



**Performance Report for Cooperative Agreement No: NA16SEC4810007
for the Period from March 1, 2017 to August 31, 2017**

University of Maryland Eastern Shore

Living Marine Resources Cooperative Science Center

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I. Accomplishments

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

What are the major goals of the project?

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

Education Goals:

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

Research Goal:

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

Administration Goals:

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

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

1. Major Activities:

Education Goals:

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

DSU: Attended ARD meeting and aligned with DSU recruiter to find new students

HU: Handed out LMRCSC brochures, spoke to individual students with the required GPA, facilitated summer student placement at UMES

OSU: Advertised opportunity for PhD position within the LMRCSC at OSU during Fall 2016 and interviewed several candidates during Winter 2017.

RSMAS: We invited potential Ph.D. students to the RSMAS student recruitment event on February 3. Students visited the campus and met with potential advisors and current graduate students

UMES: Center staff provided a recruitment booth at the UMES Open House on March 25, the Washington Metropolitan Area Alumni Reception on March 27, and the UMES Honors Program Meeting on August 31.

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

The Center used this reporting period to plan for workshops that will be offered to students including the “Literacy in NOAA mission related disciplines: A cohort experience” workshop that

will be offered for one week in March 2018, and Data management workshop that is being offered to students in fall 2017. The course began during the final days of this reporting period. Graduate students in the program have begun to take classes including courses offered at the Center to enable them to acquire core competencies in marine and fisheries science. Additional specific examples include:

DSU: Brian Galvez spends boat time with New Jersey Department of Environmental Protection (NJDEP) and some with Delaware Department of Natural Resources and Environmental Control (DE DNREC); TyRae Freeman put together and is mailing a DE survey for commercial fishermen.

OSU: Angie Munguia completed her NERTO at the NOAA NWFSC Hammond Lab in Oregon.

RSMAS: LMRCS students are encouraged to participate in stock assessment working groups

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 – The first Scott B. Gudes scholarship was awarded to Stephanie Martinez-Rivera, a Ph.D. student at UMES. We are making preparations to receive applications for the second scholarship award.

Research Goal:

Eight collaborative research proposals funded during the previous reporting period are ongoing; the titles, names of lead PIs, and the research thematic areas to which they belong are presented in Table 1. These projects are well aligned with NOAA Fisheries research priorities. Six of the lead PIs of the projects are located at LMRCS MSIs, hence the projects are helping to build sustainable capacities at the Center MSIs; three of the lead PIs are graduate students.

Table 1. TAB projects funded for FY 2016 to 2017

#	Lead PI	Project Title	Research Thematic Area
1	Cara Schweitzer (UMES)	Discard mortality of sub-legal black sea bass in the commercial trap fishery: Impacts of air exposure and acute temperature changes.	Assessment
2	Bradley Stevens (UMES)	Biological baseline data for Jonah Crab Management	Assessment
3	Stephanie Martinez-Rivera (UMES)	Reproductive Biology of red deepsea crabs, <i>Chaceon quinquegens</i> .	Assessment
4	Tara Cox (SSU)	Refining stock structure of common bottlenose dolphins (<i>Tursiops truncatus</i>) through photo-identification and genetic analysis	Assessment
5	Shari Wiley (HU)	The Impact of Increasing Sea Surface Temperatures on Piscivore and Planktivore Species Dynamics: An Ecosystem-Based Modeling Approach	Climate & Ecosystems
6	Joseph Pitula (UMES)	Ecosystem impact of a harmful algal bloom species (<i>Dinophysis acuminata</i>) on aquaculture shellfish	Healthy Habitats
7	Jessica Miller (OSU)	Migration and foraging ecology of at-risk species: Columbia River Chinook salmon and Atlantic weakfish	Assessment
8	Ammar Hanif (IMET)	Comparing the diet and microbiome of Atlantic menhaden and Eastern oyster using DNA barcoding	Assessment

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 began with the start of the Fall Semester on August 28, 2017.

Ethical Conduct of Research Training for Students and Faculty:

DSU: All DSU students attended training

OSU: Angie Munguia completed a course at OSU that meets University ethics requirements. Ethical conduct of scientists is also often discussed in Miller Lab Meetings.

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

SSU: One summer intern in the Rising Sophomore Experiential Training Program at SSU participated in a seminar on Ethical Conduct of Research.

UMES: The four summer interns in the Rising Sophomore Experiential Training Program at UMES participated in a seminar on Ethical Conduct of Research.

Administration Goals:

a) Grant funds for FY 2017 have been subcontracted to LMRCSC institutions

b) LMRCSC Implementation Plan was revised and re-submitted to NOAA EPP for review

c) The Center advertised vacant personnel positions, including the Postdoctoral Research Fellows, Assistant Professor at Hampton University (HU), and the Education Lead at Savannah State University (SSU). Dr. Margaret Sexton was appointed Acting Assistant Director of the LMRCSC. It is anticipated that the Post-doctoral position will be filled by November 2017.

The position posting for the Educational Expert was developed as a Visiting Assistant Professor in the School of Teacher Education and distributed, and will be filled in October 2017.

d) The Center conducted its monthly Executive Committee meetings, and Science Committee meetings

e) The Communication Specialist of the LMRCSC, Ms. Anne Dudley, focused her time on disseminating information on activities and accomplishments of the Center. She prepared a newsletter that was released in April 2017, and is finalizing another one that will be released in September 2017.

f) The LMRCSC, working with the College of Exploration, has developed a Comprehensive Evaluation Plan for the Center that was revised and re-submitted to NOAA EPP. An evaluation report for the first year of the award has been prepared by the College of Exploration and is currently being reviewed by the LMRCSC.

g) The Center leadership has worked to enhance engagement with NOAA Fisheries scientists using various means including giving a webinar on the LMRCSC to the SEFSC Director and Division Chiefs, conference calls with the NEFSC to discuss Center capabilities and areas where NOAA scientists and LMRCSC scientists and students can collaborate.

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-one (21) students have been identified/recruited to the Center as members of Cohort 1 (2016 – 2017), including 6 Ph.D., 6 M.S., and 9 B.S. Additionally, ten (10) students have been identified/recruited so far as members of Cohort 2 (2017-2018) including 5 Ph.D., 2 M.S., and 3 B.S. students.

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

Consistent with our goal specified in the Implementation Plan, five rising sophomores participated in 2017 summer programs. The students participated in the REU program at UMES (4) and SSU (1) that encompassed training in NOAA related research disciplines, professional development activities, and special workshops during which they were taught about NOAA and NOAA undergraduate scholarships such as NOAA EPP undergraduate scholarship and Hollings scholarship. They learned the process of developing and submitting a competitive application package. Dr. Maggie Sexton implemented the program at UMES whereas Dr. Dionne Hoskins-Brown implemented the program at SSU. Students will be tracked to determine whether they submitted applications to the NOAA undergraduate scholarship programs and if they were successful.

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

The first Scott B. Gudes scholarship was awarded to Stephanie Martinez-Rivera, a Ph.D. student at UMES. We are making preparations to receive applications for the second scholarship.

Building of a Strong Center Cohort Community: Plans for building a strong cohort community at the LMRCSC have been discussed at the LMRCSC Executive Committee meeting and will be fostered via a) Cohort Building Workshop in Spring 2018, b) Student Seminar Series that will continue in Fall 2017, c) Data management course that is being taught in Fall 2017, and d) Professional Development workshop at UMES offered by Dr. Maggie Sexton biweekly for undergraduate students and monthly for graduate students in Fall 2017, Spring 2018.

Research Goals:

Eight collaborative proposals were funded by the LMRCSC after reviews by the Technical Advisory Board (TAB) in the previous reporting period. These projects (Table 1) continued during this period. Other research projects supported with leveraged funds from agencies such as NOAA, NSF, USDA, are on-going at the LMRCSC.

Administration Goals:

- a) Dr. Maggie Sexton has been appointed Acting Assistant Director of the LMRCSC. Interviews for the Post-doctoral Position at UMES is on-going and the position will be filled by November, 2017.
- b) The LMRCSC Implementation Plan was revised and re-submitted to NOAA for review.
- c) At SSU, a partnership was formalized with the School of Teacher Education to share the Education Expert position. The Education Expert position will be filled by October 2017. Dr. Dionne Hoskins has been serving as Education lead for the LMRCSC in an acting capacity.
- d) A Comprehensive Evaluation Plan for the LMRCSC was developed and submitted to NOAA EPP
- e) The Center held its monthly Executive Committee meetings during which plans to execute student development and professional activities were discussed.

- f) The Center held its Science meeting at NOAA SEFSC, Miami, FL in April 2017
- g) The Center’s website has been substantially modified and is regularly updated.
- h) Fall newsletter to disseminate information on LMRCSA accomplishments is in preparation for production in September 2017; the spring newsletter was produced in May 2017.

4. Key outcomes or other achievements:

- a) A total of 31 students (21 in Cohort 1, 10 in Cohort 2) have been recruited to the Center
- b) Plans for more rigorous evaluations of the LMRCSA have commenced.
- 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 postsecondary students, early professionals, postdocs, and faculty?

Students recruited to the Center have begun taking courses to enable them acquire core competences in marine and fisheries science, and are defining their research projects. They have also discussed with their advisors the Student Development Plan. Thirteen (13) students are enrolled in the Data Management for Scientists course that is being offered in fall 2017.

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

The following table includes examples of the Center’s communication activities and coverage of the Center that occurred during the current funding period including information on the FY16 award and that of leveraged projects:

Table 2. Examples of LMRCSA Communication Activities during the Reporting Period

Date	Publication	Story Title	Link
9/12/2017	Tidewater Press (AFS Tidewater Newsletter)	Update from UMES Student Subunit	(PDF)
8/3/2017	Field Fresh: NEFSC Science in Motion	A Day in the Life of Darius Sanford	https://nefsc.wordpress.com/2017/08/02/a-day-in-the-life-of-darius-sanford/
8/1/2017	UMCES Environmental Insights - August 2017	Rose Jagus awarded Elkins Professorship	http://www.umces.edu/news/imets-rose-jagus-awarded-elkins-professorship?utm_source=UMCES+Newsletter+August+2017&utm_campaign=Environmental+Insights+August+2017&utm_medium=email
7/28/2017	Sea Grant Monthly e-newsletter and Website	Sea Grant announces the 2018 Knauss Fellowship finalists	http://seagrant.noaa.gov/News/FeatureStories/TabId/268/ArtMID/715/ArticleID/756/Sea-Grant-announces-the-2018-Knauss-Fellowship-finalists.aspx?utm_source=June%2FJuly+2017+SG+newsletter&utm_campaign=June+July+2017+e-newsletter&utm_medium=email
7/25/2017	Channel 47 WMDT (ABC Affiliate)	Shark Washes Ashore in Ocean City	http://www.wmdt.com/home/shark-washes-ashore-in-ocean-city/592890247
7/18/2017	UMCES Website	IMET’s Rose Jagus awarded Elkins Professorship	https://www.umes.edu/LMRCSA/Pages/News-Articles/2017/IMET-S-ROSE-JAGUS-AWARDED-ELKINS-PROFESSORSHIP/

7/12/2017	LMRCSC Website	NOAA LMRCSC alumna from Hampton University aims for career in marine science education and outreach	https://www.umes.edu/LMRCSC/Pages/News-Articles/2017/NOAA-LMRCSC-ALUMNA-FROM-HAMPTON-UNIVERSITY-AIMS-FOR-CAREER-IN-MARINE-SCIENCE-EDUCATION-AND-OUTREACH/
7/5/2017	NOAA Fisheries website	From Beaches to the Bottom of the Sea, Microplastics Are Everywhere	https://www.nefsc.noaa.gov/press_release/pr2017/features/microplastics/
5/12/2017	UMES The Key	Aquatic resources and ecosystems symposium	https://issuu.com/umes.edu/docs/web_key_may_12_issue_2017?e=22255080/48560342
5/10/2017	LMRCSC Spring 2017 Newsletter	LMRCSC Spring 2017 Newsletter	https://www.umes.edu/LMRCSC/Pages/News-Articles/Spring-2017-Newsletter/Spring-2017-Newsletter/
5/2/2017	Chesapeake Quarterly	Maryland's 2016 Knauss Fellowships	http://chesapeakequarterly.net/V16N1/side1/
3/17/2017	County Times	UMES student fisheries organization to host aquatic resources and ecosystems symposium	http://www.csctimes.com/schools/umes-student-fisheries-organization-host-aquatic-resources-ecosystems-symposium/
3/2/2017	The Columbian	Ocean conditions appear improving for salmon	http://www.columbian.com/news/2017/mar/02/ocean-conditions-appear-improving-for-salmon/#
3/2/2017	FisheryNation.com	Ocean conditions appear improving for salmon	http://fisherynation.com/archives/tag/marisa-litz

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

Education Goals: As examples, the Center will;

- a) Continue its efforts to recruit students into the Center; at present 10 students have been recruited into Cohort 2, including 5 Ph.D., 2 M.S. and 3 B.S.
- b) Offer to students a workshop on Data Management in Fall 2017. In addition, an Introduction to Environmental and Resource Economics course will be offered to the students in spring 2018.
- c) Offer to students a workshop on Literacy in NOAA related sciences in spring 2018

- d) Work with sophomores supported during the Summer 2017, as well as any other sophomores recruited during Fall 2017 to develop application packages for the NOAA undergraduate scholarship programs
- e) 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.
- f) Continue to mentor students and encourage them to present at professional meetings.

Research Goals: As examples, the Center will;

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

Administration Goals: Examples are given below.

