	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
NSF	Grant	10/1/17	9/30/19	\$36,285	\$4,363	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	11/1/17	6/30/19	\$9,370	\$194	Eric Schott	Opening the door for research on a pathogenic virus of the soft clam <i>Mya arenaria</i>	Funds support PIs salary
NSF	Grant	7/1/17	6/30/20	\$359,437	\$30,215	Eric Schott	Determining how variation in life history & connectivity drive pathogen-host dynamics	Funds support PIs salary

**Total = \$730,008 for the reporting period**

# Appendices

## Appendix I: External Evaluations Report of the LMRCSC

### Living Marine Resources Cooperative Science Center External Evaluation Year 3 Report (2018-2019)

#### **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.

#### **Evaluation Plan**

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? □*

The emphasis on *evidence claims* in these guiding questions is consistent with the external evaluation planned and underway for the LMRCSC as implemented by Bishop and Walters. Annually, the external evaluators are implementing data collection to obtain evidence 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 LMRCSC to collect evidence that supports the overarching questions and the project goals and objectives.

#### **Year Three Data Collection and Evaluation Focus**

For year three of the external evaluation, evidence collection focused on current graduate and undergraduate students, NOAA Scientists who are working with these students or with the LMRCSC in a support position, and project co-PIs. In the fall of 2018, surveys were developed and disseminated to the LMRCSC funded students in the NERTO projects and the TAB projects, as well as to the NOAA and university scientists who were working with these students. A follow-up survey for undergraduate students was disseminated in late Spring 2019.

Additionally, the evaluation effort continued at the Spring 2019 student workshop held at the

University of Maryland—Eastern Shore campus. The evaluators attended the workshop again in 2019 to conduct interviews with select students and project leadership, and to administer a post-workshop survey to the student participants.

Finally, the evaluators implemented a series of site visits to interview select project personnel in the spring, 2019, semester. In January of 2019, the evaluators visited the University of Miami, Rosenstiel School of Marine and Atmospheric Science, to interview one of the LMRCSC co-PIs, Dr. Beth Babcock, and two of the graduate students at that location who are funded by LMRCSC. In May 2019, the evaluators visited with Dr. Ashok Deshpande, a researcher at the James J. Howard Marine Sciences Laboratory at Sandy Hook NJ. Dr. Deshpande is an ongoing mentor to LMRCSC students and a member of the technical advisory committee for LMRCSC, who has supervised both TAB and NERTO projects. And finally, in June 2019, the evaluators attended the LMRCSC Science Meeting in Silver Spring, MD, to interact with and interview select students, project personnel, NOAA scientists and NOAA EPP personnel.

The evidence summaries in the following narrative are organized under subheadings to delineate the source of the data. In most cases, the surveys are summarized entirely, but in the interest of space, select items that were not intended to align with the NOAA EPP guiding questions, or which failed to elicit adequate response data were abridged or omitted.

### ***NERTO Student Survey Data and Summaries***

A group of five students provided extensive response data to describe their NERTO projects and other, related information regarding their participation in LMRCSC. Student projects included research on or in: fisheries related to striped bass and menhaden; fisheries related to black sea bass and NOAA HabCam system; flow cytometry training; PBDE extractions training and related work; and oyster health. All of these projects clearly extend NOAA's mission science as required under the overarching questions noted above. When asked to sort their projects based on NOAA priorities, most students selected seafood safety and aquaculture, followed by ecosystem science, living resource management, and fisheries health. Three of the five were required to manage, analyze or manipulate large datasets during their NERTO experience, and three of the five also considered the social science implications of their research during the NERTO.

Items five through ten on the survey drilled down to the relationships between the students and the NERTO mentors. An important observation was the duration of the relationships between the scientists and students. While one student reported working with the mentor for only one semester, the remaining students reported extensively longer working relationships: from a full academic year (two more students) to multiple years (the additional two students). The durability of these working relationships suggests a strong commitment to this element of LMRCSC by the NOAA scientists, but also the strong possibility that these mentoring relationships have become more than one dimensional academic projects, and likely are authentic mentorships. Response data (item 6) shows an average of over 20 hours weeks of work time with the mentor directly on these projects—again contributing to the evaluator conclusion that these are authentic mentorship relationships. Students further reported multimodal communications strategies from in person to a variety of distance communications technologies involved in the project. Every student reported that the mentor had provided positive support for their academic work, with most skewing toward significant support. The same was observed regarding support for the students' professional careers: students perceived strong, positive support for their professional development from these NOAA scientists. And finally, narrative response data is consistently found to strengthen the value of selected response or ranked response items. These students provided rich affirmations of the role of their mentors/NOAA scientists:

- My mentor has supported my career development by serving as a recommender for both a PhD opportunity involving fisheries analysis as well as a NOAA job opportunity;
- He introduced me to and integrated me into a federal science career environment. He involved me in weekly meetings, introduced me to colleagues in the lab, helped me make connections with people involved in research similar to mine, and was always available to support or to answer questions I had;

- Provided excellent information on the process of conducting research for the federal government.
- He proof reads all of my work and offers constructive criticism. Keeps me up to date with workshops and conferences;
- He has communicated with me about post-doctoral fellowship and other agencies I should apply for jobs with.

Items eleven and twelve asked about primary benefits and career skills that were obtained from the NERTO project. Students provided a range of technical and laboratory related skills, but more interestingly, described the social benefits of networking, working in a NOAA lab, and making connections in that environment as it related to their life and career choices. This was true in item twelve as well. There were skills listed: working in R, lab skills, image analysis skills, lab skills, record keeping. But responding students also pointed to networking, working on teams and collaboratively, and working in a multidisciplinary environment as well.

Items thirteen through eighteen were a series of selected response or ranking items related to careers and academic success. All of the students strongly agreed or agreed that NERTO was a positive influence on career decisions. Four of the five agreed that NERTO helped with other academic work. Each student suggested that NERTO had inspired them toward a career choice—using language like encouragement, collaboration, providing insight, and helping me realize. Four of the five respondents were highly positive that NERTO had given them good insight into NOAA organizational culture (in the context of eventual career choices) and four of the five perceived that NERTO had created a network for the student that was related to future success in the workforce. From other items in the survey, it seems that the fifth student in the above response sets who seems not to have had such a positive perception or outcome had developed concerns about employability in NOAA with federal budget issues and job openings. These concerns may not be unwarranted and should be considered in the broader challenge of recruiting underrepresented populations into the federal workforce at a time when the federal workforce is experiencing serious stresses.

Item nineteen asked to what extent the mentor introduced the students to other colleagues (an opportunity that was mentioned briefly above by a couple of respondents). Each of the five reported some instance of this occurring, with three stating “quite a bit” and one reporting “significantly.”

Item twenty asked about any challenges the students experienced scheduling or completing their NERTO projects. There were no actionable clusters of responses to this item. Two students described difficulty obtaining housing. One described difficulty obtaining information and forms, but clarified that it was obvious the website had been updated and improved, and that Dr. Chigbu was accessible to students and able to help. This student was the only substantive respondent to item twenty-one (what other types of support would have improved the experience) and described a need for better access to the forms. A single student response should not be considered actionable in this case, as the issue was not recognized by the other students.

Item twenty-two asked respondents “what have you learned about the social implications of your science during your NERTO experience?” This item is directly attached to previous interests expressed by NOAA EPP. The responses were, overall, weak to this item, suggesting that students were not attuned to these social implications. This may be considered in reviewing the programming for the graduate student workshops and webinars moving forward.

Item twenty-three asked respondents, “As a result of my NERTO experience, I feel a sense of belonging to NOAA mission science fields.” Again, this item emerged directly from NOAA EPP stated interests for the Centers. Each of these five respondents Strongly Agreed or Agreed that this was a true statement.

Item twenty-four solicited any additional career support information that LMRCSC might provide, and elicited only one substantive response: the respondent had encountered George Liles’ presentation regarding NOAA employment and suggested that other LMRCSC students be made aware of this content and presentation.

Item twenty-five asked for suggestions “to improve the NERTO process” that students would like to suggest to the LMRCSA administration. While there was no single cluster of similar responses, individually, four of the responses seemed substantive (note: the evaluators are only passing these on to the LMRCSA leadership; we make no judgment as to the relevance nor credibility of the responses). These responses included:

- Some of the information on the process for establishing and completing the NERTO seem very ambiguous. It would help to establish clearer and more precise instructions;
- I believe it’s unnecessary and redundant to develop a project with your NOAA mentor, and then have to go through the whole SSIO application process like there’s a possibility you’re not going to get the internship;
- More involvement in the NERTO setup to diminish setbacks and speed the process;
- Have the university not take so long with the paperwork.

### ***NERTO Scientist/Mentor Survey***

An electronic survey was created and disseminated to the NOAA scientists who developed and/or supervised the student projects to obtain their perspectives on the projects, with four of these individuals providing responses. The reader should note that these projects include the same ones to which the students responded in the previous section, but from the scientist’s perspectives. For the projects represented by these individuals, two were focused on ecosystem science and two on stock assessment. Two of the respondents also included living resource management, and physiology and immunology as topic areas. Of interest, none of the scientists report social impacts of these NERTO projects—suggesting some disconnect in the use of this language between the NOAA EPP indicator language and the NOAA field scientists. This should be reviewed by LMRCSA leadership personnel.

Item four asked respondents to “describe any opportunities your NERTO intern(s) had to practice large data set management or analysis during the project.” The responses mirrored the students substantively: learning new modeling and programming techniques; preparing aging structures for lane snapper by, in part, querying a life history database, entering and extracting records; statistical modeling procedures; and managing large flow-cytometric data sets emerging from the project. These seem to support and model NOAA EPPs stated interest in conveying these skills to the LMRCSA graduate students.