- a) Continue Executive Committee meetings
- b) Hold Board of Visitors meeting Nov. 2 at Savannah State University
- c) Continue to collect data for evaluation of Center's activities, programs, and accomplishments
- d) Continue to disseminate information about the Center to the public including producing Newsletters.
- e) Ensure that all students have taken Ethical Conduct of Research Training course

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: Nothing to report

Publications in Journals:

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

17 publications (2 student authors identified by *); LMR CSC scientists are in bold

Publications in journals	Justification
Allman, AL, Williams, EP, Place AR . 2017. Growth and enzyme production in blue crabs (<i>Callinectes sapidus</i>) fed cellulose and chitin supplemented diets. J. Shellfish Res. 36, DOI: 10.2983/035.036.0132.	leveraged
Bond, M. E., J. Valentin-Albanese, E. A. Babcock , D. Abercrombie, N. F. Lamb, A. Miranda, E. K. Pikitch, D. D. Chapman (2017) Abundance and size structure of a reef shark population within a marine reserve has remained stable for more than a decade. Marine Ecology Progress Series 576:1-10. doi:10.3354/meps12241	Leveraged
Fadaei, H, Williams, E, Place, AR , Conolly, J, Ghosh, U. 2017. ASSIMILATION EFFICIENCY OF SEDIMENT-BOUND PCBS INGESTED BY FISH IMPACTED BY STRONG SORPTION, Env. Tox. & Chem. 36: DOI:10.1002/etc.3932	leveraged
Feng, X, Williams, EP, Place AR . 2017. High genetic diversity and implications for determining population structure in the blue crab <i>Callinectes sapidus</i> . J. Shellfish Res. 36, 1-12.	leveraged
Grüss, A., J. T. Thorson, S. R. Sagarese, E. A. Babcock , M. Karnauskas, J. F. Walter III, M. Drexler. 2017. Ontogenetic spatial distributions of red grouper (<i>Epinephelus morio</i>) and gag grouper (<i>Mycteroperca microlepis</i>) in the U.S. Gulf of Mexico. Fisheries Research 193:129-142 doi:10.1016/j.fishres.2017.04.006	Leveraged
Grüss, A., J.T. Thorson, E.A. Babcock , and J. H. Tarnecki. 2017. Producing distribution maps for informing ecosystem-based fisheries management using a comprehensive survey database and spatio-temporal models. ICES Journal of Marine Science doi:10.1093/icesjms/fsx120	Leveraged
Grüss, A., K. A. Rose, J. Simons, C. H. Ainsworth, E. A. Babcock , D. D. Chagaris, K. De Mutsert, J. Froeschke, P. Himchak, I. C. Kaplan, H. O'Farrell* and M. J. Zetina-Rejon. 2017. Recommendations on the Use of Ecosystem Modeling for Informing Ecosystem-Based Fisheries Management and Restoration Outcomes in the Gulf of Mexico. Marine and Coastal Fisheries. 9:1, 281-295, DOI:10.1080/19425120.2017.1330786	Leveraged
Haq S, Bachvaroff TR, Place AR . 2017. Characterization of acetyl-CoA carboxylases in the basal dinoflagellate <i>Amphidinium carterae</i> . Marine Drugs: Advances and New Perspectives in Marine Biotechnology II, 15(6). pii: E149. doi: 10.3390/md15060149	leveraged
Hill, JM, Williams, EP, Masters, B, Place, AR . 2017. Multiple paternity in the blue crab (<i>Callinectes sapidus</i>) assessed with microsatellite markers. J. Shellfish Res. 36, DOI: 10.2983/035.036.0130.	leveraged
Larkin, M & Place, AR . 2017. Running the Stop Sign: Read through of a premature UAG termination signal in the translation of a zebrafish (<i>Danio rerio</i>) taurine biosynthetic enzyme. Marine Drugs: Advances and New Perspectives in Marine Biotechnology II, 15(6). pii: E162. doi: 10.3390/md15060162.	leveraged
Lawrence, A*, Green, S*, Chung, JS 2017. Isolation and tissue distribution of insulin-like androgenic gland hormone cDNA sequence from the androgenic gland of red deep-sea <i>Chaceon quinque-dens</i> , Marine Drugs, 15(8) DOI: 10.3390/md15080241.	TAB, LMR CSC student stipend

O'Farrell* H, A. Grüss, S. R. Sagarese, E. A. Babcock , and K. A. Rose. 2017. Ecosystem modeling in the Gulf of Mexico: current status and future needs to address ecosystem-based fisheries management and restoration activities. <i>Reviews in Fish Biology and Fisheries</i> . DOI 10.1007/s11160-017-9482-1	Leveraged
Place, AR & Plough, LV, 2017. The genetic enablement of the blue crab <i>Callinectes sapidus</i> . <i>J. Shellfish Res.</i> 36: 227-229.	leveraged
Thao, Y.T., D. T. N. Linh, V. C. Si, T. W. Carter and R. T. Hill . 2017. Isolation and selection of microalgal strains from natural water sources in Vietnam with potential for edible oil production. <i>Mar. Drugs</i> 15(194): doi:10.3390/md15070194.	leveraged
Williams, E, Place, A & Bachvaroff, TR. 2017. Transcriptome analysis of core dinoflagellates reveals a universal bias towards "GC" rich codons. <i>Marine Drugs: Advances and New Perspectives in Marine Biotechnology II</i> , 15(5). pii: E125. doi: 10.3390/md15050125.	leveraged
Williams, EP, Feng, X, Place, AR . 2017. Extensive heteroplasmy and evidence for fragmentation in the <i>Callinectes sapidus</i> mitochondrial genome. <i>J. Shellfish Res.</i> 36: DOI: 10.2983/035.036.0129	leveraged
Zhao Zhao, Michael Gonsior, Jenna Luek, Stephen Timko, Hope Ianiri, Norbert Hertkorn, Philippe Schmitt-Kopplin, Xiaoting Fang, Qinglu Zeng, Nianzhi Jiao, and Feng Chen . 2017. Picocyanobacteria and deep-ocean fluorescent dissolved organic matter share the same optical properties. <i>Nature Communication</i> , DOI:10.1038/ncomms15284	leveraged

6 publications under review or accepted (1 student author identified by *)

Manuscripts that are under review or accepted for future publication	Justification
Flowers, EM, Johnson, AF, Aguilar, R, Schott, EJ . Prevalence of a pathogenic crustacean virus near flow-through crab aquaculture. Submitted Aug 15, 2017 to <i>Diseases of Aquatic Organisms</i> .	leveraged
Li , DX, Zhang, H, Xiao-Huang Chen , Zhang-Xian Xie , Yong Zhang , Shu-Feng Zhang , Lin Lin, Feng Chen , Da-Zhi Wang. Metaproteomics reveals major microbial players and their metabolic activities during the blooming period of a marine dinoflagellate <i>Prorocentrum donghaiense</i> . <i>Environmental Microbiology</i> . In press.	leveraged
Matta, M. E., Miller, J. A. , Short, J., Helser, T., Hurst, T. P. Rand, K., Ormseth, O. <i>In press</i> . Spatial and temporal variation in otolith elemental signatures of age-0 Pacific cod (<i>Gadus macrocephalus</i>) in the Gulf of Alaska. Accepted.	Leveraged
Miller, J. A. , Carlton, J.T., Chapman, J.W., Geller, J. B., Ruiz, G.M. (<i>Accepted pending revisions</i>). Transoceanic dispersal of the mussel <i>Mytilus galloprovincialis</i> on Japanese tsunami marine debris: A model for evaluating rafting of a coastal species at sea. <i>Marine Pollution Bulletin</i> . Accepted pending revisions.	Leveraged
Nancy I. Lewis, John Claude Achenbach, Lee Ellis, Joseph S. Pitula , Cheryl Rafuse, Detbra S. Rosales*, Jennifer L. Wolny, Pearse McCarron. Morphometric, Phylogenetic, Growth and Toxicity Assessment of <i>Coolia monotis</i> Meunier (Dinophyceae) from Nova Scotia, Canada. <i>Harmful Algae</i> . In Review.	D.S. Rosales (student, Cohort 1) and J.S. Pitula (UMES faculty) were supported by LMRCSC during

	the preparation of this manuscript.
Ta, N., Miller, J. A. , Chapman, J. C., Pleus, A. E., Calvanese, T., Miller-Morgan, T., Burke, J., and Carlton, J. T. C. Accepted. The Western Pacific barred knifefjaw, <i>Oplegnathus fasciatus</i> (Temminck & Schlegel, 1844) (Pisces: Oplegnathidae) arriving with tsunami debris on the Pacific coast of North America. Aquatic Invasions. Accepted.	Leveraged

Books: None

Book Chapters: None

Thesis/Dissertations: None

Conference Papers, Posters and Presentations:

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

12 oral presentations (5 student presenter)

Oral presentations at professional meetings	Justification
Chen, F. 2017 Ecological Roles of Picocyanobacteria and Cyanophages. Aoshan Forum: Deep Ocean Ecosystem: Extreme environments and life process, Qingdao, China, August 29-30.	leveraged
Chen, F. 2017 Transportation of Picocyanobacterial cDOM to the Deep Ocean. Aoshan Forum: Deep Ocean Ecosystem: Extreme environments and life process, Qingdao, China, August 29-30.	leveraged
Chung, JS. 2017. Becoming a sook: It is all in her eyes. Duke Marine Laboratory	leveraged
Griffin*, E.K., Z. Wong, R.M. Perrtree, and T.M. Cox . 2017. Evaluation of the southern boundary of the Northern Georgia Southern South Carolina Estuarine System stock of common bottlenose dolphins (<i>Tursiops truncatus</i>) in the waters around Savannah, GA. Presented at the Southeast and Mid-Atlantic Marine Mammal Symposium, Beaufort, NC April 7-9, 2017.	LMRCSC student stipend
Major, S. R., D. Stephens, E. Pagliaroli, L. Xiao, R. Powell and R. T. Hill . 2017. Succession of the microbial communities in microalgal polycultures for biofuel production. ASM Microbe 2017. New Orleans, LA.	leveraged
Miller, J. A. , Morgan, C. A., Beckman, B. R., Burke, B. J., Van Doornik, D. M., Weitkamp, L. A. 2017. Migratory patterns of Snake River spring Chinook salmon: comparison of hatchery and presumably wild yearlings. Salmon Ocean Ecology. Seattle, WA.	Leveraged
Rosales*, D. and Pitula, J. 2017. The Impacts of Harmful Dinoflagellates and <i>Vibrio</i> sp. On Aquaculture in The Delaware Inland Bays. Presented at Living Marine Resources Cooperative Science Center (LMRCSC) Annual Science Meeting, NOAA Southeast Fisheries science Center, Miami, FD, April 2017.	FY 16 TAB project

Chigbu, P. 2017. A comprehensive, integrated educational framework for recruiting and training of underrepresented minorities in marine and fisheries sciences. Presented at the American Fisheries Society annual meeting, Tampa, FL, August 20-24, 2017.	Based on work funded by the LMRCS
Peters, R.* and Chigbu, P. 2017. Site fidelity and growth rate of juvenile black sea bass, <i>Centropristis striata</i> , in the Maryland Coastal Bays using mark-recapture. Presented at the American Fisheries Society annual meeting, Tampa, FL, August 20-24, 2017.	Leveraged
Olsen, N.A.* and Stevens, B.G. 2017. Reproductive biology of Jonah crabs, <i>Cancer borealis</i> , in the Mid-Atlantic Bight. Presented at the American Fisheries Society Tidewater Chapter 31st Annual Meeting, Virginia Beach, VA, March 9-11, 2017	FY 16 TAB project
Olsen, N.A.* and Stevens, B.G. 2017. From pest to plate: Using morphometry to help improve management of Jonah crabs, <i>Cancer borealis</i> , in the mid-Atlantic Bight. Presented at the American Fisheries Society 147 th annual meeting, Tampa, FL, August 20-24, 2017.	FY 16 TAB project
Wilson, A. (2017) Larval Fish Assemblages in the Gulf of Mexico during the Deepwater Horizon Oil Spill. Presented at the American Fisheries Society Annual Meeting, Tampa, FL August, 2017	Leveraged

Posters: 9 (*6 student presenters)

Poster presentations at professional meetings	Justification
Flowers, E.M., Johnson, A., Aguilar, R., Schott, E.J. 2017. Disease prevalence in proximity to flow through crustacean aquaculture in a North American Atlantic estuary Association for the Science of Limnology and Oceanography. March, Honolulu, HI.	leveraged
Green*, S., Chung, J.S. 2017. Elucidating the presence and expression of the crustacean hyperglycemic hormone of the red deep-sea crab, <i>Chaceon quinque-dens</i> . DelMarVa's Aquatic Resources & Ecosystems Research Symposium, University of Maryland Eastern Shore, Berlin, MD, April, 2017.	LMRCSC student stipend
Griffin*, E.K., Z. Wong, R.M Perrtree, and T. Cox. 2017. Evaluation of the southern boundary of the Northern Georgia/Southern South Carolina Estuarine System stock of common bottlenose dolphins (<i>Tursiops truncatus</i>) in the waters around Savannah, GA. Presented at Savannah State University 7th Annual Research Conference, Savannah, GA April 10, 2017. Poster.	LMRCSC student stipend
Hanif,* A, James White, Rosemary Jagus, Allen Place. Menhaden: Nature's ultimate environmental sampler. Delmarva's Aquatic Resources & Ecosystems Symposium, University of Maryland Eastern Shore, Berlin, MD, April 2017	LMRCSC student stipend
Lawrence*, A, Green*, S, Chung, JS. The isolation of an insulin-like androgenic gland hormone in the male deep-sea red crab, <i>Chaceon quinque-dens</i> . DelMarVa's Aquatic Resources & Ecosystems Research Symposium, University of Maryland Eastern Shore, Berlin, MD, April, 2017.	LMRCSC student stipend
Miller, J. A. , Morgan, C. A., Beckman, B. R., Burke, B. J., Van Doornik, D. M., Weitkamp, L. A. 2017. Migratory patterns of Snake River spring Chinook salmon: comparison of hatchery and presumably wild yearlings. Salmon Ocean Ecology. Seattle, WA.	Leveraged

Rosales*, D. and Pitula, J. 2017. The Impacts of Harmful Dinoflagellates and <i>Vibrio</i> sp. On Aquaculture in The Delaware Inland Bays. Presented at Living Marine Resources Cooperative Science Center (LMRCSC) Annual Science Meeting, NOAA Southeast Fisheries science Center, Miami, FD, April 2017.	TAB
Ferranti, D., Peters, R.* and Chigbu, P. 2017. A Comparison of the Abundance and Size of Black Sea Bass in the Delaware and Maryland Coastal Bays. Presented at the American Fisheries Society annual meeting, Tampa, FL, August 20-24, 2017.	Leveraged
Spitznagel, M., Small, H., Shields, J., Lively, J., Johnson, A., Schott, E.J. Association of a virus pathogenic to Atlantic blue crabs (<i>Callinectes sapidus</i>) with fishing and aquaculture practices National Shellfisheries Association. Nashville, TN. March 26-30, 2017.	leveraged

Other Publications:

Other products	Justification
Babcock E.A. , and Cortes E. 2017. Bayesian surplus production models for shortfin mako sharks: are the results consistent when using different software packages? ICCAT Collective Volume of Scientific Papers SCRS/2017/055	Leveraged
O, Farrell*, H. and E. A. Babcock. 2017 Evaluation of environmental conditions as predictors for mako shark CPUE using generalized linear mixed modeling and quantile regression. ICCAT Collective Volume of Scientific Papers SCRS/2017/057	Other LMRCSC

Technologies or Techniques: None

Patents: None

Inventions: None

Websites: 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
Dennis	McIntosh	DSU	Participating faculty	20
Stacy	Smith	DSU	Project Director	80
Deidre	Gibson	HU	Project Director	160
Nefertiti	Smith	HU	BS student	40
Munguia	Angelica	OSU	MS student	80
Miller	Jessica	OSU	Project Director	35
Elizabeth	Babcock	RSMAS	Project Director	7
David	Die	RSMAS	Faculty	3.5
Halie	O'Farrell	RSMAS	Ph.D. student	173
Dionne	Hoskins-Brown	SSU	Project Director	40
Tara	Cox	SSU	mentor	20
Tsvetsan	Bachvaroff	UMCES	mentor	30
Feng	Chen	UMCES	mentor	20
J. Sook	Chung	UMCES	mentor	40
Nick	Hammond	UMCES	mentor	20
Russell	Hill	UMCES	mentor	20
Rosemary	Jagus	UMCES	Project Director	80
Allen	Place	UMCES	mentor	10
Eric	Schott	UMCES	mentor	30
Dave	Secor	UMCES	mentor	10
Paulinus	Chigbu	UMES	Center Director and Principal Investigator	80

Anne	Dudley	UMES	Data, Information, and Communication Manager	124
Onjale	Scott	UMES	Operations Professional Program Coordinator	160
Margaret	Sexton	UMES	Research Assistant Professor	160
Bradley	Stevens	UMES	Distinguished Research Scientist	160
Ida	Tilghman	UMES	Administrative Assistant	160

2. What organizations have been involved as partners?

Provide additional information such as:

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

Type of partner organization	Name	Location	Partners contribution to the project
State government	NJDEP	Galloway, NJ	Helped students collect samples
Regional Fishery Management Organization	International Commission for the Conservation of Atlantic Tunas		PhD student participated in ICCAT stock assessment of mako sharks
NOAA	SEFSC	Lafayette, LA	Taught student to perform genetic analyses; hosted NERTO

Have other collaborators or contacts been involved? Yes

If Yes, describe involvement and time spent.

Last name	First name	Title/Affiliation	Description of involvement
Biedenweg	Kelly	Human Dimensions professor, OSU	Helped with student recruiting for Cohort 2 and will be faculty advisor for Cohort 2 student Brittany King
Chapman	Demian	Marine Science Professor, FIU	Provided shark data
Grecco	Mike	Marine Fisheries, DNREC	Weakfish sampling
Horodysky	Andrij	Assistant Professor, Hampton U	Collaborator on TAB project
Macintosh	Dennis	Associate Professor, DSU	Collaborator on TAB project
Neilan	Brian	Marine Fisheries, NJDEP	Weakfish sampling
Pitula	Joe	Associate Professor, UMES	Collaborator on TAB project
Stevens	Bradley	Professor, UMES	Collaborator on TAB project

Sylvia	Gil	Economics professor, OSU	Helped with social science outline for CSC and participated in meetings with Chigbu and NOAA economists.
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Have NOAA collaborators or contacts been involved? Yes

If Yes, describe involvement and time spent.

Last name	First name	Title/Affiliation	Description of involvement
Beckman	Brian	NWFSC	Provided field and lab experience for A. Munguia during NERTO
Brill	Richard	NMFS, VIMS	Collaborator on TAB project
Cortes	Enric	SEFSC	Ph.D. committee member for Halie O'Farrell
Deshpande	Ashok	NEFSC	Internship mentor for Darius Sanford
Friedland	Kevin	NMFS, NEFSC, Woods Hole	PhD committee member for Hanif; Collaborator on TAB project
Hinton	Susan	NWFSC	Provided field and lab experience for A. Munguia during NERTO
Kibler	Steven	NOS/NCCOS, Oxford MD	Collaborator on dinoflagellate toxins
McNatt	Regan	NWFSC	Provided field experience for A. Munguia during NERTO
Messick	Gretchen	NOS/NCCOS, Oxford MD	Collaborator on blue crab health and disease
Morton	Steve	NMFS, Center for Coastal Fisheries and Habitat Research	Collaborator on blue crab research
Poach	Mathew	NMFS JJ Howard Marine Sciences Lab, Sandy Hook, N	Collaborator on red crab research
Rivera	Jose	NMFS Habitat Conservation Division, Puerto Rico	Collaborator on sponge research
Roegner	Curtis	NWFSC	Provided field experience for A. Munguia during NERTO
Rosel	Patricia	SEFSC	M.S. committee member for Emily Griffin
Sharma	Rishi	SEFSC	Collaborator
Sullivan	Jim	NOS/MBO/Formulation & Planning Division, Silver Spring, MD	PhD committee member
Thorson	Jim	NWFSC	Collaborator

Townsend	Howard	Oxford Lab	M.S. committee member for Brian Galvez
van Dolah	Francis	NOS/NCCOS, Hollins Marine Lab	Collaborator on dinoflagellate research
Walter	John	SEFSC	Collaborator
Weinberg	James	NMFS/NEFSC Resource Evaluation & Assessment Division	Ph.D. committee member for Green & Lawrence
Weitkamp	Laurie	NWFSC	MS committee for A. Munguia and NERTO mentor

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-one (21) students have been identified as members of Cohort 1 of which 19 belong to underrepresented minority groups. Ten (10) students have been identified as members of Cohort 2; all of them belong to underrepresented minority groups. LMRCSA activities focus on training programs that are preparing students for work on essential fish habitat, marine protected species and ecosystems.

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

Success of the MS degree program in the Marine Sciences, as supported by the NOAA LMRCSA at SSU led to the creation of a MS degree in Mathematics that started this year, as well as a successful bid for a Title VII grant to fund graduate fellowships.

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

The LMRCSA, through its Student Development Plan, will produce a cadre of more prepared students for careers in marine and fisheries science. The presence of the LMRCSA and its support for these students in Cohort 1 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 collaboration to fill the NOAA Education Expert position at SSU has started dialogues about mission similarities in the LMRCSA and the SSU School of Teacher Education.

**What is the impact of the NOAA award on the Center's data and information resources?
To whom and how is this information and the Center accomplishments communicated?**
Nothing yet to report.

How has the Center successfully conducted transfer of research results and new technologies in support of NOAA mission-aligned R2X?
Nothing yet to report

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

At UMCES, Nick Hammond offered "Startup CEO Training" for interested members of the public.
May 2017: IMET Open House for interested members of the public. Jagus and Place gave presentations at the Balticon, the Maryland Science Fiction convention.

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:

There were no changes in the performance of the award objectives.

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

Loss of LMRCSC support of UMCES IMET's summer undergraduate internship program due to budgetary constraints has negatively impacted our recruitment of graduate students and reduced mentoring opportunities for current graduate students. \$60,000 Elkins award to Rose Jagus will support undergraduate internship program for summer 2018. Matching funds for this are being sought from foundations.

Changes that have a significant impact on expenditures:

--Nothing to report--

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 College of Exploration completed and submitted to the LMRCSC a report of the External Evaluation of year 1 programs and activities of the LMRCSC. The report is currently being reviewed by the LMRCSC.

Direct Student Support – 21 students were recruited to Cohort 1; 10 students have so far been recruited to Cohort 2.

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:

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

First	Last	Cohort #	Degree	Partner	Tuition	Stipend	Travel	NERTO	One-time Research Support
TyRae	Freeman*	1	M.S.	DSU	\$13,505	\$10,500			\$2,500
Brian	Galvez*	1	M.S.	DSU	\$6,881	\$11,308	\$533		\$7,500
Ileana	Fenwick*	1	B.S.	HU		\$4,959			

Isaiah	Milton*	1	B.S.	HU		\$5,060	\$355			
Nefertiti	Smith*	1	B.S.	HU		\$1,500				
Cristin	Mayes*	1	M.S.	HU						
Angie	Munguia*	1	M.S.	OSU	\$11,937	\$22,712		\$2,452		
Halie	O'Farrell*	1	Ph.D.	RSMAS	\$15,200	\$14,862	\$0	\$0	\$1,529	
Darius	Sanford*	1	B.S.	SSU		\$11,669		\$3,885		
Emily	Griffin	1	M.S.	SSU	\$17,004	\$45,526	\$900	\$3,322	\$2,323	
Shadaesha	Green*	1	Ph.D.	UMCES	\$3,324	\$11,818				
Ammar	Hanif*	1	Ph.D.	UMCES	\$2,604	\$19,131	\$60			
Amanda	Lawrence*	1	Ph.D.	UMCES	\$5,334	\$10,007	\$65			
Nakia	Coit*	1	B.S.	UMES	\$3,902	\$5,952	\$278	\$0	\$0	
Nylah	McClain*	1	B.S.	UMES	\$0	\$4,202	\$0	\$0	\$0	
India	Oliver*	1	B.S.	UMES	\$7,804	\$826	\$0	\$0	\$0	
Malisa	Smith*	1	B.S.	UMES	\$0	\$4,400	\$0	\$0	\$0	
Chryston	Otubu*	1	B.S.	UMES		\$4,959	\$138			
Rebecca	Wenker	1	M.S.	UMES	\$0	\$0	\$0	\$0	\$0	
Stephanie	Martinez-Rivera*	1	Ph.D.	UMES						
Detbra	Rosales*	1	Ph.D.	UMES	\$0	\$4,455	\$223			\$1,421
Kendra	Dorsey*	2	B.S.	HU						
Janelle	Layton*	2	B.S.	HU						
Brittany	King*	2	Ph.D.	OSU						
Desmond	Love*	2	B.S.	UMES						
Andre	Price*	2	M.S.	UMES						
Enid	Munoz-Ruiz*	2	M.S.	UMES						
Jorge	Rodriguez*	2	Ph.D.	UMES						
Laura	Almodovar-Acevedo*	2	Ph.D.	UMES						
Cara	Schweitzer*	2	Ph.D.	UMES						
Kasondra	Rubalcava*	2	Ph.D.	UMES						

*Underrepresented minorities

First	Last	Cohort #	Degree	Partner	Cohort Experience	NERTO	One-time Research	Ethical Conduct of	Data Management	NOAA Mentor
TyRae	Freeman*	1	M.S.	DSU	Spr 18	Sum 18	Sum 18	Y	Fall 17	Y
Brian	Galvez*	1	M.S.	DSU	Spr 18	Sum 18	Sum 18	Y	Fall 17	Y
Ileana	Fenwick*	1	B.S.	HU	Spr 18	n/a	Sum 17	Y	n/a	n/a

Isaiah	Milton*	1	B.S.	HU	Spr 18	n/a	Sum 17	Y	n/a	n/a
Nefertiti	Smith*	1	B.S.	HU	Spr 18	n/a	Sum 17	Fall 17	n/a	n/a
Cristin	Mayes*	1	M.S.	HU	Spr 18	Sum 18	Sum 18	Fall 17	Fall 17	Y
Angie	Munguia*	1	M.S.	OSU	Spr 18	Spr 17	Spr 18	Y	Fall 17	Y
Halie	O'Farrell*	1	Ph.D.	RSMAS	Spr 18	Sum 18	Sum 18	Y	Fall 17	Y
Darius	Sanford*	1	B.S.	SSU	Spr 18	Sum 19	n/a	Fall 17	n/a	Y
Emily	Griffin	1	M.S.	SSU	Spr 18	Fall 17	Sum 17	Fall 17	Fall 17	Y
Shadaesha	Green*	1	Ph.D.	UMCES	Spr 18	Sum 18	Spr 18	Y	Fall 17	Y
Ammar	Hanif*	1	Ph.D.	UMCES	Spr 18	Fall 17	Spr 18	Y	Fall 17	Y
Amanda	Lawrence*	1	Ph.D.	UMCES	Spr 18	Sum 19	Sum 18	Y	Fall 17	Y
Nakia	Coit*	1	B.S.	UMES	Spr 18	Sum 19	n/a	Y	n/a	n/a
Nylah	McClain*	1	B.S.	UMES	Spr 18	Sum 18	n/a	Y	n/a	n/a
India	Oliver*	1	B.S.	UMES	Spr 18	Sum 19	n/a	Y	n/a	n/a
Malisa	Smith*	1	B.S.	UMES	Spr 18	n/a	n/a	n/a	n/a	n/a
Chryston	Otubu*	1	B.S.	UMES	Spr 18	n/a	n/a	Y	n/a	n/a
Rebecca	Wenker	1	M.S.	UMES	Spr 18	Sum 18	Sum 18	Fall 17	Fall 17	Y
Stephanie	Martinez-Rivera*	1	Ph.D.	UMES	Spr 18	Sum 18	Sum 18	Fall 17	Fall 17	Y
Detbra	Rosales*	1	Ph.D.	UMES	Spr 18	Spr 18	Sum 17	Fall 17	Fall 17	Y
Kendra	Dorsey*	2	B.S.	HU	Spr 18	n/a	Sum 17	Fall 17	n/a	n/a
Janelle	Layton*	2	B.S.	HU	Spr 18	n/a	Sum 18	Fall 17	n/a	n/a
Brittany	King*	2	Ph.D.	OSU	Spr 18	TBD	Spr 18	Fall 18	Fall 18	TBD
Desmond	Love*	2	B.S.	UMES	Spr 18	n/a	n/a	Sum 18	n/a	n/a
Andre	Price*	2	M.S.	UMES	Spr 18	Spr 18	Spr 18	Fall 17	Fall 17	Y
Enid	Munoz-Ruiz*	2	M.S.	UMES	Spr 18	Sum 18	Spr 18	Spr 18	Fall 18	Y
Jorge	Rodriguez*	2	M.S.	UMES	Spr 18	Spr 18	Spr 18	Spr 18	Fall 17	Y
Laura	Almodovar-Acevedo*	2	Ph.D.	UMES	Spr 18	Sum 17	Fall 17	Y	Fall 17	Y
Cara	Schweitzer*	2	Ph.D.	UMES	Spr 18	Sum 18	Spr 18	Y	Fall 18	Y
Kasondra	Rubalcava*	2	Ph.D.	UMES	Spr 18	Sum 18	Spr 18	Spr 18	Fall 18	TBD

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.