Items five through eleven were a series of short or selected response items regarding discrete aspects of the mentoring role. Respondents each worked with a single student (item five), with three of the respondents working up to five hours weekly, and one working up to ten hours weekly. Each of the respondents perceived the time allocated for project work was appropriate. With respect to mentoring aspects of the work, one respondent reviewed online materials and one referenced forms that were required, but none described or offered that they were offered or provided support to guide the mentoring aspects of the work with graduate students. Nevertheless, all of the scientists perceived they were sufficiently prepared for this mentoring role, and each perceived that they were matched well with the students with whom they worked, and that their students were well prepared for the work requirements.

The scientists were asked to describe the types of work and skills-practice they required of their interns. These responses included:

- He had to practice new modeling and computer programming methods, such as how to develop his own likelihood formulae and estimate parameters to maximize the likelihood in the computer coding software R;
- The intern learned how to age lane snapper, constructed growth curves and tested for differences between male and female growth curves;
- Field work—collecting fish, invertebrates, and water quality data. Lab work—preparing samples for stable isotope analysis. Analytical work—statistical modeling stable isotope ratios;

- Collecting hemolymph samples from mussels and conducting flow-cytometric analysis of hemocytes probed with fluorescent indicators of specific physiologies.

These skills correlate substantially with expectations for NOAA mission science content areas, and support a conclusion the NERTO projects were well developed for both NOAA EPP goals, and to support the graduate students learning and development for the NOAA science career pipeline.

The remaining survey questions probed additional aspects of the NERTO, the mentorship, NOAA alignment concerns, and the broader goals and objectives of the LMRCSC. For each of the respondents, these were new relationships with new students, with little if any prior contact between the scientist and student. Three of the scientists further described how the project had also afforded “social and emotional support to the students” as a component of the mentoring experience. This included helping obtain housing for a student, involving the student in social activities with other colleagues and lab staff, career discussions, and assistance with research writing and presentation skills. The scientists not only helped students develop technical skills, but discussed the relationship of the project to potential dissertation topics, career plans, and future research. Three of the respondents further described explicit opportunities and experiences that further linked the student to the NOAA specific research field. These included opportunities to work with several other, related research programs in the same lab, meeting personnel, providing papers to the student that supported the work, and inviting the student to participate in other field survey programs. Three of the four also intentionally introduced the students to other colleagues in the research field—which would be invaluable for expanding the students’ networks of potential mentors, advisors, and potential employment opportunities.

Item eighteen asked “what do you perceive to be the benefits of the NERTO to students?” The responses were varied and worth duplicating here, as again, these seem to support the overarching NOAA EPP mission and LMRCSC goals and objectives for graduate students:

- Opportunities for networking and being mentored on expertise not available at their local institution.
- The intern was able to experience several research programs conducted by a NOAA laboratory and interact with federal scientists. This experience would be helpful in determining if a career as a federal scientist would be a good fit.
- It opens up other doors/avenues for students to learn about research in other organizations. It provides an opportunity for students to network with other scientists outside of their university.
- The student had access to sophisticated technology and a group of scientists and technicians familiar with their operation and usefulness.

Item nineteen reversed the previous question’s focus, and asked “what were the benefits of the NERTO to you as a researcher?” for the scientists to consider. The responses included networking and capacity building, and the opportunity to get important work completed with student help. Interestingly, one scientist commented on the enthusiasm of the intern as a help to the scientists, causing them to remember the reason why they were doing their work. One respondent reported he/she advanced her own knowledge because the internship prompted him/her to study an area of science that wasn’t familiar prior to launching the project. A second scientist also reported personal learning from the results of the student’s project.

Item twenty sought to capture any specific challenges to undertaking the NERTO, but given the sample size of responses, no theme emerged in the data. One respondent, however, pointed to the difficulty in finding housing for the student—an issue that emerged in conversation with another scientist with the evaluation team at a site visit to one of the project co-PI facilities.

Each of the respondents perceived that the NERTO projects were related, or significantly related to NOAA mission science. The respondents further perceived that all of these graduate students were good candidates for future NOAA mission workforce employment—which is a primary

goal of NOAA EPP for the LMRCSC.

In the closing survey items, when given the opportunity to advise the LMRCSC regarding additional support for interns, no substantive responses emerged. The scientists did offer that they wished personally that they had obtained additional training in analytical programming, statistical analysis, and support developing a generalized ability to continue learning, as employment skills will change over time from graduate school.

In the main, when comparing the responses of the NERTO supervising NOAA scientists and the NERTO graduate students, there is a singular focus from both audiences that the projects were highly positive, related to NOAA mission science, were heavily skills-driven and developmental for the students (and in some cases also for the scientists). While this response number is low, the consistent data suggest that LMRCSC is also serving an important professional development function with the NOAA scientists themselves. This should be considered part of support for NOAA science under the overarching questions provided by NOAA EPP, and as further evidence that the LMRCSC is strong, and accomplishing—with supportive evidence—its goals and objectives for students and for NOAA science and scientists.

### ***TAB Project Scientist Data***

Similar to the NERTO scientist and student surveys summarized above, the scientists and students who sponsored, led, or participated in TAB projects for the LMRCSC over the previous year were surveyed to obtain descriptive and impact data to describe the implementation of this important element of the LMRCSC. A total of nine scientists responded to the survey, with five responding for multiple projects and four responding for a single TAB project. Seven of the respondents were university faculty members, and two were NOAA scientists. The written descriptions of the TAB projects were clearly aligned with NOAA mission science. These included work with harmful algal blooms, diseases impacting blue crabs, distribution and persistence of HABs, a variety of baseline modeling projects on a number of commercial valuable fin-fish and shell fish species, and a variety of habitat projects. The scientists were asked to assign a content area to their respective projects based on NOAA categories important to EPP for the LMRCSC. The responses indicated 44% were related to ecosystem science, 33% to living resources management, and 22% to stock assessment work. And while the NERTO scientists were ambiguous with regard to the social impacts of those projects, there were clear and distinct social impacts described for the TAB projects, including:

- The impact of land use on HABs and related fisheries;
- Improving sustainability of fisheries and improving management of sea turtles;
- Broader impacts to coastal habitats and species, including impacts on HABs to shellfish aquaculture;
- Some indication of community outreach work associated to TABs;
- Better definitions of habitats for impacting species; and
- The use of data to define fishery target groups, set catch or size limits, and to establish policies and restrict habitats.

Item six asked respondents to “describe any opportunities your students had to learn or practice large data set management or analysis during the project. The responses were clear that this was indeed a significant learning objective or outcome of the TAB projects, and supported this important feature of the LMRCSC. Examples from the substantive narrative responses that are typical of the set of responses included:

- Analyzing deep sequencing results of bacterial populations in oysters;
- A student will work with large data set of stranded sea turtles and produce a large data set of results on growth and isotope ratios in sea turtle bones;
- The student learned how to extract water quality information from a Regional Ocean Modeling System (ROMS) model.
- Students collect and analyze their own data. Some use larger data sets collected by NOAA or other agencies. Projects that used such data include Cold-water Corals



(NOAA Habitat dataset); Black sea bass food habits (NOAA food habits database); and BSB habitat suitability (Chesapeake Bay ROMS and climate data).

Item seven revealed a range of, typically, 1-3 students per scientist working on TAB projects, although one scientist responded that he/she led a group of 7-8 graduate students and 10-12 undergraduate students, working in teams of 1-2 per project. Eight of the nine scientists reported working approximately 5 hours per week (up to) and one of the respondents reported working more than twenty hours per week. It is presumed this last respondent was also the respondent working with the larger number of students in item seven above. Seven respondents indicated their time allocation for the TAB students/projects was appropriate, with one scientist indicating that the time required was excessive.

Item ten asked scientists to “describe the preparation received to mentor students in a TAB project.” While most did not point to preparation specific to the LMRCSC, it was clear that these were experienced scientists, who had mentored numerous students over the years in research settings and felt comfortable extending their prior experience into the LMRCSC work. In a direct probe of this confidence in item eleven, all of the scientists reported their preparation for mentoring students was sufficient for these TAB requirements.

Item twelve revealed all nine scientists perceived that there was a strong and positive match between the students they were assigned or selected, and themselves personally. Item thirteen continued this strong positive assessment, revealing that all the scientists perceived their students were adequately prepared for the projects as assigned. Item fourteen probed more deeply into these work projects, by asking the scientists to describe the work and skills-practices required of the students in these TAB projects. These responses as anticipated reflected a wide range of scientific skills for laboratory, field, and analytic work, including a variety of specific content topic areas related to particular species involved in the projects.

Item fifteen explored the range of time that the scientist had worked with the specific students. It was clear that, for most situations, there was a previous working or academic relationship between the students and the scientists—which would be expected based on the observation most of these TAB projects were coordinated by university scientists where the students were matriculating.

Item sixteen probed into the research on mentoring. Respondents were asked to discuss ways that they provided social and emotional support to their students, as recommended in mentoring research. The responses were rich, and suggested these scientists took seriously the broader needs that students had. Responses included:

- Talking regularly to students;
- Encouraging students to attend meetings, to network with others, and to discuss concerns;
- We have transparent dialogue about issues, thoughts, and plans;
- I ask them about home life and stress levels, and encourage them to work together;
- I pair students and encourage them to work together, take students to lunch and discuss projects, problems, and life in general;
- I try to make them feel like a part of our team of employees, contractors, and students by inviting them to participate in group meetings and social activities;
- Over the years, we have discussed careers, how to manage projects successfully, and how to work with committees; and
- I host gatherings and celebrations for students at my home so they can relate to me socially. I provide emotional support if I feel a student needs it.

Item seventeen asked respondents to describe how they had encouraged or enhanced their student’s career development. Responses were, again, rich and demonstrative of the scientists’ awareness of early career formation among young colleagues, and their helpfulness in these TAB

projects. Responses included: pushing students to present at conferences, assessing their abstracts and posters; encouraging them to publish; encouraging them to apply for NOAA fellowships and internships; CV development, grant writing; working to improve scientific thinking and writing. Clearly, these types of supportive activities are appropriate and have emerged in other research on mentoring success for science disciplines and careers.