Recruiting for this activity took place during this period. Five students participated in the rising sophomore experiential training program at the LMRCSC in summer 2017. Four students took part in the program at UMES; one student took part in the program at Savannah State University. These students also participated in other activities designed for students in the NSF Research Experiences for Undergraduates in marine and estuarine science at UMES and SSU. The names of the students, home institutions, academic year and their majors are presented below:

Summer 2017 Rising Sophomore Experiential Training Program Participants

#	First & Last Name	Home Institution	Year	Major	Site of the RSETP*
1	Nakia Coit	UMES	Fr	Biology	UMES
2	India Oliver	UMES	Fr	Env. Sci	SSU
3	Ileana Fenwick	HU	Fr	Mar. Sci.	UMES
4	Chryston Otubu	HU	Fr	Mar. Sci.	UMES
5	Isaiah Milton	HU	Fr	Mar. Sci.	UMES

*RSETP = *Rising Sophomore Experiential Training 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, dates completed, participants, outcomes for Center measures of success.

Student name(s)	Activity name and/or description
Brian Galvez	Participated in education (teaching fishing techniques to city students) at DNREC
Nefertiti Smith	Research training in zooplankton genetics
Halie O'Farrell	ICCAT stock assessment meeting
Halie O'Farrell	RSMAS TA training class
Rebecca Wenker	Age and Growth Analysis with R, AFS annual meeting, Tampa, FL
Shadaesha Green	PROMISE-AGEP Summer Success Institute
Ammar Hanif	PROMISE-AGEP Summer Success Institute
Amanda Green	PROMISE-AGEP Summer Success Institute
Darius Sanford	In-semester internship w/ Dr. Hoskins-Brown

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

Interviewing of candidates for the position of Postdoctoral fellow at UMES has been completed. It is anticipated that the position will be filled in November 2017 after which an approved Postdoctoral Plan that has input from the Postdoctoral Research Associate will be submitted to NOAA EPP. The Postdoctoral position at SSU was advertised, but no suitable candidate was found. The position is being re-advertised.

Pre-Publication Manuscript Submission -

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

	Target # of manuscripts	Proposed date of submission
DSU Faculty	3	9/30/2017
RSMAS Faculty	2	Dec-17
RSMAS Students	1	Apr-18
SSU Faculty	2	17-Oct

Papers currently in review: The projects on which the papers are based were not directly supported with FY16 funds. The papers are however, outcomes from leveraged programs, and the preparation of the manuscripts occurred during this reporting period when LMRCS Principal Investigators (J. A. Miller, J. S. Pitula) and students (D.S. Rosales) were supported.

Manuscripts that are under review or accepted for future publication	Justification
Flowers, EM, Johnson, AF, Aguilar, R, Schott, EJ . Prevalence of a pathogenic crustacean virus near flow-through crab aquaculture” Submitted Aug 15, 2017 to Diseases of Aquatic Organisms.	leveraged
Li , DX, Zhang, H, Xiao-Huang Chen , Zhang-Xian Xie , Yong Zhang , Shu-Feng Zhang , Lin Lin, Feng Chen , Da-Zhi Wang. Metaproteomics reveals major microbial players and their metabolic activities during the blooming period of a marine dinoflagellate <i>Prorocentrum donghaiense</i> . Environmental Microbiology. In press.	leveraged
Matta, M. E., Miller, J. A. , Short, J., Helser, T., Hurst, T. P. Rand, K., Ormseth, O. <i>In press</i> . Spatial and temporal variation in otolith elemental signatures of age-0 Pacific cod (<i>Gadus macrocephalus</i>) in the Gulf of Alaska. Accepted.	Leveraged
Miller, J. A. , Carlton, J.T., Chapman, J.W., Geller, J. B., Ruiz, G.M. (<i>Accepted pending revisions</i>). Transoceanic dispersal of the mussel <i>Mytilus galloprovincialis</i> on Japanese tsunami marine debris: A model for evaluating rafting of a coastal	Leveraged

species at sea. Marine Pollution Bulletin. Accepted pending revisions.	
Nancy I. Lewis, John Claude Achenbach, Lee Ellis, Joseph S. Pitula , Cheryl Rafuse, Detbra S. Rosales*, Jennifer L. Wolny, Pearse McCarron. Morphometric, Phylogenetic, Growth and Toxicity Assessment of <i>Coolia monotis</i> Meunier (Dinophyceae) from Nova Scotia, Canada. Harmful Algae. In Review.	D.S. Rosales (student, Cohort 1) and J.S. Pitula (UMES faculty) were supported by LMRCS C during the preparation of this manuscript.
Ta, N., Miller, J. A. , Chapman, J. C., Pleus, A. E., Calvanese, T., Miller-Morgan, T., Burke, J., and Carlton, J. T. C. Accepted. The Western Pacific barred knifejaw, <i>Oplegnathus fasciatus</i> (Temminck & Schlegel, 1844) (Pisces: Oplegnathidae) arriving with tsunami debris on the Pacific coast of North America. Aquatic Invasions. Accepted.	Leveraged

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	Start date	Role	Time Commitment	Line Office	Project Title
Howard Townsend	Brian Galvez	17-Sep	Committee member and NOAA mentor	3 months plus	NOAA Coop. Oxford Lab	Feeding ecology of Atlantic weakfish using dual stable isotope and gut content analyses
James Weinberg	Shadaes ha Green	17-Sep-16	NERTO mentor and committee member		NMFS	Size and maturity of male red crabs
AK Leight	Ammar Hanif	1-Jun-17	NERTO mentor		NCCOS	
Kevin Friedland	Ammar Hanif	1-Dec-13	Committee member and TAB collaborator		NMFS	Diet and microbiome of Atlantic menhaden
John Jacobs	Ammar Hanif	1-Jun-17	TAB collaborator		NCCOS	Comparing the diet and microbiome of Atlantic menhaden and Eastern oyster using DNA barcoding
Eric Cortes	Halie O'Farrell	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	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	1-Sep-17		~1.5 month/year	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
John Jacobs	Detbra Rosales	1-Sep-17	Technical Assistance		NOAA/NO S/NCCOS /Coop. Oxford Lab	Assessing The Impacts of Harmful Dinoflagellates In The Delaware Inland Bays.

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 19 and graduated 0 in NOAA- mission sciences.
2. **Total number of EPP-funded post-secondary students** who are trained 21 and graduate 0 in NOAA-mission fields relevant to this announcement.
3. **Number of EPP-funded graduates who enter the NOAA mission workforce as hires** by NOAA 0, NOAA contractors 0, NOAA partners 0, resource management agencies 0, NGO community 0, academia 0 or as entrepreneurs 0.
4. **Number of EPP-funded graduates who participate in and complete NOAA agency mission-related postdoctoral level programs** 0.

5. **Total new funds leveraged with NOAA EPP award** (including post-secondary student support) = \$145,272

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-one (21) students have been identified/recruited to the Center as members of Cohort 1 (2016 – 2017), including 6 Ph.D., 6 M.S., and 9 B.S. Ten students have been recruited to Cohort 2 (2017-2018) including 5 Ph.D., 2 M.S., and 3 B.S. students.

Outputs:

(a) Increase quantitative and analytical skills – Students are acquiring quantitative and analytical skills by taking courses such as Data management for scientists that is being offered in fall 2017, and by participating in internships and REU programs.

(b) Increased competence in applying STEM to decision making, policy and management – Some of the students took fishery policy course offered in spring 2017, and others attended the AFS meeting held in August 2017 that enabled them to acquire some knowledge and competence in applying STEM to decision making, policy and management.

(c) Increased skills to use large data sets, geographical information systems (GIS) and statistical analysis, computer modeling, and algorithm development – Arrangements were made during this period to offer a course covering Data Management for Fall 2017.

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

Twenty-one (21) students have been identified/recruited to the Center as members of Cohort 1 (2016 – 2017), including 6 Ph.D., 6 M.S., and 9 B.S.

(a) **Number of degrees earned annually in NOAA mission-related disciplines** - None of the students graduated during this reporting period.

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

Student Name	Activity/project title	NOAA personnel involved	NOAA Location
Angelica Munguia*	Juvenile salmon long term-habitat monitoring and field collections for action effective monitoring research (AEMR) in the Lower Columbia River and Estuary (LCR&E). Angie collected thesis data, including yearling Chinook for salmon diet	Laurie Weitkamp, Curtis Roegner, Regan McNatt, Susan Hinton, Brian Beckman	NWFSC in Hammond, Oregon

	and stable isotope analysis. She improved her understanding of wetland habitats and their connectivity to mainstem; expanded her knowledge of fish identification, collection, and processing methods; and improved her understanding of prey flux and how to extrapolate export from wetlands. She went into the field with several different NOAA scientists at the Hammond Lab to learn new skills and interact with several scientists, including Curtis Roegner, Regan McNatt, Susan Hinton, Brian Beckman, and Laurie Weitkamp.		
Emily Griffin	Refining stock structure of common bottlenose dolphins (<i>Tursiops truncatus</i>) through photo-identification and genetic analysis	Patricia Rosel	SEFSC
Darius Sanford*	Determination of polyethylene microbeads accumulation in the Eastern oysters, <i>Crassostrea virginica</i> , using high frequency sound waves	Ashok Despande	NEFSC

*URM

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

The grant has made it possible for 8 collaborative research projects to be funded for the period of 2016 – 2017, which will enable more Center scientists to be available to mentor and advise undergraduate and graduate students. In addition, 10 NOAA scientists have been identified to serve as mentors of the students during the NERTO program or as collaborators in the TAB funded projects. The NERTO has increased exposure to NOAA training and encouraged faculty to increase their flexibility in scheduling graduate students' field work and academic schedules.

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

Outputs	# During this Reporting Period
Seminars	15
New courses offered	0
New programs developed	0
New degrees offered	1
# of students supported by the LMRCSC	21
Total degrees awarded	0
Degrees awarded to URM	0

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

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

Outputs:

(a) Increased number of URM students in student development activities that will lead them to the attainment of degrees and/or employment in NOAA mission fields = **19** URM students at the LMRCSC took part in student development activities.

(b) Increased number of URM students who select to pursue higher education in NOAA mission fields = **10** URM students at the LMRCSC are pursuing higher education in NOAA mission fields during this reporting period.

5.2 Scientific Research

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

NOAA scientists are already collaborating with Center scientists as well as working with some of the graduate students; suitable mentors are being identified for the remaining students. The Center is in the process of completing search for the two post-doctoral positions at two MSIs (UMES and SSU) which will help increase research capacity 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 eight LMRCSC TAB projects has a NOAA scientist as a collaborator.

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

(c) **Number of intra-institutional collaborative partnerships established and maintained in support of NOAA's mission = 6**

(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.

(e) **Number of inter-institutional collaborative partnerships established and maintained in support of NOAA's mission = 6** partnerships have been established.

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

Eight collaborative research projects were funded by the LMRCSC for the period of 2016 – 2017. These projects were funded after they had been reviewed by the Technical Advisory Board (TAB) based on a number of criteria one of which is their alignment with NOAA's mission and strategic priorities.

Outputs:

	# From Projects Directly Supported with FY 16 Funds	# from Leveraged Projects
# of peer reviewed publications	1	19
# of presentations	10	11
# Tools developed	1	1
Use of LMRCSC research results and tools by NOAA & other stakeholders	0	0
# of instances LMRCSC publications are cited	0	0
# of LMRCSC students, staff or faculty recognized nationally for LMRCSC research	0	0

TAB Funded Research Projects in 2016-2017

In 2016-2017, the LMRCSC funded eight small research projects approved by the Technical Advisory Board (TAB). Some of these were continuations of projects funded in previous years. Three of these were awarded to lead investigators at UMES, one each at HU, SSU, and UMCES-IMET, and two were joint projects between UMES/UMCES-IMET, and OSU/DSU, respectively. Numerous other scientists and students at LMRCSC institutions were involved, as well as many NOAA investigators. Topics included bycatch and discard mortality, reproduction and maturity, genetic stock structure, climate change impacts, harmful algal blooms, fish migration, and trophic ecology. These projects involved a total of five PhD students, three MS students, four undergraduate students, and nine NOAA collaborators. Abstracts of the projects are presented below; more detailed reports can be found in Appendix I.

Project Number: 17-01

Project Title: Discard mortality of sub-legal black sea bass in the commercial trap fishery: Impacts of air exposure and acute temperature changes.

Project Abstract: Bycatch within the commercial fisheries is of growing concern because discarded bycatch can succumb to immediate or delayed mortality. Delayed mortality in black sea bass (BSB, *Centropristis striata*) is assumed to be 21% by the ASMFC, but can be difficult to assess and is poorly understood. Underestimation of bycatch mortality can lead to overfishing and render stock assessment models ineffective. To obtain better estimates of mortality within the BSB trap fishery, we assessed reflex action mortality predictor (RAMP) scores on discarded BSB from two sites in two seasons. Preliminary estimate of discard mortality was 50.8% and fish that died had significantly higher RAMP scores (mean 3.13) than those that survived (0.78; t test $P < 0.001$, $n = 435$). The occurrence of barotrauma significantly contributes to an increase in RAMP score (χ^2 : $P < 0.0001$). However, smaller fish were not more susceptible to mortality (t test $P = 0.23$). Our results to date support the hypothesis that RAMP is a sufficient method to predict delayed mortality.

Thematic Area Addressed: Stock Assessment Support

Lead Scientist(s): Brad Stevens (UMES)

NOAA Collaborator(s): Richard Brill (NMFS/NEFSC), and Virginia Institute of Marine Science

LMRCSC Collaborator(s): Andrij Z. Horodysky, (Hampton University).