Item eighteen asked “in what ways did you introduce your student(s) to your research field. These responses included introducing them to colleagues and encouraging networking opportunities. Other responses described the time invested in the research aspects of the TAB projects that included building awareness of the research field, content enhancement, reading articles and other materials, and communication with team members. One respondent described how he/she networked the students(s) with prior students who had worked on the same project in order to build the network of connected students with awareness of the project and the field of inquiry. It is clear from the range and richness of these responses that career awareness was in the minds of the scientists mentoring the TAB projects. Interestingly, all nine of the respondents reported that they had introduced their students to other colleagues in the field.

Items twenty and twenty-one addressed the benefits of the TAB projects to both the students and the scientists. The benefits that were perceived for the students seemed reasonable given the design of the TAB projects, and included: experience with proposal writing, experience with grants management, opportunities to work with and communicate with NOAA scientists and labs, opportunity to network and to be linked into the NOAA community. Other practical skills included improving writing ability, budget development, experience with teams, setting goals, and attending conferences. The benefits for the scientists included working with diverse students, obtaining some salary support for themselves and for funding students to expand their (scientists) research efforts and agenda. Interesting, several respondents described their own learning from these projects, with one noting that the TAB “expanded or broadened” his/her research interests, and one describing that a student had better hands-on skills than he/she had and so his/her own learning and reputation was enhanced by the student.

Item twenty-two asked respondents to describe specific challenges related to undertaking a TAB project. There was a clear focus in these responses related to funding issues. For some, it was awkward or difficult to execute funding agreements, deal with paperwork, or move funds into accounts. For others, the limitations of funding to leveraging dollars, given difficulties in obtaining these leveraged dollars, is problematic. Restrictions for use of funds, likely a NOAA restriction outside of LMRCS control, emerged for other respondents.

The closing set of items (twenty-three through twenty seven) elicited responses from scientists that these TAB projects were strongly aligned to NOAA mission science—an observation also made by the evaluators in reviewing the content descriptions of the TAB projects. Eight of the responding scientists perceive that these students will be good candidates for NOAA’s future mission workforce. Item twenty-five sought input on expanded academic support that may be beneficial to students. This item elicited suggestions about the need for post-graduate internships or short-term employment in NOAA labs or with NOAA partners, conference travel funds, and perhaps greater exposure to other, alternative career choices—although this wasn’t explained well. A cluster of responses emerged to encourage more training in statistics, computer programming, and writing skills which are consistent with other pipeline research conducted by the evaluation team. And finally, responses related to the overall efficacy of the LMRCS project and recommendations for improvement overall seemed to focus on enhancing communications opportunities and networks between and among LMRCS partners and supporting institutions, and NOAA agencies, personnel and laboratories with all of the students involved.

#### ***TAB Student Data***

The TAB student survey response data were far more limited, with only three students providing responses. It is likely that disruptions in the communications channel as a result of the federal government shut down this year resulted in a disruption in transmitting the surveys to students in a timely manner. Nevertheless, students will be surveyed in early April at the spring

workshop at the UMES facility as a part of the LMRCSC student training event, and so there will be additional opportunities to elicit impact data from the perspective of the students themselves. The summary of the current TAB student survey will be limited based on concerns about sample sizes in these responses.

Of the three students responding, two were doctoral students, and one was a masters level student. It was clear, from the content provided and the other related survey items that these students were involved in TAB projects that were related to NOAA mission science, i.e. seafood safety and aquaculture, and habitat assessment. The doctoral students were required to work with large datasets, and all of the students were engaged with projects that had a social implication, and could explain this implication.

The response items four through fifteen, though limited in number, were completely consistent with the responses summarized above by the scientists who supervised these TAB projects, including time on task, relationship with the mentor, time and communication with the mentor, and other benefits and work opportunity provided. When describing the career relationship to their TAB experience, one student wrote: “it immersed me into what life would be like as an academic, or a research scientist. It has demonstrated both the pros and cons of that.” Another wrote that “it has helped me to figure out that I would like to have a job as a research scientist in seafood safety.” These responses suggest the students “see” the projects much as they were described by the larger number of scientists who responded to this round of seasonal surveys.

Items seventeen through twenty suggest the students were engaged in networking with potential career mentors, met other NOAA scientists and were involved, through these TAB projects, in processes that meaningfully connected them to NOAA research and career pathways. The remaining narrative items didn’t produce meaningful clusters of responses to warrant inclusion in this report, but these data will be retained and considered with the April student workshop survey results, which will have similar items.

### ***Undergraduate Student Survey***

In spring of 2019, a survey was distributed to undergraduate students who are funded by LMRCSC, as a follow-up to a similar instrument that was used in year one of this current project. As with data collection for the other stakeholder groups, the intent with the undergraduate survey is to obtain evidences to address the EPP guiding questions regarding the STEM pipeline, support for NOAA mission science, and the administrative processes of the LMRCSC systemically.

For this survey implementation, ten students responded collectively from Hampton University, Savannah State University, and the University of Maryland—Eastern Shore. All of these students are pursuing BS degrees currently, either in Marine Science explicitly, or in related fields. All of these students report that they have maintained their major and career goals consistently since coming into relationship with the LMRCSC program.

Items five, six, and seven on the survey related to the respondents’ identification and selection of a career field in science. All respondents indicated a desire for a senior researcher or similar level position, which would require graduate preparation. Item six asked respondents how and when they first considered a career in science. Interestingly, eight of the ten indicated this decision was formed very early: in elementary, middle or high school years. This suggests that early identification and recruitment of potential STEM majors and STEM career professionals is a viable and effective activity in and of itself—and as is practiced widely across STEM institutions. This observation could potentially be useful to the overall NOAA EPP interests in minority recruitment as a strategy for consideration for a longer view of the career pipeline. Item seven asked for a rationale for pursuing a STEM career. Six of the ten respondents indicated some value position: helping people, improving the planet, environmental concerns, solving problems, beyond basic interests or dispositions toward science knowledge.

Item eight asked respondents to describe research or field experiences in which they had participated with funding from the LMRCSC. Responses were varied, as anticipated, and included lab work, an internship at a NOAA laboratory, educational outreach at an elementary school and work on a regional site of the National Ocean Sciences Bowl, using lab techniques under supervision

of a PI, obtaining their degree (scholarship funds), and an REU at one of the collaborating institutions. The variety of responses is cohesive with the types of funding that are indeed available to support undergraduates, and these responses—beyond the substance of the work—denotes a familiarity with the LMRCS program and its scope, and supports effective program communications (as an administrative function of the LMRCS).

Items nine and ten focused on professional mentors, which the respondents might have. There was a common or recurring pattern of responses indicating that students had mentors—or perceived that they did—and that these were most typically influential faculty members with whom the students had taken one or more courses in college. The mentors were characterized as being supportive, passionate and personable, of offering support in both academic and life-related areas of concern. The mentors were described as having offered professional opportunities, or providing links to these opportunities for students: somewhat as clearing houses or network hubs for the students to move into the STEM fields with knowledgeable guides. In item eleven, all ten of the respondents further indicated—in addition to any other information or networking information they had received from mentors—that each had received explicit orientation information to the LMRCS from a faculty member or LMRCS representative at their respective home institutions.

There is evidence in STEM educational research that participation in co-curricular STEM related activities is a valuable aspect of formation of early career interests. Based on this evidence, a series of questions were developed and included in the undergraduate survey, to allow a richer understanding of the pool of recruited students. In item twelve, five of the ten students identified a high school level STEM focused program in which they had participated outside of classes. By the post-secondary level, nine of the ten respondents were able to identify multiple co-curricular STEM activities in which they had participated. These post-secondary activities included numerous federally funded initiatives (REUs, HBCU Pathway programs, McNair Scholars) as well as LMRCS funded efforts and institution specific efforts. And finally, in item fourteen, six of the ten respondents identified STEM related hobbies or community activities in which they engaged, to include various volunteer efforts, and outdoor recreational activities such as hiking, boating, and fishing. These responses, collectively, are supportive of other findings that STEM-interested young adults and early career professionals are developed over time through a variety of formal and non-formal influences that expose these individuals to science through multiple lenses, formal and informal and curricular and extra-curricular. It seems this holistic approach should be considered critically as a programming strategy.

Item sixteen asked respondents if anyone from their immediate family was employed in a science related career field. Nine of the ten respondents stated *No* to this item. This pattern is meaningful, and suggests the recruitment strategies employed by LMRCS has extended beyond the cycle of students following familial career patterns and attracted young adults from different backgrounds. In the follow-up item (seventeen), the respondents nevertheless reported that they did receive encouragement by a parent or adult role model. These included mothers, fathers, and others who were interested in these respondents pursuing their passions. Only three respondents responded negatively, that they did not have family support.

Item eighteen asked respondents their view of employment prospects for STEM careers over the next ten years. Perception of employability has been observed to be a motivator for career selection among post-secondary adults. All ten of the respondents view STEM careers as Very Employable to Moderately Employable over the next decade in these responses.

Item nineteen asked respondents to identify sources of federal funding they receive to support their education beyond the LMRCS funds. One student each responded Pell grant, NSF REU funding, and Hope Scholarship funding. No additional support was reported.

Items twenty and twenty-one asked respondents to identify any additional activities which could be offered through LMRCS in which they would be interested, and to provide a rationale for these activities. Responses included: coding seminars, REUs, work-study projects, social mixers or other activities for collective social connectivity among LMRCS students. Other responses included additional conferences, study abroad and community service opportunities. Respondents

viewed these types of activities as important for networking and relationship building among peers, but also related to expanding their skill sets and helping them explore interests and build experiences.

Item twenty-two asked respondents to identify the most beneficial university course they had taken in the past year and to explain why that course was beneficial or helpful. Eight respondents identified a science course, either content or lab-based, and explained that these courses were directly related to future employment. Two respondents identified a technical writing course as the most beneficial course, and noted that this course was related to manuscript writing and scientific writing tasks necessary for future careers.

Item twenty-three asked respondents to describe how their knowledge of NOAA mission science and fisheries science had been enhanced over the past year—a direct sub-question from the NOAA EPP question set. Seven of the ten respondents provided some level of positive affirmation and description of enhanced knowledge of NOAA science. One particularly interesting and practical response was that this enhanced knowledge of NOAA fisheries science interests had proven beneficial in writing essays for science-based scholarships, as the respondent was able to discuss personal goals and mission related to NOAA fishery science in the essay. This level of specificity in the response is validating, as is the demonstrated, novel use of this enhanced awareness.

Items twenty-four through twenty-six were simple rating items designed for quick feedback on overall program administration issues. Responses to item twenty-four demonstrate 50% of the ten students rated interaction between LMRCSC institutions as high or medium quality, and 50% rated it as low or non-existent. In item twenty-five, six respondents rated their overall knowledge of the LMRCSC as a NOAA EPP initiative as high or medium level knowledge, with three respondents rating it as low knowledge and one as no knowledge. Overall and in consideration of the fact these are undergraduate students with potentially only a short time in the program, this knowledge level is positive, and likely reflects the orientation to LMRCSC that is provided by the program leadership at the partnering universities. And finally, in item twenty-six, eight of the ten respondents indicated they were very interested or interested in eventually continuing their interaction with LMRCSC through its alumni organization.

Item twenty-seven asked respondents to identify their perceived, greatest challenge moving forward toward completing their career-related education. Responses were nearly unique across all ten of the students. The responses included: managing the learning curve, finances, finding a job, lack of personal focus and discipline, balancing family needs, passing the GRE, and—again—finding a position or employment.

Item twenty-eight solicited input on additional support structures, resources or information that would be helpful to the respondents in meeting career goals. Again, while no common pattern of responses emerged, the individual responses were interesting and in most cases, would be relatively cost-free: interaction with people in the field, connections and networking; mentorship, information on graduate programs and additional, individual experiences. Two individuals did suggest stipends or other financial support.

Item twenty-nine asked about interactions with LMRCSC graduate students. Five of the ten respondents indicated from a great deal to moderate amounts of contact. The other five respondents reported little (one) to no interaction (four). And finally, in item thirty, nine respondents indicated that it was very likely they would continue in graduate school to study fisheries or a related ocean topic, and the remaining respondent marked likely to occur.

### ***Spring Student Workshop Survey***

In late spring 2019 (March 31-April 4), a student workshop was convened at UMES for the cohort 3 students, and a few remaining cohort 2 students who had schedule conflicts in 2018 with the workshop then. This weeklong workshop was designed to build the social and professional network of the students with each other across institutions, and with NOAA scientists and the project leadership. There were extensive workshops aligned to NOAA mission science, career development, and professional skills training. At the conclusion of the workshop, a survey was

administered to the graduate students attending (with questions derived from the guidance questions provided by NOAA EPP) and summarized here.

As reflected in items one through three on the survey, each of the twelve respondents are actively pursuing either MS or Ph.D. degrees, and collectively represent each of the seven affiliated schools within the LMRCSC. Their expected major or emphasis areas are all in fisheries science, natural resources or habit conservation areas—and clearly aligned with one of the four mission science content areas described by NOAA EPP and NOAA broadly. Each student is able to name a NOAA scientist and laboratory specifically with whom they are working (these names are omitted to protect student and scientist privacy). Enrollment date within the LMRCSC collected in item six verifies that administrative policy for cohort enrollment and tracking is consistently applied for this program and attendees.

Items seven and eight solicited overall perceptions of the workshop. There were no negative perceptions recorded here, although three respondents perceived the workshop could have been shorter. Select interviews on this point with students suggests that some Ph.D. students prefer not to lose momentum at work in the spring by attending the workshop—but this is simply the nature of the project, which even they acknowledge.

Item nine was an extensive, rating item that listed each implemented area of the workshop content, and asked respondents to rate by most important to least important, each of the areas. There were clear and statistically significant (chi square) differences observed in the ratings when the social/professional items were clustered and compared to the science content elements. It seems the students express confidence that they have other access to the science content, and that they prefer to use the workshop time to expand social networks with peers, scientists, and project leadership; to learn about a variety of career pathways and opportunities; professional skills and community building. Two respondents reiterated this issue of community development and interpersonal relationships in discussing their ratings.

Item ten asked respondents their level of agreement with a statement about their understanding of NOAA and the LMRCSC overall goals and objectives as a result of the workshop. All respondents strongly agreed or agreed that the workshop met the goal of expanding their understanding of these. In a follow-up question in item eleven, all respondents strongly agreed or agreed that the workshop enhanced their individual understanding of NOAA Mission Science—and the specific content modules used in the workshop, as observed by the evaluation team, confirms this strong content element was addressed.

Items twelve, thirteen, and fourteen provided text boxes for respondents to write open ended narrative around the prompts of most helpful information provided in the workshop, ways the workshop refined academic goals, and ways in which the workshop advanced or refined career goals. The strongest focus in all of the response data centered on how the workshop expanded their understanding of the human dimensions of fisheries science, management, and habitat restoration. This response cut across all three of these items, so clearly impacted the students. Interestingly, the workshop seems to have influenced two of the MS students to apply for doctoral programs.

Items sixteen through eighteen drilled down into the workshop's support for student and faculty collaboration, mentoring or other relationships with NOAA scientists, or other potential benefits from the workshop. Several student responses captures the overall focus of the narrative responses provided by the group and are quoted here:

- *Meeting my peers and fostering science relationships was a great benefit, and may one day lead to collaboration.*
- *Bringing different experts together to talk about professionalism in NOAA fostered collaboration.*
- *The workshop greatly increased my grant writing skills.*
- *Through presentations and social interactions, I learned more about NOAA science and the types of jobs available.*
- *It provided support by introducing us to the NOAA scientists and developing a professional relationship and contact with them.*

- *I learned the importance of integrated science so that scientists from different training expertise should collaborate to address broader questions.*

The strong, positive feedback from the participating students in the 2019 workshop is consistent with the evaluation team's observations from the workshop. There were additional, planned social experiences in 2019 as a result of the feedback from the 2018 workshop, which were reflected in the student evaluations. These, along with the professional skills training, career orientation and networking opportunities matched the desired outcomes for this group of students and demonstrates effective administrative and communications efforts to identify and meet student perceived needs.

### **Evaluator Site Visits**

As in the earlier years of the project, the evaluation team continued in year three to conduct site visits to partnering institutions or with individuals who are among the stakeholders of the LMRCSC. In addition to attending the Spring Student Workshop at UMES in March-April 2019, this year the evaluation team:

- visited with Dr. Beth Babcock and two of her graduate students at the University of Miami;
- visited the James J. Howard Marine Sciences Laboratory in Sandy Hook NJ, to interview Dr. Ashok Deshpande, who participates on a technical advisory committee for LMRCSC and who mentors TAB and NERTO students (he was identified as a mentor by one or more students in the student surveys); and
- attended the LMRCSC Science Meeting in Silver Spring, MD, to both observe and to interact with students, scientists, LMRCSC senior personnel, and NOAA EPP personnel.

These site visits have been highly instrumental in forming a more in-depth view of the scope and impact of the LMRCSC by the evaluation team. While the paper records of the project made available to the evaluators have been very helpful, informative, and have contributed to evaluation reporting, field observations of the senior collaborators and students enhance the credibility of the evaluator observations by allowing feedback from key stakeholders in their own professional environments. From these observation meetings and interviews, it is clear that the LMRCSC, as one CSC in the broader NOAA EPP portfolio of effort, is a complex organization that is attuned both to its "down stream" stakeholder constituencies, i.e. the students, faculty, and university partners, but also attuned and responsive to its broader NOAA EPP responsibilities. The administrative functions outlined in the operating plan and center policy are realized most directly by the students and faculty at the university and research laboratory sites, through contractual relationships and responsibilities. The evaluators have observed a consistency in administrative policy, in fiscal policy, and in communication strategies—such as student orientations, common courses or skill sets, a common identification of the NOAA mission science categories as the organizing structures for TAB and NERTO projects and course selections for degrees. The LMRCSC, from local site perspectives, is an *executing* entity that contributes to career attainment by minority students at NOAA laboratories.

A number of specific observations were identified or noted at the Science Meeting in Silver Spring, MD, or collected from interactions between the evaluators and NOAA EPP or other NOAA personnel. There are clear interests and generalized concerns expressed by NOAA EPP (some of these will be addressed in the Conclusions) for unified communications, branding and accreditation of project related work—across all of the Centers, not only LMRCSC. Additionally, there was a perception of value in continuing to foster and enhance the interactions between graduate students and NOAA scientists: to enhance both populations' understanding of the work and interest of the other's, and to leverage this enhanced knowledge through communications that can better link students and scientists, and graduating students with laboratories and employment opportunities. This enhanced communications further highlighted NOAA's mission science and mission priorities between NOAA and LMRCSC students and professionals.

### **Focus Group Discussions with LMRCSC Partners and Staff**

At the site visit in March/April (the spring student workshop at UMES), the evaluators further developed observation notes around the NOAA EPP questions 3.2, 3.3 and 3.5 from interviews with the co-PIs from the partnering institutions of higher learning in the LMRCSC. These notes seem

particularly valuable to document in this final report and so are included at length as follows:  
**Response to NOAA EPP Question 3.2:**

Interviews with co-PIs demonstrate the CSC funding has increased the capacity of the partnering institutions to recruit and train minority students by providing *student restricted funding* for use with scholarships and expenses for these graduate students. This expansion of the laboratory workforce leverages the capacity of both NOAA labs and partner labs to undertake NOAA mission-aligned and mission-critical research from NOAA science priority areas that would typically exceed the capacities of these labs without the students. “This creates a win-win-win opportunity for NOAA, the partners, and the students.” It further introduces the students into the NOAA research community and creates networks for them that have been found to result in employment opportunities following graduation for these CSC students. Robinson et al. (2007) documented that the CSCs had provided a significant proportion of the recently hired minority scientists across NOAA—demonstrating that the CSC networking opportunities for these students had significant impact on eventual employment gains for this key population.