LMRCSC Research Student(s): Cara Schweitzer (PhD, UMES)

Start Date: 1 Sept 2016

End Date: 31 December 2017

Project Number: 17-02

Project Title: Biological baseline data for Jonah Crab Management

Project Abstract: The Jonah crab (*Cancer borealis*) supports a rapidly increasing fishery in the Northeast United States, and is considered a data-poor species. Lack of information on abundance, biology, growth, age, or reproduction, prohibits adequate management. Jonah crab are caught almost exclusively as bycatch in the Southern New England lobster fishery, but as that fishery has declined, fishers are targeting Jonah crab directly. As a result, landings have increased 5-fold since 2002, to about 7500 t. This has spurred development of a Fishery Management Plan in 2016 that includes a minimum legal size (4.75") based on scant information. Therefore, this research will update fundamental biological and reproductive information of Jonah crab in the Mid-Atlantic Bight necessary to manage this species with an unknown stock status. Morphometric analyses were conducted to estimate size at 50% sexual maturity (SM_{50}) based on a modified version of Somerton's (1980) computer technique. Using log-transformed data on chela height and chela length versus CW in male Jonah crabs, SM_{50} was found to be 98.44 mm CW and 100.19 mm CW, respectively—both being below the minimum legal size. Fecundity will be estimated and a gonadosomatic index for female crabs will be generated to estimate reproductive cycles. This information is critical for defining size limits and management areas for the Jonah crab fishery in the Mid-Atlantic Bight.

Thematic Area Addressed: Stock Assessment Support

Lead Scientist(s): Bradley G. Stevens (University of Maryland Eastern Shore)

NOAA Collaborator(s): Burton Shank (NOAA/NMFS)

LMRCSC Collaborator(s):

LMRCSC Research Student(s): Noelle A. Olsen (MS, UMES), Melati Tarrant (UG REU, University of Rhode Island).

Project Number: 17-03

Project Title: Reproductive biology of red deep-sea crabs, *Chaceon quinquegens*.

Project Abstract: Red deep-sea crab, *Chaceon quinquegens*, support a small but valuable federally-managed fishery in the Mid-Atlantic and southern New England since the 1970's. The scant information about their biology, abundance, growth, age and reproduction causes major concerns about the status of the stock. Therefore, they are considered a data-poor fishery. This student-led proposal focuses on determining size at maturity using histology, understanding reproductive cycles and hormonal control of reproduction, and estimating fecundity and sperm competition. This is essential information required for managing red deep-sea crab fisheries. Crabs were collected in the Mid-Atlantic Bight at depths of 300-700 m aboard NOAA research vessels during 2011 to 2013, and aboard commercial vessels during 2014 to 2016. Crabs were measured and gross morphology was recorded including the presence, size and color of ovaries and external eggs. Histological analysis of ovary samples was used to determine five stages of ovarian development. Estimates of SM_{50} calculated by non-linear logistic regression range between 81-90 mm in carapace width. Six stages of embryo development were determined, and estimates of size-specific fecundity range between 34,000 and 188,000. Results suggest that red crabs have a biennial reproductive cycle. Using a degenerate PCR and 5' and 3' RACE cloning strategy, a full-length cDNA sequence encoding the MIH was cloned. Ovarian stage 1 and 3 hepatopancreas tissues were used for transcriptome sequencing. Over 142 million sequencing reads were obtained, and 50,088 transcripts were assembled. In March 2017, an additional 100 primer sets were generated for selecting potential genetic markers to examine the population

structure of this species in the United States. This project is committed to NOAA's mission of providing scientific data to improve, supplement, and enhance management of deep-sea red crabs and other deep-sea crab fisheries with multi-year reproductive cycles.

Thematic Area Addressed: Stock Assessment Support

Lead Scientist(s): Stephanie Martinez Rivera (PI, Ph.D. student, UMES), Shadaesha Green (Co-PI, Ph.D. student, IMET), Bradley G. Stevens (Co-PI, UMES), Sook Chung (Co-PI, IMET)

NOAA Collaborator(s): Chris Long (AFSC, Kodiak, AK), James Weinberg (NEFSC, Woods Hole, MA)

LMRCSC Collaborator(s): Bradley G. Stevens (Co-PI, UMES), Sook Chung (Co-PI, IMET)

LMRCSC Research Student(s): Stephanie Martinez-Rivera (PhD student, UMES), Shadaesha Green (PhD student, IMET).

Project Number: 17-04

Project Title: Refining stock structure of common bottlenose dolphins (*Tursiops truncatus*) through photo-identification and genetic analysis

Project Abstract: Accurately identifying discrete stocks of common bottlenose dolphins is a critical task for marine mammal management. This project supports research investigating population structure and distinguishing stock boundaries through sighting histories and genetic analyses to (1) re-assess the southern boundary of the Northern Georgia/Southern South Carolina Estuarine System (NGSSCES) stock as indicated by recent residency data, (2) determine if there is a stock boundary at the Wilmington River, and (3) demonstrate the utility of integrating long term photo-identification and genetic analyses in a robust analysis. Biopsy samples were obtained from 69 of these individually identifiable common bottlenose dolphins with long-term sighting histories (2009-present). Mitochondrial DNA sequencing has been conducted and haplotypes have been identified. Mapping and spatial analyses are ongoing. In most studies, the single sampling location is the only geographic information matched to a genetic sample; in contrast, this study uses long-term sighting histories to better inform genetic analyses. Long-term sighting data associated with spatial location may allow for finer-scale examination of stock structure across a geographic boundary. The development of this unique methodology using photo-identification and genetic data has broad applications to other stocks in the Southeast United States as well as for other cetacean species for which photo-identification and genetic data are available. This project contributes to NOAA's mandate to manage protected resources by re-examining the southern stock boundary of the NGSSCES stock of common bottlenose dolphins as well as developing methods that may be used for other stocks in the future.

Thematic Area Addressed: Stock Assessment Support

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

NOAA Collaborator(s): Patricia Rosel (NOAA/NMFS); Brian Balmer (NOAA contractor; National Marine Mammal Foundation)

LMRCSC Collaborator(s): Joseph Pitula (UMES)

LMRCSC Research Student(s): Emily Griffin, (MS student, Savannah State University); Debra Baskerville (UG, UMES)

Project Number: 17-05

Project Title: The Impact of Increasing Sea Surface Temperatures on Piscivore and Planktivore Species Dynamics: An Ecosystem-Based Modeling Approach

Project Abstract: Ecosystem-based fishery management has rapidly become the standard approach for assessing the viability of commercial fishery stocks. Species interaction and seasonal fluctuations play key roles in understanding the impact that harvesting has on species sustainability. However, as the effect of climate change on weather conditions and average temperatures becomes exceedingly dramatic, immediate action must be taken to include mechanisms into population models that account for climate change to avoid deleterious effects that could lead to the collapse of important commercial fisheries. We propose a quantitative analysis that incorporates such mechanisms to demonstrate the impacts of increasing sea temperatures on fish production in several key species in the Chesapeake Bay ecosystem.

Thematic Area Addressed: Assessment; Climate and Ecosystems

Lead Scientist(s): Shari Wiley, HU

NOAA Collaborator(s): Howard Townsend, NOAA Cooperative Oxford Laboratory

LMRCSC Collaborator(s): Andrij Horodysky, HU

LMRCSC Research Student(s): Cristin Mayes (M.S. student, HU)

Project Number: 17-06

Project Title: Ecosystem impact of a harmful algal bloom species (*Dinophysis acuminata*) on aquaculture shellfish

Project Abstract: Land development within the Maryland Coastal Bay watershed induces a suite of environmental stressors that negatively impact aquatic animal health, such as eutrophication leading to the development of harmful algal blooms (HABs). The proposed study seeks to monitor an ongoing bloom event, which has led to increased numbers of the potential toxin-producing species *Dinophysis acuminata*. The impact of this organism on animals within the MCB remains undetermined. It is vital to understand its impact on resident shellfish that act as the primary filter feeders during bloom events, as these species will serve as the first level of bioaccumulation of toxin in the food chain. Indirectly, reduced fitness in these organisms may also lead to reduced ability to clear blooms during HAB events.

Thematic Area Addressed: Safe Seafood and Aquaculture

Lead Scientist(s): Joe Pitula, UMES

NOAA Collaborator(s): John Jacobs, NOAA Cooperative Oxford Laboratory

LMRCSC Collaborator(s): Gulnihal Ozbay, DSU

LMRCSC Research Student(s): Detbra Rosales (PhD student, UMES)

Project Number: 17-07

Project Title: Migration and foraging ecology of at-risk species: Columbia River Chinook salmon and Atlantic weakfish

Project Abstract: Quantifying habitat use for migratory fish is challenging yet important for the development of sound management and recovery plans. Given that migratory fish are highly mobile and often have short, habitat-specific residence times, research approaches that can shed light on diet, growth, or condition during migration continue to be developed and refined. Longitudinal studies, or those that follow specific cohorts of fish during their migration, can quantify spatial variation in foraging, growth, and sometimes mortality, thus providing information on habitat use. Interior Columbia River Chinook salmon (*Oncorhynchus tshawytscha*) and Weakfish

(*Cynoscion regalis*) are two migratory species of concern. Interior Columbia River Chinook salmon have been listed under the Endangered Species Act since 2005, and habitat restoration within the lower Columbia River and Estuary is a key element of their recovery plan. The Atlantic weakfish stock has been depleted since around 2002, and recent assessments indicated that natural mortality may be the cause for the stock's inability to rebound despite fishing mortality decreases since 2011. Therefore, we implemented a longitudinal study design to quantify foraging and growth using traditional diets, stable isotope, and otolith chemical analyses during migration for these two, commercially important migratory species.

Thematic Area Addressed: Healthy Habitats

Lead Scientist(s): Jessica Miller, OSU

NOAA Collaborator(s): Laurie Weitkamp, OSU

LMRCSC Collaborator(s): Stacy Smith (DSU)

LMRCSC Research Student(s): Brian Galvez (M.S. student, DSU), Sawyer Finley, NSF REU Summer student at OSU (leveraged)

Project Number: 17-08

Project Title: Comparing the diet and microbiome of Atlantic menhaden and Eastern oyster using DNA barcoding

Project Abstract: Atlantic menhaden (*Brevortia tyrannus*) and Eastern oysters (*Crassostrea virginica*) diets derive from filtration of the water columns, consuming planktonic organisms. Both are powerful filtering organisms, though exactly what items are being filtered still remain largely unknown. This comparison will help to assign trophic levels and develop more accurate food web models and assess ecosystem health. Stomach contents of each organism reflect their ability to function as an environmental sampler. Identification of stomach contents is difficult due to items being largely unrecognizable by conventional methods, therefore contents will be investigated using primers that target the hypervariable regions of the 16S and 18S ribosomal DNA (rDNA) using Illumina's MiSeq high-throughput sequencing technology. To our knowledge this has yet to be done for these two filter feeding species. The results from this study could help efforts to restore the Choptank River, a large tributary of the Chesapeake Bay, which is a project focus of the NOAA-Cooperative Oxford Lab and also help train minority students in the field of marine biology.

Thematic Area Addressed: Assessment: Climate and Ecosystems

Lead Scientist(s): Ammar Hanif (Ph.D. student, UMCES-IMET)

NOAA Collaborator(s): John Jacobs (NOAA-COL, Oxford, MD)

LMRCSC Collaborator(s): Bradley Stevens (UMES), Joe Pitula (UMES)

LMRCSC Research Student(s): Ammar Hanif (PhD student, UMCES); Malisa Smith (UG, UMES)

5.3 CSC Administration

Outcome 1. Increased CSC capacity to support and sustain education and research in NOAA mission areas.

Outputs:

- (a) Funds leveraged with CSC award to support NOAA mission in education and research amount to **\$1,130,273**. Additional details can be found in Section VII of this report.

Outcome 2. Increased engagement by CSCs with the URM communities to enhance the mission workforce pipeline.

Output:

- (a) *Number of structured activities to recruit and retain students, particularly from URM communities:* The Center participated in several recruitment events aimed at recruiting URM students into LMRCSC institutions.
- (b) *Number of MSI inter-institutional collaborative partnerships established and maintained in support of NOAA's mission:* 6.

Outcome 3. To increase communication of CSC accomplishments and capacity

Outputs: (a) *Number of LMRCSC products used by stakeholders,* (b) *Number of featured articles in print or digital media referencing the NOAA LMRCSC:*

The LMRCSC Communication Specialist is preparing a newsletter that will be released in Fall 2017, and has also been busy modifying and updating the LMRCSC website. The spring LMRCSC newsletter was released in May 2017.

Outcome 4. Increased use of post-secondary education evaluation methodologies

Outputs: (a) Number of best practices that are measurable, scalable and transferrable, (b) Consistent use of established evaluation practices, including higher education practices, to measure effectiveness of each component of the award:

Internally, methodologies are being developed by the Education Expert who will begin in the next assessment period.

The College of Exploration that serves as External Evaluator of the LMRCSC has developed, as part of the Center's Comprehensive Evaluation Plan, surveys that incorporate post-secondary education evaluation methodologies that will be used to collect data and evaluate the Center. An Evaluation report for FY16 conducted by the College of Exploration has been submitted to the LMRCSC and is currently being reviewed.

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VII. Financial Information

1. Total NOAA funding breakout

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

Postsecondary Direct Student Support:

Tuition:	\$87,494.68
Stipend:	\$193,846.09
Travel:	\$2,552.70
NERTO:	\$9,659.07
One-time Research:	\$15,273.13
Total:	\$308,825.67

Collaborative Research:

Eight collaborative projects in the amount of \$321,279 in direct cost were funded during the previous reporting period.

2. Total leverage funding breakout

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

Postsecondary Student Support:

Source	Type	Start date - end date	Total amount	Current 6 month period	PI	Project title	Contribution to Center
NSF	Grant	2/1/15-1/31/18	\$200K	\$30K	Gibson, D.	Cryptic Diet of the Doliolid...	Funds are used to support MS student Natalia Lopez.
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 ASLO conference.
NSF	Grant	9/1/15-8/31/20	\$3,000.00	\$300,000	Gibson, D.	Partnership in Research and Education in Materials (PREMP	Funds are used to support GRE training for 4 MES students.