**Response to NOAA EPP Questions 3.3 and 3.5:**

*Ongoing monitoring of project internal communications, documentation, and administrative reports for evidence of project growth and expansion of capacity; individual interviews of each PI/Co-PI annually; semi-structured, guided focus group discussion with project leadership annually.*

On Monday, Tuesday, and Wednesday mornings, April 1-3, the project evaluators convened interview sessions and semi-structured, guided focus group discussions with the Project Director, the co-PIs, administrative staff members (including communications director, the assistant LMRCSO director, the education director, the fiscal and data management director, and the Project Lead Scientist) to ascertain progress toward meeting each element of the project implementation plan. Copies of the implementation plan were available and circulated, as well as the *NOAA EPP Guiding Questions* for evaluation efforts. Discussions considered key accomplishments for the year, as well as opportunities for advancement of goals and objectives, and emerging and previously collected evidences of project goal attainment. Substantive time was given to review for gaps in implementation (none were identified) as well as a focused consideration of available and potential evidences to substantiate program claims. These discussions addressed each of the three primary focus areas of the NOAA EPP guiding questions, i.e. workforce and NOAA mission science objectives, support for NOAA scientists and mission-aligned research, and CSC administrative functions. Several action steps were identified for the evaluation team or project management in the immediate next quarter to half year. These included:

*Action Items:*

1. Survey for the TAB Committees (see questions 2.3-5)
2. Paragraphs on best practices—1) TAB review process; 2) Mentorship of undergrads and high school students by Grad Students; 3) Mentorship of Grad Students by Scientists and NOAA Scientists.
3. The TAB process is unique to LMRCSO. It provides a simulation of a real world career task, learned in an atmosphere of scaffolded mentoring by scientists. Ideal for building career skills for eventual scientists.
4. Compiling student courses to demonstrate: social science connections, policy and management awareness or preparation, NOAA decision-making (likely observable during NERTO while in the labs). Maggie and/or Victoria need to compile these classes so we can check off where students have classes in any of these areas.

The focus group discussions also raised follow-up questions associated to other elements of the project that require investigation to obtain clarifications related to implementation steps or evidence collection moving forward. These questions include:



*Questions:*

1. Is the LMRCSC engaged with, or defining correctly, social science integrations as NOAA EPP wants (or social impacts)?
2. Are we at CSCs graduating more minority fisheries graduates than fisheries graduates at other large universities?
3. What is the “value added” of the CSC beyond the student scholarships? One value added piece is observed in the NERTO and TAB survey data: the scientists are benefitting from the ability to get research conducted by students that they cannot otherwise have the time or funding to do themselves?
4. To what extent do the complexities of budget requirements, spending restrictions, and cohort approach to funding creating difficulties for the CSC to best meet students’ needs? Are current interpretations of budget guidance and fiscal policies accurate as intended by NOAA EPP?
5. Have we fully captured all of the dimensions of the Administrative questions provided by NOAA EPP?
6. Are the undergraduate students being effectively supported and challenged in the LMRCSC so as to leverage this critical pool of young students for application into graduate opportunities in the pipeline? It may be that additional social opportunities for these younger students be considered as a means to socialize them into the ocean science and fisheries pipelines.
7. With respect to Question 3, administrative processes, it should be a strong consideration that the co-PIs have a face-to-face team meeting annually at the (alternating) Spring Workshop or NOAA EPP Forum, for general project management discussions and future planning. The evaluators acknowledge that there is a monthly executive committee phone call, which accomplishes much that is positive with respect to project management and work tasks. There would still be value, however, in an annual face-to-face meeting. This meeting would leverage travel funds and annual events, which are already implemented in any event. (The LMRCSC leadership is actively working to schedule this meeting.)

The focus groups also revealed two challenges moving forward that may need additional conversation with NOAA EPP. First, the *Student Tracker* and *Online Individual Student Work Plan* data portals continue to be difficult to use on the front end, and also for extraction of information on the back end. Given the critical need for consistent and thorough documentation of student activities, it is important that these functionality challenges be mitigated (improvements have emerged recently that are helping this situation). Second, the overall complexity of budget utilization suggests a need for continued conversation with NOAA EPP regarding pathways for simplifying the budget management functions so as to best use and leverage funding for student benefit.

**Conclusions**

These data collection activities were undertaken to consider the overarching NOAA EPP objectives and questions, as these are further sustained in the LMRCSC work with scientists and students.

**Primary Finding for Year 3**

The data provide evidence that the LMRCSC is *directly supporting scientists to work with diverse students*, in ways that *positively support NOAA mission science*, NOAA’s future mission workforce, and *the individual needs of these students for meaningful career mentoring*, science content and skills development, and *recruitment into the career pipeline* through social support, mentoring, networking, and introduction to the discipline by meaningful scientists and faculty members.

**Discussion and Recommendations**

The students are obtaining opportunities, through LMRCSC fiscal support, training, and linkages to scientists (university and NOAA), and mentoring, to meaningfully expand their capacity to engage NOAA mission science, to use large dataset management and analytic skills, and to

enhance their connections to NOAA's workforce and an expansive and diverse network of scientists and peers who are at various stages in the career pipeline. These students and their scientist mentors perceive the value and benefits of the NERTO and TAB experiences—and clearly these experiences also benefit the scientists themselves.

Concerns over paperwork, fiscal constraints, work and project timetables all seem within the typical concerns expressed by these professionals, and are deemed insufficient to elicit response with the exception of fiscal policy, which is discussed below. Large systems' work efforts, through required standardization of work flow and management, typically raise such concerns.

With respect to fiscal policy, it is clear that LMRCSA is administered in a typical institutional oversight and policy environment. Nevertheless, the evaluators perceive a level of concern among senior personnel, and even graduate students, that seems worthy of discussion. The year/cohort model of funding—given the multi-year, dynamic environment of graduate education—seems to be highly problematic in consideration of the balance between use of funds toward authentic, mission needs, and restricting the use of funds within potentially arbitrary accounting parameters.

**Recommendation 1)** Given the level of concern vocalized by stakeholder members, the LMRCSA leadership is strongly encouraged to schedule and convene a focused *conversation* on balancing fiscal accountability with the need for some degree of financial flexibility in meeting emergent needs of this highly critical group of students. Initially, this conversation should be among LMRCSA PIs, and then, if necessary, result in recommendations from LMRCSA to NOAA EPP.

**Recommendation 2)** The leadership of LMRCSA is encouraged to consider the expressions of need for enhanced communications among the entire community of stakeholders, and to continue, and highlight, its ongoing efforts in support of NOAA EPP and NOAA mission science evidenced in these NERTO and TAB experiences. It seems clear there are numerous examples of high impact, social impact, and student impact projects among these NERTO and TAB experiences that serve as evidence of the strong, positive impacts of LMRCSA overall, and—importantly—NOAA EPP. The broader science community and public could only benefit from enhanced awareness of these accomplishments. This communications effort would require enhanced networking between and among university and NOAA personnel and project alumni. The activation of these LMRCSA alumni in support of current and future students and project elements could only be a benefit.

**Recommendation 3)** Based on observations from interactions at the Science Meeting, it is recommended that care be taken to review all documents, presentations, etc. give credit to NOAA EPP and the contract number consistently. This was an expressed concern from NOAA EPP personnel.

**Recommendation 4)** The LMRCSA center-wide research project should be prioritized and implemented per the project implementation commitments. This issue was raised both at the Science Meeting in Silver Spring, MD, and also by the co-PIs at UMES at the spring workshop meetings. It is noted that project leadership has moved forward with planning a team meeting on the topic of this research project. *The project leadership should prioritize progress on this project during year four. The evaluation team does not yet have insight into the rationale for the delay of this project element.*

**Recommendation 5)** Compile and document recruitment practices used across the various institutions that have proven successful. It is clear from conversations with project co-PIs, and more so from a variety of literature sources, agency planning documents and concerns, that early identification, support, and scaffolding of minority students with interest in STEM areas is critical. The LMRCSA has enjoyed and documented success in locating and recruiting these gifted young adults, and has leveraged these efforts with other efforts by the partnering institutions to work with even younger secondary youth or pre-adolescent populations to create an even longer pipeline. This work is critical to the nation and documenting the LMRCSA success would benefit many agencies and institutions.

**Recommendation 6)** LMRCSA leadership have compiled information regarding the Social Science Impacts/Human Dimensions of the various research projects and activities conducted under the Center. It is recommended, given NOAA's broader agency concerns for social science impacts, that

these Center efforts continue and that these are communicated broadly to students, center partners and NOAA personnel. It is further recommended that a systematic review of student NERTO and TAB projects be conducted to ascertain these social science and human dimensions impacts.

## **Appendix II: TAB Funded Research Projects in 2017-2019**

**Project Number:** 18-01

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

**Thematic Research Area:** Fishery Socio-Economics

### **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. This study focusses on the underrepresentation of racial and ethnic groups in marine and fisheries related science professions and aims to provide an analysis of how life experiences and identity shape marine and fisheries science related career decisions of individuals across different racial and ethnic groups and career levels (undergraduates, graduates and professionals). This study uses in-depth interviews and a qualitative data analysis approach to analyze the effects of life experiences and identity on career decisions. To date, we've conducted 24 in-depth semi-structured interviews with participants across different racial and ethnic groups and career levels (undergraduate student, graduate student, professional). Data obtained from these interviews has yet to be analyzed.

**Principal Investigator:** Brittany King, Oregon State University

**Co-PI:** Kelly Biedenweg, Oregon State University

**NOAA Partner:** Kevin Werner, NWFSC: Northwest Fishery Science Center

**Other Partner:**

**Students:** Brittany King (PhD, OSU)

**Keywords:** Fisheries; Social science; Underrepresentation

**Start Date:** 9/1/2019      **End Date:** 3/31/2020

### **Results to Date**

To date, we've conducted 24 in-depth semi-structured interviews with participants across different racial and ethnic groups and career levels (undergraduate student, graduate student, professional). Data obtained from these interviews has yet to be analyzed.

### **Relevance to NOAA**

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 LMRCS 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 LMRCS student researcher, Brittany King, the opportunity to integrate social science research into the LMRCS 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.

## **Presentations or Publications**

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

King, Brittany. 2019. Underrepresentation of racial and ethnic groups in marine and fisheries science professions. NOAA Living Marine Resources Cooperative Science Center Annual Science Meeting, Silver Spring, MD

**Project Number:** 18-03

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

**Thematic Research Area:** Stock Assessment Support

### **Abstract**

The assessment of King mackerel in the Gulf of Mexico uses an index for estimating spawning stock biomass; this index is developed using a statistical model that is parameterized by fitting to larval count data from annual plankton surveys. The model used to make the index does not explicitly consider spatiotemporal variation, which is inherent to the larval count data or environmental variability which can also influence local population density. Biomass trends can be misrepresented by a 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 which help to achieve NOAA's sustainable fisheries goals. King mackerel spatial distributions vary over time as adults migrate seasonally and change their distribution based on the quality of their environment. Migrations cause shifts in their spawning locations from year to year, and this then impacts the larval stage as their distribution is dependent on the location of spawning, and the local oceanography. We have used geostatistical models to answer the following question: Will accounting for spatiotemporal variation reduce the uncertainty in the estimates of the index, or indicate new biomass trends? We have also used non-spatial general additive models to determine environmental factors that have a significant impact on King Mackerel density. Current results indicate that incorporating spatiotemporal variability produces different trends in abundance. Results also suggest that time of day, chlorophyll, sea surface temperature, and depth impact larval mackerel density and should be considered in a geostatistical model to develop a more ecosystem based index of abundance. Further analysis should be conducted to validate these findings.

**Principal Investigator:** LaTrese Denson, University of Miami - Rosenstiel School of Marine and Atmospheric Science

**Co-PI:** Elizabeth Babcock, University of Miami - Rosenstiel School of Marine and Atmospheric Science

**NOAA Partner:** John Walter, SEFSC: Southeast Fishery Science Center

**Other Partner:** Dionne Hoskins-Brown, hoskins@savannahstate.edu

**Students:** LaTreeese Denson (PhD, RSMAS); Alexandria Ambrose (Undergraduate, RSMAS)

**Keywords:** Fisheries; Marine Biology; Population dynamics; larval surveys, spatiotemporal modeling, biomass indices, King mackerel, Gulf of Mexico

**Start Date:** 9/12/2018      **End Date:** 8/31/2019

### **Results to Date**

When developing the index of abundance for King Mackerel larvae, model results indicated that both of the indices, the original non-spatiotemporal and the spatiotemporal model identify many of the same trends in the early years, but in the later years, 1999 and beyond, there is a slightly lower estimate of density in the spatiotemporal index. Results also indicated spatial variation has been more informative than spatiotemporal variation to the development of the index of abundance. Analysis of the environmental impact on larval King mackerel density indicate that Time of Day (Day or Night), sea surface temperature, chlorophyll and depth had significant impacts on the density of King Mackerel larvae encounter rate and probability of occurrence. These factors will be included in the future spatiotemporal index of abundance to further improve model fit and to incorporate ecologically sound hypotheses about the influence of the environment on King Mackerel abundance.

### **Relevance to NOAA**

This project contributes to NOAA's long-term goal of Healthy Oceans by improving the understanding of the Gulf of Mexico 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**

Conducting this project has facilitated the training of underrepresented minorities in NOAA related sciences at multiple levels of education. This increases and diversifies the pool of applicants who are trained and ready to join the NOAA workforce

### **Presentations or Publications**

Denson L. S., Babcock E. A., Walter J. F., (2018). The effect of spatial and temporal variation on larval indices used for King Mackerel in the Northern Gulf of Mexico. Oral presentation, ICES Annual Science Conference in Hamburg, Germany.

Ambrose A., Denson L.S., Babcock E. A., (2019). The effect of the environment on the distribution and density of King Mackerel in the Gulf of Mexico. Oral presentation, University of Miami RSMAS Internship Seminar in Miami, FL.

Denson L. S., Babcock E. A., Walter J. F., (2019). Incorporating Spatial and Spatiotemporal Variation into Indices of Abundance for King Mackerel in the Gulf of Mexico. To be presented at the AFS Annual Conference in Reno, Nevada in October 2019.

**Project Number:** 18-04

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

**Thematic Research Area:** Healthy Habitats

**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 project aims 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. A total of 60 genetic samples and 51 POP samples were collected in February and March 2019. The genetic samples were sexed by Dr. Patty Rosel at a NOAA lab. The POP samples were analyzed by LMRCSC student Sena Tay in summer 2019 in G. Ylitalo's lab at the Northwest Fisheries Science Center. Specifically, Tay analyzed POP concentrations in 34 adult male bottlenose dolphins. Tay et al. manuscript is currently in preparation with G. Ylitalo and members of her lab.

**Principal Investigator:** Tara M. Cox, Savannah State University

**Co-PI:** Carolina Bonin Lewallen, Hampton University

**NOAA Partner:** Gina Ylitalo, NWFSC: Northwest Fishery Science Center

**Other Partner:**

**Students:** Sena Tay (Undergraduate, SSU)

**Keywords:** Protected Species

**Start Date:** 8/1/2018

**End Date:** 7/31/2019

**Results to Date**

A total of 60 genetic samples and 51 POP samples were collected in February and March 2019. The genetic samples were sent to a NOAA lab for sexing of the individuals. The POP samples were analyzed by LMRCSC student Sena Tay in summer 2019 at the Northwest Fisheries Science Center in Seattle, Washington.

**Relevance to NOAA**

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). 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). The additional 34 samples of males that were collected in spring 2019 were analyzed for contaminants in G. Ylitalo's lab in summer 2019 by LMRCSC student Sena Tay. This will provide a robust baseline POP contaminant level for the Northern Georgia Southern South Carolina Estuarine System (NGSSCES) Stock and allow for comparison to the other two Georgia stocks of common bottlenose dolphins.

### **Broader Impacts**

This study 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.

### **Presentations or Publications**

Tay, S.D., J.M. Beaulieu, R.M. Perrtree, J.M. Rutland, E. Griffin, B.C. Balmer, T.M. Cox. 2019. Reproductive histories to inform contaminant analyses of common bottlenose dolphins *Tursiops truncatus* near Savannah, GA. SEAMAMMS, Washington DC, poster.

Cox, T., J. Leslie, S. Tay, R. Perrtree, G. Ylitalo, B. Balmer, J. Bolton, D. Boyd, E. Griffin, P.E. Rosel. 2019. Patterns of persistent organic pollutant concentrations in common bottlenose dolphins (*Tursiops truncatus*) at multiple spatial scales. World Marine Mammal Conference, Barcelona, Spain. December 2019. poster.

**Project Number:** 18-05

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

**Thematic Research Area:** Stock Assessment Support

### **Abstract**

Spatiotemporal variation in demographic parameters can strongly influence a species' population dynamics but is generally not included in sea turtle population due in part to lack of sufficient data. For example, Kemp's ridley sea turtles that inhabit the U.S. Atlantic Coast grow slower than conspecifics that inhabit the U.S. Gulf of Mexico (GoM) Coast, which may lead to differences in age at maturation for individuals or whole cohorts. To evaluate the influence of this variation on Kemp's ridley population dynamics, we are developing an improved age-structured population model that incorporates habitat-specific vital rate estimates (growth, survival). Using a ~30 year dataset of somatic growth rates obtained through skeletochronology, we have developed habitat-specific (Atlantic, GoM) maturation schedules for this species. In addition, ongoing analyses are using 20 years of stranding length frequency data collected through the Sea Turtle Stranding and Salvage Network to estimate habitat-specific survival rates that will be included in the model. Ongoing analyses will examine model sensitivity to changes in stage-and habitat-specific model parameters. This project will help answer critical questions about the contribution of somatic growth variation, habitat use, and Atlantic turtles, which have been excluded from all existing population models, to

Kemp's ridley population dynamics.

**Principal Investigator:** Matthew Ramirez, Oregon State University

**Co-PI:** Selina Heppell, Oregon State University

**NOAA Partner:** Jeffrey Moore, SWFSC: Southwest Fishery Science Center

**Other Partner:** Elizabeth Babcock, RSMAS

**Students:** Matthew Ramirez (PhD, OSU); Tamara Popovska (Undergraduate, OSU)

**Keywords:** Marine Biology; Protected Species; Population dynamics

**Start Date:** 9/1/2018

**End Date:** 8/31/2019

### **Results to Date**

Matthew interned with Dr. Moore at the SWFSC in La Jolla, CA from 1 October to 21 December 2018. During that time Matthew led the development of an improved age-structured population model for Kemp's ridley sea turtles. Modeling efforts began with the modification of the existing Kemp's ridley population model used for the species' status assessment (NMFS and USFWS 2015). Major modifications included: (1) migration of the base model from Excel to R, (2) separation of Atlantic and GoM juvenile life stages, (3) incorporation of habitat-specific maturation schedules and survival rates, (4) incorporation of variable recruitment from pelagic to benthic life stages (based on stable isotope analyses previously conducted by MDR), and (5) incorporation of variable recruitment from Atlantic to GoM benthic life stages (based on stranding length frequency data). The model uses negative log-likelihood estimation (Equation 1) to predict the number of nests laid by Kemp's ridley sea turtles on their main nesting beaches in Mexico. The model is deterministic and uses the number of female hatchlings produced each year from the three core nesting beaches, where 100% nest counts are performed, to 'initiate' the model each year.