Elkins Professorship	Grant	7/11/17 - 8/10/18	\$ 60,000	\$ -	Rosemary Jagus	Summer Internship Program	Funds will be used to continue with the LMR CSC summer internship program in 2018
Ocean Leadership	Grant	12/1/17-6/30/18	\$10,000	0	Dionne Hoskins-Brown	NOSB Regional Site	Provides outreach and recruitment opportunity for Center students and faculty
NSF	Grant	2/15/15-1/31/20	\$321,910.00	not available	Tara Cox, Chris Hintz	Bridge to Research in Marine Sciences: a summer Research Experiences for Undergraduates to NSF	Brings diverse early career students to the Center institution

Collaborative Research:

Source	Type	Start date - end date	Total amount	Current 6 month period	PI	Project title	Contribution to Center
MIPS	Grant	2/1/15 - 1/31/18	\$ 152,738	\$ 10,269	Allen Place	Plant Based Aquafeed with Low Leaching Taurine	Funds supported partially students and the PIs salary
ERS	Grant	8/1/16 - 12/31/17	\$ 6,600		Allen Place	Spatial and temporal analysis of phytoplankton in the Great Lakes for a One Year period	Funds supported partially students and the PIs salary
Blue Ocean Bio.	Grant	5/1/17 - 4/30/18	\$ 78,306	\$ 10,142	Allen Place	Blue Ocean Bio: Phosphate Mitigation using Oolitic Bahamian Carbonate Sands at Girl Scout Camp Todd	Funds supported partially students and the PIs salary
NIH / NSF	Grant	9/24/12 - 1/31/18	\$ 959,640		Allen Place	Translation regulation of gene expression in toxic dinoflagellates	Funds supported partially students and the PIs salary

ECO HAB	Grant	9/1/15 - 8/31/18	\$ 136,833	\$ 12,109	Allen Place	Integrating Cell and Toxin Cycles of <i>Karlodinium veneficum</i> with Key Environmental Regulators: <i>In Situ</i> Studies of Hypoxia Research and Control Act	Funds supported partially students and the PIs salary
NOAA SEFSC	MOU	1/2000-pres	~100,000	\$ 50,000	Dionne Hoskins-Brown	NOAA CMER	Funds provide time and effort for Hoskins-Brown to serve as Institutional PI and research scientist
TIDES	Grant	5/1/16 - 4/30/17	\$ 25,000	\$ 8,234	Eric Schott	Inquiry-based exploration of urban waterfront biodiversity: DNA barcoding protocols and support for High School Education	Funds support PIs salary
EPICORE	Grant	8/1/17 - 1/30/18	\$ 10,921	\$ -	Eric Schott	In vivo challenge assay of the effect of bacterial probiotics against AHPND shrimp pathogens for Epicore Bionetworks, Inc.	Funds support PIs salary
DPW	Grant	7/12/16 - 7/13/17	\$ 12,988	\$ 7,332	Eric Schott	Microbial Source Tracking as a Tool for Assessing and Managing Fecal Contamination through UB	Funds support PIs salary
NOAA	Grant	6/1/15 - 5/31/18	\$ 299,381	\$ 37,397	Eric Schott	Disease and Discard Mortality in the Blue Crab Fishery: using New information about an old virus to improve management of the resource	Funds supported partially students and the PIs salary
USDA	Grant	9/1/15 - 8/31/18	\$ 12,513	\$ 3,752	Eric Schott	USDA - NRAC Testing and Application of Novel Probiotic Bacteria	Funds support PIs salary

NSF	Grant	7/1/17 - 6/30/18	\$ 137,110	\$ 2,778	Eric Schott	NSF: Determining how Variation in life history & connectivity drive pathogen-host dynamics	Funds supported partially students and the PIs salary
MIPS	Grant	9/1/14 - 5/31/17	\$ 115,829	\$ 23,898	Feng Chen	Turning Chicken Manure into fertilizer and clean energy	Funds supported partially students and the PIs salary
MIPS	Grant	8/1/2015 - 7/31/17	\$ 66,278	\$ 27,377	Feng Chen	Manure and Bio-Flocculation in Algal Technology	Funds supported partially students and the PIs salary
MIPS	Grant	2/1/17 - 1/31/18	\$ 53,318	\$ 15,886	Feng Chen	Increase methane in chicken Manure Digesters	Funds supported partially students and the PIs salary
USDA	Grant	10/1/16 - 9/30/18	\$ 60,253	\$ 14,875	Feng Chen	An examination of the autochthonous sources of urea in watersheds and the potential role of microbial activity	Funds support PIs salary
NSF	Grant	07/1/16-06/30/19	\$300,000	\$10,000	Horodysky,A	Linking environment to form and function by quantifying the effects of ocean acidification on visual and auditory neurobiology in marine fishes	Funds are used to support Horodysky and 1 LMRCSC cohort 2 student tuition.
NSF	Grant	5/1/12 - 4/30/18	\$ 627,489	\$ 4,008	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
Several	Grant	11/23/15 - 11/23/17	\$ 9,999	\$ 1,514	J. Sook Chung	The Blue Crab Genome Initiative	Funds support PIs salary

NIST	Grant	1/1/16 - 12/31/17	\$ 127,402	\$ 46,298	J. Sook Chung	NIST: Crustacean metabolomics: Identification of potential growth and reproductive indicators for aquaculture using NMR and MS approaches 53%	Funds support PIs salary
NOAA NWFSC/ US COE	contract services	8/2017-03/2018	\$30,100	\$ 19,500	Miller	Juvenile Chinook salmon migration through the Columbia River estuary and coastal ocean	Complement research of MS student A. Munguia
BPA	travel for Miller	Mar-17	\$ 650	\$ 500	Miller	Attendance at the Salmon Ocean Ecology Meeting	
NIH / NSF	Grant	9/24/12 - 1/31/18	\$1,055,270	\$127,974	Rosemary Jagus	Translation regulation of gene expression in toxic dinoflagellates	Funds supported partially students and the PIs salary
MIPS	Grant	2/1/15 - 10/31/17	\$ 118,871	\$ 15,037	Russell Hill	Harvest of Algal Blooms for Crude Oil Production	Funds supported partially students and the PIs salary
MIPS	Grant	9/9/14 - 5/31/17	\$ 51,033	\$ 1,364	Russell Hill	Turning Chicken Manure into fertilizer and clean energy	Funds supported partially students and the PIs salary
MIPS	Grant	2/1/17 - 1/31/18	\$ 68,823	\$ 31,092	Russell Hill	Treating Algae to Reduce Nox Emissions in Biocrude	Funds supported partially students and the PIs salary
MIPS	Grant	8/1/15 - 7/31/17	\$ 18,000	\$ 5,911	Russell Hill	Manure and Bio-Flocculation in Algal Technology	Funds supported partially students and the PIs salary
MIPS	Grant	2/1/17 - 1/31/18	\$ 29,731	\$ 11,546	Russell Hill	Increase methane in chicken Manure Digesters	Funds supported partially students and the PIs salary
NIST	Grant	1/1/16 - 12/31/17	\$ 297,598	\$153,058	Russell Hill	Institute of Marine and Environmental Technology (IMET) Post-Doctoral Research	Funds support PIs salary

						Program in Environmental and Marine Science	
NSF	Grant	7/1/15 - 6/30/18	\$ 308,440	\$ 43,245	Yantao Li	Understanding the Prokaryotic Pathways for Triacylglycerol Synthesis and Turnover in the Plastid of Microalgae and Implications for Biofuels	Funds supported partially students and the PIs salary
ONR	Grant	4/1/15 - 3/31/18	\$ 54,000	\$ 5,179	Yantao Li	Liquid Hydrocarbon Production with Electobiome Platform	Funds supported partially students and the PIs salary

Appendices

Appendix I: TAB Funded Research Projects in 2016-2017

Project Number: 17-01

Project Title: Discard mortality of sub-legal black sea bass in the commercial trap fishery: Impacts of air exposure and acute temperature changes.

Project Abstract: Bycatch within the commercial fisheries is of growing concern because discarded bycatch can succumb to immediate or delayed mortality. Delayed mortality in black sea bass (BSB, *Centropristis striata*) is assumed to be 21% by the ASMFC, but can be difficult to assess and is poorly understood. Underestimation of bycatch mortality can lead to overfishing and render stock assessment models ineffective. To obtain better estimates of mortality within the BSB trap fishery, we assessed reflex action mortality predictor (RAMP) scores on discarded BSB from two sites in two seasons. Preliminary estimate of discard mortality was 50.8% and fish that died had significantly higher RAMP scores (mean 3.13) than those that survived (0.78; t test $P < 0.001$, $n = 435$). The occurrence of barotrauma significantly contributes to an increase in RAMP score (χ^2 : $P < 0.0001$). However, smaller fish were not more susceptible to mortality (t test $P = 0.23$). Our results to date support the hypothesis that RAMP is a sufficient method to predict delayed mortality.

Thematic Area Addressed: Stock Assessment Support

Lead Scientist(s): Brad Stevens (UMES)

NOAA Collaborator(s): Richard Brill (NMFS/NEFSC), and Virginia Institute of Marine Science

LMRCSC Collaborator(s): Andrij Z. Horodysky, (Hampton University).

LMRCSC Research Student(s): Cara Schweitzer (PhD student, UMES)

Start Date: 1 Sept 2016

End Date: 31 December 2017

Scientific Merit:

Three sampling series were defined for Summer 2017: Series I was completed in August 2017, and consisted of tagging, RAMP analysis, and cage holding for delayed mortality. Series II will be conducted September- October and will consist of tissue collection for barotrauma damage and analysis for Hsp70 upregulation. Series III will be conducted in late October. This series will consist of tagging, RAMP analysis, cage holding, and blood collection.

To date n=435 sublegal BSB bycatch have been assessed for delayed mortality. Fish were sampled from two sites with mean depths of 23 m (Site S) and 27.6 m (Site D). Fish were caught by commercial fishermen using standard trap lines with 20 traps per line. Once on deck, sublegal BSB were sorted and placed into a 50 gal container filled with seawater before being processed. Fish were measured, tagged with a T-bar Floy tag, and subjected to RAMP assessment. Reflexes assessed included: gag, operculum retraction, dorsal fin flexure, and mouth open/close. Barotrauma was also incorporated in the RAMP score, including whether fish were floating, or exhibited stomach prolapse giving a final score range from 0: no signs of reflex loss and no signs barotrauma to 6: loss of all reflexes and extensive barotrauma. Once assessed, fish were placed into holding containers filled with seawater and held until assessments were completed for all fish. Once assessments were complete fish were placed in sea cages (1.2 m x 1.2 m x 0.6 m). Sea cages were left on the bottom at capture sites for 2-5 days after which live fish were counted and released.

During series I average ΔT from sea floor to air temperature was 9.5 °C. Fishing mortality with a ΔT of 9.5 °C was 50.8%. However, it should be noted that during this first series, there was a cold front drastically reducing ΔT . Preliminary data from August 2016 showed fishing mortality at 100% with a ΔT of 17.4 °C.

Preliminary analysis has looked at the relationships between RAMP score, mortality, and barotrauma. Analysis has shown a significant correlation between RAMP score and mortality. The mean RAMP score for fish surviving the fishing procedure was 0.78, whereas the mean RAMP score for mortality was 3.13 (student t test $P < 0.001$). Additionally, barotrauma was a strong influence for mortality ($\chi^2 = P < 0.0001$). However, our data do not suggest that smaller fish are more susceptible to mortality (t test $P = 0.23$), given the length range of sub-legal fish captured (19-29 cm).

Limitations: This study looks at the direct effects of trap fishing and ΔT on BSB mortality, therefore fish are placed in sea cages to ensure 100% return rate of tagged fish (survived). However, sea cages eliminate exhaustive stress and predation rate, which is a factor occurring in the natural setting after bycatch release. Furthermore, fish that have succumbed to barotrauma are placed in sea cages before they are allowed to naturally decompress; on the other hand, fish that are normally discarded within seconds of capture would have the ability to swim down to the ocean floor reducing the risk of barotrauma, therefore this recompression of some fish may be an offset to those factors.

Future Directions: Series II & III are planned to be completed by the end of October 2017. Series II will be conducted September- October and will consist of tissue collection for barotrauma damage and analysis for Hsp70 upregulation. Series III will be conducted in late October. This series will consist of tagging, RAMP analysis, cage holding, and blood collection.

Products: None yet.

Relevance: There is currently little published data or information regarding discard rate and post-release mortality within the BSB commercial fishing industry. Published values are poorly

documented and may not accurately depict current practices. There are also no published data validating RAMP assessments for BSB, which could improve future mortality assessments. Results of this research should also produce recommendations for alternative fishing practices to reduce post-release mortality and improve the sustainability of the BSB fishery. The **NMFS Strategic Research Plan** for 2013-2018¹ includes the specific priority of “Studies on impacts of bycatch on non-target species.” The Northeast Fishery Science Center research priorities include “fishery-independent data on commercial and recreational fisheries catch and bycatch,” and this priority is also included by several other NOAA Fishery Science Centers.

Broader Impacts: Our results will be communicated at several scientific conferences and meetings, on the LMRCS website, and at the annual UMES Research Symposium. We hold an annual workshop (“FishTalk”) with state management agencies and local fishermen to present our research results. This project will engage graduate and undergraduate students from underrepresented communities in NOAA mission-relevant STEM research. The results of this project will contribute to the Ph.D. Dissertation of a minority graduate student (Cara Schweitzer, Hispanic-American).

Project Number: 17-02

Project Title: Biological baseline data for Jonah Crab Management

Project Abstract: The Jonah crab (*Cancer borealis*) supports a rapidly increasing fishery in the Northeast United States, and is considered a data-poor species. Lack of information on abundance, biology, growth, age, or reproduction, prohibits adequate management. Jonah crab are caught almost exclusively as bycatch in the Southern New England lobster fishery, but as that fishery has declined, fishers are targeting Jonah crab directly. As a result, landings have increased 5-fold since 2002, to about 7500 t. This has spurred development of a Fishery Management Plan in 2016 that includes a minimum legal size (4.75”) based on scant information. Therefore, this research will update fundamental biological and reproductive information of Jonah crab in the Mid-Atlantic Bight necessary to manage this species with an unknown stock status. Morphometric analyses were conducted to estimate size at 50% sexual maturity (SM_{50}) based on a modified version of Somerton’s (1980) computer technique. Using log-transformed data on chela height and chela length versus CW in male Jonah crabs, SM_{50} was found to be 98.44 mm CW and 100.19 mm CW, respectively—both being below the minimum legal size. Fecundity will be estimated and a gonadosomatic index for female crabs will be generated to estimate reproductive cycles. This information is critical for defining size limits and management areas for the Jonah crab fishery in the Mid-Atlantic Bight.

Thematic Area Addressed: Stock Assessment Support

Lead Scientist(s): Bradley G. Stevens (University of Maryland Eastern Shore)

NOAA Collaborator(s): Burton Shank (NOAA/NMFS)

LMRCSC Collaborator(s):

LMRCSC Research Student(s): Noelle A. Olsen (MS student, UMES), Melati Tarrant (UG REU, University of Rhode Island).