Through a collaboration with Dr. Elizabeth Babcock at RSMAS, we completed a meta-analysis of sea turtle growth rate data. Products of this effort included updated von Bertalanffy growth curves for each sea turtle species. These data were used to develop maturation schedules for Kemp's ridley turtles to be used in the model. Skeletochronology and logistic regression were also used to develop habitat-specific maturation schedules that were included in the model and compared to results from the meta-analysis. Transition probabilities for turtles moving from pelagic (ages 0-1) to small benthic life stages (ages 1-2) were estimated based on stable isotope data collected from bone tissue. These analyses found a distinct shift in stable nitrogen isotope values when turtle made this habitat shift. Using these data, it was determined the 50% of pelagic turtle transition to benthic habitat at age 1 whereas 50% transition at age 2. Annual estimates of the proportion of pelagic turtles transitioning to benthic habitats in the Atlantic versus the GoM were estimated using ocean circulation models in a collaboration with Dr. Nathan Putman (Ecological Associates, Inc.) (e.g., Putman et al. 2013).

Unexpected delays in obtaining stranding length frequency data for Kemp's ridley turtles necessary to proceed with estimation and parameterization of survival rates via catch curve analysis delayed completion of this model. The final data were supplied by NOAA in August 2019 and final model parameterizations have since commenced. These data are being used to develop habitat-specific survival rate estimates for juvenile life stages. All other survival rate estimates will be derived via NLL. Final analyses, to be completed within the next two months, will examine model sensitivity to changes in life history parameters associated with Atlantic Ocean life stages so as to enhance our understanding of the contribution of this subpopulation to overall species population dynamics.

### **Relevance to NOAA**

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 have learned a variety of quantitative methods used for population and statistical modeling, including catch curve analysis, model fitting, and sensitivity analysis. This project also provided Matthew an opportunity to collaborate with NOAA scientists from multiple science centers.

### **Presentations or Publications**

Both Matthew and Tamara attended and presented their research at the International Sea Turtle Symposium in February 2019. A manuscript outlining the results of our sea turtle growth rate meta-analysis is currently in prep and will be submitted to Marine Ecology Progress Series this fall.

Ramirez, MD, L Avens, LR Goshe, ML Snover, and SS Heppell. 2019. Density-independent decline in Kemp's ridley somatic growth rates following the Deepwater horizon oil spill. International Symposium on Sea Turtle Biology and Conservation, Charleston, SC.

Popovska, T, E Babcock, and MD Ramirez, L Avens, LR Goshe, and SS Heppell. 2019. A meta-analysis of somatic growth in sea turtles. International Symposium on Sea Turtle Biology and Conservation, Charleston, SC.

**Project Number:** 18-08

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

**Thematic Research Area:** Stock Assessment Support

### **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 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).

**Principal Investigator:** Eric A. Lewallen, Hampton University

**Co-PI:** Carolina Bonin Lewallen, Hampton University

**NOAA Partner:** Laurie Weitkamp, NWFSC: Northwest Fishery Science Center

**Other Partner:** Linda Park, NWFSC: Northwest Fishery Science Center

**Students:** Josette McClean (MS, Hampton U); Janelle Layton (Undergraduate, Hampton U)

**Keywords:** Bycatch; Fisheries; Marine Biology; Population dynamics; Ecosystems

**Start Date:** 4/1/2019

**End Date:** 8/31/2021

## Results to Date

We have weighed, measured and extracted DNA from 20 Pacific lamprey and are in the process of fine tuning the protocols to maximize DNA quality and yield.

## Relevance to NOAA

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 in marine and freshwater habitats.

## Broader Impacts

During the first year of this project we will finalize specimen collections and sample processing (e.g., voucher preservation, gut dissection, gut content preservation). The master's student included (Josette McClean) joined the research team in June of 2019, and will carry out genetic analyses. Ms. McClean will complete a 3 month internship at the NOAA Northwest Fisheries Science Center during the summer of 2020. 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.

## Presentations or Publications

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. American Society of Limnology and Oceanography, San Juan, PR, February 23 - March 1st, 2019 (podium).

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. Emory University, Atlanta, GA, September 30 - October 2, 2018 (poster).

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 (poster).

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 (poster).

**Project Number:** 18-11

**Title:** Assessment of Microplastics in *Placopecten magellanicus* as Possible Indicators of Plastic Pollution from the Georges Bank, Mid-Atlantic Stock Fisheries

**Thematic Research Area:** Healthy Habitats

## 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 a 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 and what kind of polymers compose the microplastics that pollute scallops. 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. A subsample of microplastics will be analyzed with Raman spectroscopy to characterize plastic composition. 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.

**Principal Investigator:** Enid Munoz Ruiz, University of Maryland Eastern Shore

**Co-PI:** Ali Ishaque, University of Maryland Eastern Shore (UMES)

**NOAA Partner:** Ashok Deshpande, NEFSC: Northeast Fishery Science Center

**Other Partner:**

**Students:** Enid Munoz Ruiz (MS, UMES)

**Keywords:** Fisheries; Ecosystems; Toxicology, pollution, microplastics

**Start Date:** 6/1/2017

**End Date:** 5/30/2019

### **Results to Date**

Tissue with highest microplastic content is the muscle; followed by the gills and reduced levels (in comparison to the muscle). Laboratory work will be finished within the next couple of months.

### **Relevance to NOAA**

It is NOAA's mission 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 abides to NOAA's Fisheries mission, because it looks into the effects of these emerging contaminants, their potential to carry toxicants and impacts on organisms and ecosystems. Specifically, the outcomes are: (1) Find out if Atlantic sea scallops, a very important commercial species, are contaminated with microplastics, (2) if plastics are present, would they be potentially available for trophic transfer or consumption by humans.

### **Broader Impacts**

With this extensive and arduous research, we hope that Enid Munoz-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 to the many meetings and collaborations will install 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 hopes to complete this project and graduate in Spring 2020.

### **Presentations or Publications**

Microplastics in Sea Scallops. UMES Research Symposium. (2019). University of Maryland Eastern Shore, Princess Anne, MD. 3MT Presentation. Winner.

Rethink Plastics. LMRCSC Evaluation Meeting. (2019). NOAA Headquarters, Silver Springs, MD. 3MT Presentation.

**Project Number:** 19-01

**Title:** Baseline data on environmental impacts on physiological and molecular parameters determining growth for commercially valuable decapod crustacean management

**Thematic Research Area:** Stock Assessment Support

**Abstract**

The crustacean fishery in the US has been challenged due to drastically reduced landings for several decades, including the blue crab (*Callinectes sapidus*) industry in the Chesapeake Bay. Crustacean growth is hormonally regulated while environmental conditions as stress factors often have adverse effects on growth. The vast genetic diversity of *C. sapidus* is reflected in size variation and differential growth rates. This proposal seeks to measure physiological and molecular parameters that define stress impacts on the growth of animals with differential growth rates. Ultimately, the current project seeks to generate a model that will be applied to all commercially important decapod crustaceans for growth prediction under normal and stressful conditions in natural habitats.

**Principal Investigator:** J. Sook Chung, University of Maryland Center for Environmental Science

**Co-PI:** Elizabeth A. Babcock, University of Miami - Rosenstiel School of Marine and Atmospheric Science

**NOAA Partner:** Paul McElhany, NWFSC: Northwest Fishery Science Center

**Other Partner:**

**Students:** Anya Byrd (PhD, UMCES); Adjele Wilson (Undergraduate, UMES)

**Keywords:** Marine Biology; Population dynamics

**Start Date:** 9/2/2019

**End Date:** 9/1/2020

**Results to Date**

Confirmed the sequence of mTOR (the master growth regulator)

**Results to Date** No Report

**Relevance to NOAA**

This project falls under area C of the essential fish habitat. Examining the molecular mechanism governing growth and stress from constantly changing stressful environmental conditions at individual and population levels of *C. sapidus* would allow us to predict how this species would cope and deal with potential stress in the future changing ecosystems.

**Broader Impacts**

Ultimately this project aims to compile extensive data on the physiological and molecular responses to stress of animals with different growth rates, which provides a measure that could be applied over a broad spatial scale.

**Presentations or Publications**

**Project Number:** 19-02

**Title:** Evaluating physiological and immune responses of snow crabs (*Chionoecetes* sp.) to *Hematodinium* infection

**Thematic Research Area:** Stock Assessment Support

### **Project Description**

*Hematodinium* is a parasitic dinoflagellate parasite that causes bitter crab disease in infected crustaceans. Tanner crabs (*Chionoecetes bairdi*) and snow crabs (*Chionoecetes opilio*) are important fished crustaceans from the Bering Sea commonly sold collectively as snow crabs. These populations are at risk due to the high prevalence of *Hematodinium* sp. *Hematodinium* has been studied and detected worldwide, but questions remain about the parasite's life cycle and specifically how it infects the host and evades host immune destruction. *Hematodinium* may affect regulation of metabolic gene expression in infected crabs, based upon observed changes in biochemical composition. This study will determine how *Hematodinium* affects the regulation of these genes by identifying metabolic genes perturbed by infection, through analysis of mRNA transcriptomes from the hepatopancreas. In addition, we will analyze the host immune response through analysis of transcriptomes from hemocytes of infected crabs.

**P.I.:** Shanelle Haughton, UMES: University of Maryland Eastern Shore (UMES)

**Co-PI:** Dr. Joseph Pitula, UMES: University of Maryland Eastern Shore (UMES)

**NOAA Partner:** Dr. Pamela Jenson, AFSC: Alaska Fishery Science Center

**Other Partner:**

**Students:** Shanelle Haughton (PhD, UMES); Reuel Danquah (MS, UMES)

**Keywords:** Fisheries; Marine Biology; Climate Change

**Start Date:** 7/10/2019      **End Date:** 5/31/2020

**Results to Date:** No Report

**Project Number:** 19-03

**Title:** Ecological investigation of a toxic harmful algal bloom species (*Dinophysis acuminata*) and its potential impact to the aquaculture industry of Delaware Inland Bays

**Thematic Research Area:** Healthy Habitats

### **Project Description**

The rise of a new aquaculture industry in the Delaware Inland Bays will require the development of management practices. To protect environmental and human health the monitoring of HABs species is necessary. Dinoflagellates can form a resting cyst life stage that allows them to remain viable in the sediments after a bloom has passed and may act as the inoculum to future blooms when environmental conditions become ideal (Lewis et al. 1999). This project will investigate the presence of cysts in the sediments of Rehoboth Bay specific to the dinoflagellate genus, *Dinophysis*. This genus is known to produce okadaic acid, diarrhetic shellfish toxins (DST) and pectenotoxins (PTXs) (Reguera 2012). These toxins cause Diarrhetic Shellfish Poisoning (DSP) in humans even when cell densities of *Dinophysis* sp. are low ( $<10^3$  cells·L<sup>-1</sup>) and have been responsible in harvesting closures at aquaculture sites in Northern Japan, Chile, and Europe (Reguera et al. 2014). Developing methods to monitor cyst abundance within the sediments during winter months may assist in the prediction of future bloom patterns.