Start Date: 1 Sept 2016

End Date: 31 December 2017

Scientific Merit: Morphometric analyses were conducted to estimate size at 50% sexual maturity (SM_{50}) based on a modified version of Somerton’s (1980) computer technique. Using log-transformed data on chela height and chela length versus CW in male Jonah crabs, SM_{50} was found to be 98.44 mm CW and 100.19 mm CW, respectively—both being below the minimum legal

¹ <https://www.st.nmfs.noaa.gov/Assets/Strategic-Plans/NOAA%20Fisheries%20Strategic%20Plan%20Overview%202013.pdf>

size. Fecundity will be estimated and a gonadosomatic index for female crabs will be generated to estimate reproductive cycles. This information is critical for defining size limits and management areas for the Jonah crab fishery in the Mid-Atlantic Bight. The results from this project will be shared with both NOAA and the Atlantic States Marine Fisheries Commission (ASMFC) to improve federal and state management for Jonah crabs in the Mid-Atlantic Bight. The R code used to estimate SM_{50} will be made available and has the potential to be applied to other crustacean fisheries management.

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

Olsen, N.A.* and B.G. Stevens (2017). Reproductive biology and size at maturity and of Jonah crabs, *Cancer borealis*, in the Mid-Atlantic Bight. Presented at the National Organization of Gay and Lesbian Scientists & Technical Professionals 4th Biennial Out to Innovate Career Summit, Danvers, MA. March 4-5, 2017.

Olsen, N.A.* and B.G. Stevens (2017). Reproductive biology of Jonah crabs, *Cancer borealis*, in the Mid-Atlantic Bight. Presented at the American Fisheries Society Tidewater Chapter 31st Annual Meeting, Virginia Beach, VA, March 9-11, 2017.

Olsen, N.A.* and B.G. Stevens (2017). From pest to plate: Using morphometry to help improve management of Jonah crabs, *Cancer borealis*, in the Mid-Atlantic Bight. Presented at the American Fisheries Society 147th Annual Meeting, Tampa, FL, August 20-24, 2017.

Relevance: We expect that our results will support NOAA's mission of "conserve and manage coastal and marine ecosystems and resources" research by investigating aspects of the reproductive biology of Jonah crabs in the Mid-Atlantic Bight in order to 1) use morphometrics to determine size at sexual maturity needed to substantiate accurate appointment of minimum legal sizes and minimize discard mortality, and 2) estimate fecundity and track female gonadosomatic index (GSI) over time to increase understanding of stock reproductive capacity, thus improving management and long-term sustainability for the Jonah crab fishery.

Broader Impacts: This project supported MS student Noelle Olsen and provided her an opportunity to collaboratively work with academia (UMES and the Virginia Institute of Marine Science), NOAA scientists, state management, and commercial lobstermen. The research outcomes will be a part of MS student Noelle Olsen's master's thesis, and she is expected to graduate May 2018 with a masters in Marine Estuarine Environmental Science from UMES. This past summer, Noelle Olsen mentored a National Science Foundation Research Experience for Undergraduates (NSF REU) student, Melati Tarrant. Funds from this TAB grant were able to supplement the training received and experience gained by the REU student as she worked with Noelle Olsen.

Project Number: 17-03

Project Title: Reproductive biology of red deep-sea crabs, *Chaceon quinque-dens*.

Project Abstract: Red deep-sea crab, *Chaceon quinque-dens*, support a small but valuable federally-managed fishery in the Mid-Atlantic and southern New England since the 1970's. The scant information about their biology, abundance, growth, age and reproduction causes major concerns about the status of the stock. Therefore, they are considered a data-poor fishery. This student-led proposal focuses on determining size at maturity using histology, understanding reproductive cycles and hormonal control of reproduction, and estimating fecundity and sperm competition. This is essential information required for managing red deep-sea crab fisheries. Crabs were collected in the Mid-Atlantic Bight at depths of 300-700 m aboard NOAA research vessels during 2011 to 2013, and aboard commercial vessels during 2014 to 2016. Crabs were measured and gross morphology was recorded including the presence, size and color of ovaries

and external eggs. Histological analysis of ovary samples was used to determine five stages of ovarian development. Estimates of SM₅₀ calculated by non-linear logistic regression range between 81-90 mm in carapace width. Six stages of embryo development were determined, and estimates of size-specific fecundity range between 34,000 and 188,000. Results suggest that red crabs have a biennial reproductive cycle. Using a degenerate PCR and 5' and 3' RACE cloning strategy, a full-length cDNA sequence encoding the MIH was cloned. Ovarian stage 1 and 3 hepatopancreas tissues were used for transcriptome sequencing. Over 142 million sequencing reads were obtained, and 50,088 transcripts were assembled. In March 2017, an additional 100 primer sets were generated for selecting potential genetic markers to examine the population structure of this species in the United States. This project is committed to NOAA's mission of providing scientific data to improve, supplement, and enhance management of deep-sea red crabs and other deep-sea crab fisheries with multi-year reproductive cycles.

Thematic Area Addressed: Stock Assessment Support

Lead Scientist(s): Stephanie Martinez Rivera (PI, Ph.D. student, UMES), Shadaesha Green (Co-PI, Ph.D. student, IMET), Bradley G. Stevens (Co-PI, UMES), Sook Chung (Co-PI, IMET)

NOAA Collaborator(s): Chris Long (AFSC, Kodiak, AK), James Weinberg (NEFSC, Woods Hole, MA)

LMRCSC Collaborator(s): Bradley G. Stevens (Co-PI, UMES), Sook Chung (Co-PI, IMET)

LMRCSC Research Student(s): Stephanie Martinez-Rivera (PhD student, UMES), Shadaesha Green (PhD student, IMET).

Start Date: 1 Sept 2016

End Date: 31 December 2017

Scientific Merit:

Our data suggest that deep-sea red crabs have a biennial reproductive cycle. Five ovarian developmental stages were determined using histology. Size at 50% sexual maturity (SM₅₀), estimated using ovary stages and gonopore condition, ranged between 81-90 mm in carapace width (CW). Logistic regression of maturity, based on morphological condition, was 81.22 mm, but the estimate based on ovary stages was 89.80 mm CW. These results imply that mating may occur prior to completion of ovarian development. Preliminary estimates of size-specific fecundity range between 34,000 and 188,000. The full-length cDNA sequence of the molt-inhibiting hormone (MIH) was isolated using a degenerate PCR and 5' and 3' RACE cloning strategy. Eyestalk cDNAs were used to determine CHH expression in adult male and female red crabs of similar sizes. CHH expression levels were slightly higher in females (4.5x10⁶ copies/μg eyestalk total RNA, n=9) than in males (4.0x10⁶ copies/μg eyestalk total RNA, n=9). Analysis of transcriptome sequencing data revealed over 142 million reads. Processed reads were assembled, and a total of 50,088 contigs produced. This assembly will be used to map stage 1 and 3 samples to examine differential gene expression (DGE) of genes related reproduction. Selection of potential microsatellite markers is currently underway, with an additional 100 primer sets generated. Microsatellite markers (10-13) will be used to delineate the genetic distribution of the deep-sea red crab within the United States.

Products:

Green*, S., Chung, J.S. (2017). Elucidating the presence and expression of the crustacean hyperglycemic hormone of the red deep-sea crab, *Chaceon quinque-dens*. Presented at DelMarVa's Aquatic Resources & Ecosystems Research Symposium, University of Maryland Eastern Shore, Berlin, MD, April 2017. Poster Presentation

Relevance: This project is committed to NOAA's mission of providing scientific data to improve, supplement, and enhance management of deep-sea red crabs. In addition, given current uncertainties about red crab biology and their potentially low productivity and longevity, the data collected may help prevent long term ecosystem damage. This research will collect the critical information that was identified by the NOAA Red Crab Working Group. Understanding the

fecundity, size at maturity, and spawning frequency will allow for more accurate estimates of spawning stock reproductive potential. Estimates of size at maturity are necessary to set appropriate fishing mortality levels, and prevent recruitment overfishing. In addition, the crustacean hyperglycemic hormone (CHH) and the molt-inhibiting hormone (MIH) are two key crustacean neuropeptides being investigated to gain a better understanding of their functionality during reproductive cycles. Development and expansion of the fishery including new markets and product forms will be difficult without the information we propose to collect. Although our research occurs primarily in the Mid-Atlantic Bight, interpretation of crab reproductive patterns relative to temperature and depth will have implications for other deep-sea crab fisheries including those of Alaskan king and snow crabs. Results will help define management strategies for crabs with multi-year reproductive cycles in other parts of the world.

Broader Impacts: The results of this research will form part of the PhD dissertations for graduate students Stephanie Martinez-Rivera, and Shadaesha Green. Both students have spent time aboard NOAA research vessels and commercial fishing vessels. Our work will help create direct interactions between students, scientists, and fishermen that will benefit all by enabling better understanding of goals, perceptions, and needs for red crab management.

Project Number: 17-04

Project Title: Refining stock structure of common bottlenose dolphins (*Tursiops truncatus*) through photo-identification and genetic analysis

Project Abstract: Accurately identifying discrete stocks of common bottlenose dolphins is a critical task for marine mammal management. This project supports research investigating population structure and distinguishing stock boundaries through sighting histories and genetic analyses to (1) re-assess the southern boundary of the Northern Georgia/Southern South Carolina Estuarine System (NGSSCES) stock as indicated by recent residency data, (2) determine if there is a stock boundary at the Wilmington River, and (3) demonstrate the utility of integrating long term photo-identification and genetic analyses in a robust analysis. Biopsy samples were obtained from 69 of these individually identifiable common bottlenose dolphins with long-term sighting histories (2009-present). Mitochondrial DNA sequencing has been conducted and haplotypes have been identified. Mapping and spatial analyses are ongoing. In most studies, the single sampling location is the only geographic information matched to a genetic sample; in contrast, this study uses long-term sighting histories to better inform genetic analyses. Long-term sighting data associated with spatial location may allow for finer-scale examination of stock structure across a geographic boundary. The development of this unique methodology using photo-identification and genetic data has broad applications to other stocks in the Southeast United States as well as for other cetacean species for which photo-identification and genetic data are available. This project contributes to NOAA's mandate to manage protected resources by re-examining the southern stock boundary of the NGSSCES stock of common bottlenose dolphins as well as developing methods that may be used for other stocks in the future.

Thematic Area Addressed: Stock Assessment Support

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

NOAA Collaborator(s): Patricia Rosel (NOAA/NMFS); Brian Balmer (NOAA contractor; National Marine Mammal Foundation)

LMRCSC Collaborator(s): Joseph Pitula (UMES)

LMRCSC Research Student(s): Emily Griffin (MS student, Savannah State University); Debra Baskerville (UG, UMES)

Start Date: 1 Sept 2016

End Date: 31 December 2017

Scientific Merit: Stock structure of marine mammals has often been delineated by using a combination of data: photo-ID, genetics, telemetry, contaminants, and/or stable isotope ratios. In

the NGSSCES, the primary source of data has been photo-ID. Specifically, site fidelity was recently estimated in the Savannah area (southern range of the NGSSCES Stock) by using photo-ID data to calculate the probability of transitions between geographic states, which was used to develop a probability of residency. The study area was divided into a northern region (Savannah River to the Wilmington River) and southern region (Wilmington River to northern Ossabaw Sound). Analyses indicated minimal movement between these two areas. Thus, we proposed using a combination of photo-ID, genetics, and spatial analyses to further refine our understanding of stock structure of common bottlenose dolphins in northern Georgia waters.

A total of 50 biopsy samples from common bottlenose dolphins were collected in the inshore waters near Savannah, Georgia in September 2015 and February-March 2017. An additional 19 samples were obtained from animals that had stranded between 2008 and 2016 for a total sample size of 69. Twenty samples were collected from the northern region, 14 samples were collected from a buffer region, and 29 samples were collected from the southern region. Six samples were collected from stranded animals outside of the study area. DNA was extracted from all samples using the Qiagen DNeasy Blood and Tissue Kit. DNA concentrations were read on a fluorometer and diluted to 25ng/μl. A portion of the mitochondrial DNA genome was sequenced from each individual and the resultant sequences were edited and aligned using Geneious 10.2.3 to determine haplotypes. Five different haplotypes were identified within the sampled population. Four animals were identified as Ttr1, 4 were Ttr4, 2 were Tt5, 43 were Ttr6, and 16 were Ttr9. All samples were sexed via PCR and gel electrophoresis. Twenty-nine individuals were identified as female, and 40 individuals were identified as male. Photo-ID and spatial analyses are ongoing to develop an understanding of long-term ranging patterns that will then be coupled with the genetics information to further refine our understanding of stock structure. The development of this unique methodology using photo-identification and genetic data has broad applications to other stocks in the Southeast United States as well as for other cetacean species for which photo-identification and genetic data are available.

Products:

Griffin, E.K., Z. Wong, R.M. Perrtree, and T.M. Cox. 2017. Evaluation of the southern boundary of the Northern Georgia Southern South Carolina Estuarine System stock of common bottlenose dolphins (*Tursiops truncatus*) in the waters around Savannah, GA. Presented at the Southeast and Mid-Atlantic Marine Mammal Symposium, Beaufort, NC April 7-9, 2017. Oral.

Griffin, E.K., Z. Wong, R.M Perrtree, and T.M. Cox. 2017. Evaluation of the southern boundary of the Northern Georgia/Southern South Carolina Estuarine System stock of common bottlenose dolphins (*Tursiops truncatus*) in the waters around Savannah, GA. Presented at Savannah State University 7th Annual Research Conference, Savannah, GA April 10, 2017. Poster.

Griffin, E.K., Z. Wong, R.M. Perrtree, B. Balmer, and T.M. Cox. 2017. Using photo-identification and genetic data to identify fine-scale stock structure. Accepted for a poster presentation at the 22nd Biennial Society for Marine Mammalogy Conference on the Biology of Marine Mammals, Halifax, Nova Scotia, Canada, October 22 – 27, 2017. Poster

Relevance: This project directly addresses several of NOAA’s research priorities. This project contributes to NOAA’s mandate to manage protected resources by re-examining the southern stock boundary of the NGSSCES stock of common bottlenose dolphins. Monitoring protected species, such as bottlenose dolphins, is part of the “core” activities that the Southeast Fisheries Science Center must continue even when budgets are minimal. Both the Northern Georgia/Southern South Carolina Estuarine System Stock and the Central Georgia Estuarine System Stock are considered strategic stocks under the Marine Mammal Protection Act.