**P.I.:** Amanda Pappas, DSU: Delaware State University

**Co-PI:** Gulnihal Ozbay, DSU: Delaware State University

**NOAA Partner:** Gary Wikfors, NEFSC: Northeast Fishery Science Center

**Other Partner:**

**Students:** Detbra Rosales (PhD, UMCES); Amanda Williams (MS, Other); Raymond Andrews (Undergraduate, DSU)

**Keywords:** Aquaculture; Plankton; HABs

**Start Date:** 3/1/2019      **End Date:** 2/29/2020

**Results to Date:** No Report

**Project Number:** 19-04

**Title:** Validation of Monkfish Age and Growth Using Microconstituent Analysis of Hardparts

**Thematic Research Area:** Stock Assessment Support

#### **Project Description**

We are developing and validating a novel aging method for monkfish, *Lophius americanus*, to support stock assessment. The length modes for the strong 2015 year class (YC) have been clearly delineated through successive seasonal surveys, thus effectively providing monkfish of known age. Our collaborator, Dr. Anne Richards, a stock assessment expert for monkfish at the NEFSC Fisheries Biology Program has collected monthly samples of this YC from 6-mo old fish. The objective of this study is to analyze seasonal cycles of hardpart microconstituents (Ca, P, and Sr) from this YC at ages 0-3 y to compare with optical zonation methods. The patterns observed in the known age fish will provide a key to interpreting optical zonation patterns in fish of unknown age, filling a major gap in the data needed for quantitative assessment of monkfish and leading to improved scientific advice to fishery managers. The project is providing training at CBL and NEFSC, Woods Hole, of a minority masters student.

**P.I.:** Rosemary Jagus, UMCES: University of Maryland Center for Environmental Science

**Co-PI:** David Secor, UMCES: University of Maryland Center for Environmental Science

**NOAA Partner:** Anne Richards, NEFSC: Northeast Fishery Science Center

**Other Partner:**

**Students:** Benjamin Frey (MS, UMCES)

**Keywords:** Fisheries; Population dynamics

**Start Date:** 9/1/2019      **End Date:** 8/31/2020

**Results to Date:** No Report

**Project Number:** 19-05

**Title:** Evaluation of age, natal origin, and trophic history of Pacific Lamprey (*Entosphenus tridentatus*)

**Thematic Research Area:** Stock Assessment Support

### **Abstract**

The Pacific Lamprey (*Entosphenus tridentatus*) is an anadromous species native to the North Pacific Ocean. In the last 50 years, it has experienced declines in abundance within the Columbia River Basin, USA. More information on the biology and ecology of this species is needed for conservation and management. Anatomical structures have been widely used in fisheries science for biological inference yet remain relatively unexplored in Pacific Lamprey. The goal of this proposal is to broaden our understanding of lamprey by evaluating the efficacy of different structures for determining age, natal origin, and trophic position. These objectives will be achieved using lamprey statoliths and eye lenses taken from known age and origin specimens.

**Principal Investigator:** Keala Pelekai, Oregon State University

**Co-PI:** Jessica Miller, Oregon State University

**NOAA Partner:** Laurie Weitkamp, NWFSC: Northwest Fishery Science Center

**Other Partner:** Eric Lewallen, Hampton University

**Students:** Keala Pelekai (MS, OSU)

**Keywords:** Fisheries; Protected Species; Population dynamics; Ecosystems

**Start Date:** 6/1/2019

**End Date:** 4/1/2021

### **Results to Date**

To date, we have completed the dissection of all larval-stage (known age & origin) lamprey samples, which includes the removal of statoliths and eye lenses. Larval statoliths needed for the development of aging methods have been imaged and measured. The remaining larval statoliths have been archived for chemical analysis in the Spring. The larval eye lenses have been desiccated and stored for stable isotope analysis in the Fall.

### **Relevance to NOAA**

This research falls under NOAA's 'Assessment: Support and Information' thematic area by providing key life history information needed for the conservation and management of marine species. Our research seeks to develop and proof methods of aging and natal origin assignment in Pacific Lamprey (*Entosphenus tridentatus*), which currently do not exist in the literature. Overall, the goal of this research is to increase our scientific understanding through the development and evaluation of methods to determine age structure, natal origins, and trophic relationships, which will contribute to NOAA's efforts to manage and conserve Pacific Lamprey.

### **Broader Impacts**

The ability to age Lamprey is central to understand their life history and identify factors needed for freshwater survival as well as determine the duration of marine residence. Additionally, the ability to determine natal origins is needed to fully evaluate supplementation efforts. Finally, a better understanding of their trophic ecology during the marine phase, across a diversity of sizes (and presumably ages), is important for understanding factors that influence their overall productivity.

### **Presentations or Publications**

Pelekai, K.P., Miller, J., Hess, J., and L. Porter. 2019. Determination of age, natal origin, and trophic

history of Pacific Lamprey (*Entosphenus tridentatus*). Oregon Chapter of the American Fisheries Society Annual Meeting. Poster Presentation. \*Won Runner-Up for Best Student Poster Award

Pelekai, K.P. 2019. Evaluation of Pacific Lamprey age, natal origins, and trophic history through anatomical structures. Research Advances in Fisheries, Wildlife, and Ecology Symposium. Oral Presentation.

**Project Number:** 19-06

**Title:** Thermal impacts on juvenile Pacific Cod (*Gadus macrocephalus*) foraging and growth in Gulf of Alaska nursery habitats

**Thematic Research Area:** Climate and Ecosystems

**Abstract**

The Gulf of Alaska is influenced by thermal variation including climatic phenomena and marine heatwaves such as the warm 'Blob' of 2013-2016. Warming events are expected to impact age-0 Pacific Cod (*Gadus macrocephalus*) during summer growth in coastal nurseries and can influence patterns of foraging, selective mortality, and overwinter survival. Understanding thermal impacts on juvenile Cod is especially relevant given their largescale declines in adult abundance following the 'Blob'. I will examine juvenile Cod in Kodiak Island nurseries between 2006 and 2019 during representative warm and cold years in order to describe variability in hatch phenology, nursery growth, diet composition, and trophic position using otolith increment, stomach content, and stable isotope analysis. Expected results will inform Cod recruitment patterns in the face of climate change and contribute to nursery management during future warming.

**Principal Investigator:** Hillary Thalmann, Oregon State University

**Co-PI:** Jessica Miller, Oregon State University

**NOAA Partner:** Ben Laurel, AFSC: Alaska Fishery Science Center

**Other Partner:** Bradley Stevens, UMES

**Students:** Hillary Thalmann (MS, OSU); Undetermined intern for summer 2020 (Undergraduate, OSU)

**Keywords:** Fisheries; Protected Species; Population dynamics; Ecosystems; Habitats; Thermal variability

**Start Date:** 9/1/2018

**End Date:** 6/30/2021

**Results to Date**

This project was recently funded this year and is still in the early phases of data collection. We anticipate that stable isotope, stomach contents, and otolith results will be available in the next year.

**Relevance to NOAA**

Living marine resources such as Pacific Cod are critical for Alaska's commercial, subsistence, and recreational fishing industries and represent an important economic and nutritional resource at both a regional and national scale (Mathis et al. 2015). The proposed work complements and expands ongoing Pacific Cod research within the Alaska Fisheries Science Center, including efforts to identify overwintering processes during the first year of life and the validation of an individual-based transport model for Pacific Cod. Quantifying trends in Pacific Cod hatch phenology as well as growth and foraging within essential nursery habitat can illuminate changes in a nursery's ability to support a stenothermic species like Pacific Cod and lead to more effective precautionary management for long-term sustainability. For example, the North Pacific Fisheries Management Council sets an



annual specific total catch for GOA Pacific Cod based on population- and ecosystem-level risk metrics. Growth patterns, condition, and diet composition of juveniles settling in coastal nurseries can be important metrics that indicate changes in the population and inform management decisions. In addition, climate-mediated declines in Pacific Cod have important ecosystem implications, with effects cascading up the food web to top predators such as salmon, marine mammals, and sea birds (Cornwall 2019). The Kodiak Island beach seine time series is identified as a valuable dataset for the 'ecosystem indicators' section of NOAA AFSC's Assessment of the Pacific Cod stock in the GOA because it is the only dataset for nursery-age GOA Pacific Cod that spans multiple thermal regimes and includes data from the 2013-2016 MHW. Trends from these archived specimens can illustrate climate-mediated shifts in growth and production of juvenile Pacific Cod and aide in recovery efforts for the species.

### **Broader Impacts**

Stakeholders, fishermen, and related industry participants in Southeast Alaska are directly impacted by declines in Pacific Cod, and I will develop collaborative activities in Kodiak and Anchorage, AK to target these groups. 'Dock Talks' is a monthly event run by the University of Alaska Fairbanks Marine Advisory Program and the Alaska Sea Grant and hosted at the Kodiak Seafood and Marine Science Center. This event is an opportunity for Kodiak fishermen to connect and network with scientists on community-based fisheries issues. I will work with Dock Talks program coordinators to host two events: one during which I communicate my research objectives and solicit feedback from event attendees early on in my project and a second during which I communicate my findings and discuss future goals with the fisheries community. I will also work with Dr. Benjamin Laurel to organize an event associated with the Alaska Marine Science Symposium in Anchorage with the purpose of connecting Pacific Cod scientists and stakeholders across the region. I anticipate participating in such an event early in my research and again once I have completed the project.