Broader Impacts: This project provided opportunities for both graduate (Griffin) and

undergraduate (Baskerville) students to participate in collaborative research, working with NOAA mentors and SSU faculty and researchers. Griffin's analyses combining both long-term habitat use and genetics will be the basis of her Master's thesis in Marine Sciences at Savannah State University. We expect Griffin to complete her Master's degree in May 2018. Griffin then intends to continue on to a Ph.D. program in marine science. This opportunity was Debra Baskerville's first exposure to research, especially field research. She was trained in Geographic Information Systems (GIS) during her internship. Her exposure at SSU to marine life and conservation issues as well as collaborative research, data management, and the scientific method will prepare her for continuing on to graduate or professional studies.

Project Number: 17-06

Project Title: Ecosystem impact of a harmful algal bloom species (*Dinophysis acuminata*) on aquaculture shellfish

Project Abstract: Land development within the Maryland Coastal Bay watershed induces a suite of environmental stressors that negatively impact aquatic animal health, such as eutrophication leading to the development of harmful algal blooms (HABs). The proposed study seeks to monitor an ongoing bloom event, which has led to increased numbers of the potential toxin-producing species *Dinophysis acuminata*. The impact of this organism on animals within the MCB remains undetermined. It is vital to understand its impact on resident shellfish that act as the primary filter feeders during bloom events, as these species will serve as the first level of bioaccumulation of toxin in the food chain. Indirectly, reduced fitness in these organisms may also lead to reduced ability to clear blooms during HAB events.

Thematic Area Addressed: Safe Seafood and Aquaculture

Lead Scientist(s): Joe Pitula, UMES

NOAA Collaborator(s): John Jacobs, NOAA Cooperative Oxford Laboratory

LMRCSC Collaborator(s): Gulnihal Ozbay, DSU

LMRCSC Research Student(s): Detbra Rosales (PhD student, UMES)

Start Date: 1 Sept 2016

End Date: 31 August 2017

Scientific Merit: The presence of *V. parahaemolyticus* and several harmful algal bloom (HAB) species causes concerns for the proposed aquaculture sites due to environmental and human health risks associated with these organisms. We are examining the areas near proposed aquaculture sites to determine the impacts of water quality and proliferation of pathogenic bacteria on oyster aquaculture. Using a combination of microscopy and PCR-based screening methodologies, we are comparing the HAB and bacteria communities residing inside the oyster, *Crassostrea virginica*, to environmental water samples. A number of HAB species, such as *Karlodinium veneficum*, *Dinophysis spp.*, *Heterosigma akashiwo* and *Chattonella subsalsa*, were found in the Delaware Inland Bays (DIBs) during year one of the study. *V. parahaemolyticus* was detected both in the water samples and *C. virginica* gut content samples. We will present data on HAB and pathogenic bacteria species from both water and oyster samples that analyzes potential human health risks at the proposed DIB oyster aquaculture sites.

Products: Detbra will be presenting her work at the 2017 Harmful Algal Bloom Symposium in Baltimore, MD in November:

D. Rosales and J. Pitula, "Detection of *Vibrio parahaemolyticus* and Harmful Algal Species in *Crassostrea virginica* In The Delaware Inland Bays"

Relevance: This proposal addresses multiple objectives within NOAA's Next Generation Strategic Plan, including the need for developing sustainable aquaculture. This effort also contributes actions in direct support of guidelines of the President's Chesapeake Bay Executive Order²⁶ which

calls for NOAA to use sound ecosystem science to protect habitat and produce science that informs the management process. In addition, this project promotes the development of rapid and informative bioindicators of ecosystem health. The results from this study will be reported to NOAA, published in a peer-reviewed journal and presented at scientific conferences.

Broader Impacts: This study will be used to develop the PhD degree requirements for Detbra Rosales. By its nature, it also will initiate many future graduate student projects, as ultimately long-term monitoring and ecosystem models will need to be generated. This project will provide students with in-depth training in multiple facets of traditional fisheries science along with hands-on training in biomolecular techniques and ecological examinations. The student will receive direct training from both NOAA and DNR scientists during the course of this study.

Project Number: 17-07

Project Title: Migration and foraging ecology of at-risk species: Columbia River Chinook salmon and Atlantic weakfish

Project Abstract: Quantifying habitat use for migratory fish is challenging yet important for the development of sound management and recovery plans. Given that migratory fish are highly mobile and often have short, habitat-specific residence times, research approaches that can shed light on diet, growth, or condition during migration continue to be developed and refined. Longitudinal studies, or those that follow specific cohorts of fish during their migration, can quantify spatial variation in foraging, growth, and sometimes mortality, thus providing information on habitat use. Interior Columbia River Chinook salmon (*Oncorhynchus tshawytscha*) and Weakfish (*Cynoscion regalis*) are two migratory species of concern. Interior Columbia River Chinook salmon have been listed under the Endangered Species Act since 2005, and habitat restoration within the lower Columbia River and Estuary is a key element of their recovery plan. The Atlantic weakfish stock has been depleted since around 2002, and recent assessments indicated that natural mortality may be the cause for the stock's inability to rebound despite fishing mortality decreases since 2011. Therefore, we implemented a longitudinal study design to quantify foraging and growth using traditional diets, stable isotope, and otolith chemical analyses during migration for these two, commercially important migratory species.

Thematic Area Addressed: Healthy Habitats

Lead Scientist(s): Jessica Miller, OSU

NOAA Collaborator(s): Laurie Weitkamp, OSU

LMRCSC Collaborator(s): Stacy Smith (DSU)

LMRCSC Research Student(s): Brian Galvez (M.S. student, DSU), Sawyer Finley, NSF REU Summer student at OSU (leveraged)

Start Date: 1 Sept 2016

End Date: 31 December 2017

Scientific Merit: Fish, primarily young-of-the-year, were collected along the estuarine gradient, including the lower Columbia River and estuary from the head of tide to the mouth of the estuary and the upper, middle, and lower portions of Delaware Bay. Stable isotope data ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) of fish (muscle, liver, and fin) and their prey were collected along each of these gradients to quantify carbon sources supporting the fish and the trophic levels of fish and their prey (e.g., anchovy, mysid shrimp, gammarid amphipods and isopods) as they migrate through their respective habitats. For Chinook salmon, we used genetic stock identification to focus on the stock group of greatest management concern (Snake River spring/summer Chinook salmon). Otolith structural and chemical analyses to provide estimates of residence time and growth rates during migration are ongoing. Weakfish have been collected from the upper, middle, and lower portions of Delaware Bay, including 12 trawl stations in the western Delaware Bay and 11 stations from the

eastern Delaware Bay. Preliminary stable isotope data for Chinook salmon indicate a clear shift in $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ in yearlings as they migrate through the lower river and estuary, supporting the hypothesis that individuals feed and reside in these habitats long enough to alter their isotopic composition. Diet analyses indicate that insects, primarily from marshes, comprised 25% to 60% of the diet during migration. For Weakfish, smaller individuals (<60 mm) were depleted in $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ compared to larger individuals (>60 mm). Most of the weakfish collected in the Delaware Bay are less than age 3. Larger weakfish are not returning. The most 'nutritious' food for juvenile weakfish is mysid shrimp; however, we have found an invasive species of isopod in the stomachs of many juveniles.

Products:

*Munguia, A., Miller, J. A, and Weitkamp, L. A. 2017. Feeding ecology of juvenile Chinook salmon through the lower Columbia River and estuary. Oral Presentation at Lower Columbia River Partnership Workshop, Portland, OR

*Munguia, A., Miller, J. A, and Weitkamp, L. A. 2017. Characterizing feeding ecology and food web linkages of yearling Chinook salmon in the lower Columbia River and estuary. Poster Presentation at Salmon Ocean Ecology Meeting, Seattle, WA

*Galvez, B., Neilan, B., Ozbay, G., Smith, S. 2017. Stable Isotope Ratios of Weakfish from the Eastern Delaware Bay – Preliminary Data. April 2017. UMES AFS Student Subunit Meeting, Berlin, MD.

Relevance: Recovery plans rely on understanding of the factors limiting population growth. For migratory coastal species, such as Chinook salmon and Weakfish, a more complete understanding of foraging and growth during their migration contributes to: 1) evaluations of habitat restoration efforts; 2) determination of factors influencing mortality, i.e., low prey quality; and 3) identification of habitat areas with relatively high (or low) foraging and growth potential. For Chinook salmon, this research addresses information needs identified in NOAA's Biological Opinion and will provide information relevant to the conservation and management of ESA-listed, federally managed Chinook salmon populations. For Weakfish, this research aligns with Atlantic States Marine Fisheries Commission (ASMFC) goal to conduct new biological studies monitoring diets spatially, "particularly in estuaries". The ASMFC receives most of its federal funding from NOAA fisheries to carry out the Atlantic Coastal Fisheries Management Act.

Broader Impacts: NOAA LMRCSC student education and research goals met include the following: undergraduate and graduate student research is preparing future workforce for marine and fisheries sciences, and linking student to professional networks and employment opportunities in marine and fisheries sciences (Delaware Department of Natural Resources and Environmental Control, New Jersey Department of Environmental Protection, NOAA Oxford Lab, MD and NWFSC's Hammond Lab, OR), and fostering collaborative research (DSU and OSU). A. Munguia also gained valuable mentoring experience serving as a mentor to summer NSF REU intern Sawyer Finley in 2017.

Project Number: 17-08

Project Title: Comparing the diet and microbiome of Atlantic menhaden and Eastern oyster using DNA barcoding

Project Abstract: Atlantic menhaden (*Brevortia tyrannus*) and Eastern oysters (*Crassostrea virginica*) diets derive from filtration of the water columns, consuming planktonic organisms. Both are powerful filtering organisms, though exactly what items are being filtered still remains largely unknown. This comparison will help to assign trophic levels and develop more accurate food web models and assess ecosystem health. Stomach contents of each organism reflect their ability to

function as an environmental sampler. Identification of stomach contents is difficult due to items being largely unrecognizable by conventional methods, therefore contents will be investigated using primers that target the hypervariable regions of the 16S and 18S ribosomal DNA (rDNA) using Illumina's MiSeq high-throughput sequencing technology. To our knowledge this has yet to be done for these two filter feeding species. The results from this study could help efforts to restore the Choptank River, a large tributary of the Chesapeake Bay, which is a project focus of the NOAA-Cooperative Oxford Lab and also help train minority students in the field of marine biology.

Thematic Area Addressed: Quantitative Fisheries

Lead Scientist(s): Ammar Hanif (Ph.D. student, UMCES-IMET)

NOAA Collaborator(s): John Jacobs (NOAA-COL, Oxford, MD)

LMRCSC Collaborator(s): Bradley Stevens (UMES), Joe Pitula (UMES)

LMRCSC Research Student(s): Ammar Hanif (PhD student, UMCES); Malisa Smith (UG, UMES)

Start Date: 1 Sept 2016

End Date: 31 December 2017

Scientific Merit: Collection of menhaden and oyster samples are underway. A total of 15 oysters were collected during three collection dates, and are being maintained live in baskets beneath the Cooperative Oxford Lab (COL) dock. We have not been successful in collecting menhaden due mainly to weather and environmental conditions. During the summer between June and August, Malisa Smith of UMES spent 9 weeks in the lab learning various molecular and bioinformatics techniques. Using oysters taken from the COL raceway we were able to validate a DNA extraction method from their stomach contents. The DNA extracts from the oyster stomachs were shown to be amplifiable via PCR using both universal eukaryotic and universal prokaryotic primers. We were also able to validate previous high-throughput sequencing results of Atlantic menhaden stomach contents by PCR using group specific primers. These results showed that groups that were found in the stomach DNA extracts by the primers used in high-throughput sequencing could also be found using their respective group specific primer. The 18S ribosomal RNA gene of menhaden was successfully cloned into a bacterial vector. This is the first report of menhaden rDNA sequence. This DNA will be used for primer design to develop an assay to determine the level of Atlantic menhaden DNA contamination present in gut DNA extracts. A sequence of *Crassostrea virginica* rDNA is available in GenBank and has been used to design primers, and for an assay to determine the level of oyster DNA contamination present in oyster gut DNA preparations. The work will go forward once menhaden can be collected from the same site.

Products: None yet

Relevance: The Choptank River is one of the largest tributaries of the Chesapeake Bay. It is also the focus of a large restoration project closely monitored by NOAA-Cooperative Oxford Lab. One focus of this restoration is to increase water clarity by the establishment of oyster reefs. Atlantic menhaden also occupy this tributary as it facilitates an important nursery. Though Atlantic menhaden stocks are not federally managed, many of the fish that rely on menhaden as a primary food source are. Collectively oysters and menhaden help to filter the water of the overgrowth of phytoplankton that results from eutrophication. Our findings will help provide a better understanding of food web dynamics in the Chesapeake Bay and the gut contents of menhaden and oysters could be used in ecosystem health assessments serving to improve ecosystem based management policies.

Broader Impacts: This project supports student involvement and training of two minority students. PhD graduate student Ammar Hanif, whose ambition is to become a NOAA scientist, was recently selected as a NOAA-Knauss Fellow for 2018. UMES undergraduate student Malisa Smith worked at UMCES-IMET and received training in PCR verification of the results found by the MiSeq high throughput sequencing. Ms. Smith acquired knowledge and skills in trophic ecology, DNA

preparation, PCR amplification, cloning and gel electrophoresis. She also received basic laboratory safety training and completed the CITI "Use of animals" training. As a result of the internship she learned about the USM-wide, NSF funded PROMISE-AGEP and attended the Summer Success Institute. Malisa also received training in communication skills and preparation for graduate school. She completed a poster on her work, which can be taken to various undergraduate venues during the present school year. These training accomplishments reflect NOAA's emphasis on human capital, training, education, and future recruitment to NOAA. Dr. Pitula and Mr. Hanif will organize a half-day workshop at UMES on potentially useful applications of DNA barcoding to wider questions in marine systems and the ability of this technique to augment traditional analyses of both benthic and planktonic organisms. This workshop will be available by videoconferencing to other LMRCSC and CSC partners. This work also represented a collaboration with Dr. John Jacobs at NOAA-COL in Oxford MD and afforded both Mr. Hanif and Ms. Smith experience working in a NOAA laboratory.