



Performance Report for Cooperative Agreement No: NA11SEC4810002
for the Period from September 1, 2014 to February 28, 2015

University of Maryland Eastern Shore

Living Marine Resources Cooperative Science Center

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Table of Contents

List of Tables	3
Executive Summary	4
Introduction	7
Goals and Objectives	7
Section I: Status of Award Activities	7
Education Goal 1: Prepare the future workforce for marine and fisheries sciences	11
Objective 1.1: Recruit students from under-represented groups into marine and fisheries science disciplines	11
Objective 1.2: Increase retention and degree completion rates for students in marine and fisheries sciences programs	12
Objective 1.3: Assess the value-added outcomes of degree programs in marine and Fisheries sciences at the partner institutions	18
Objective 1.4: Link students to professional networks and employment opportunities in marine and fisheries sciences	18
Education Goal 2: Strengthen collaborations across universities to enhance academic programs in marine and fisheries sciences	19
Objective 2.1: Use state-of-the-art, research-based curricula to provide students with the highest quality education in marine and fisheries sciences	20
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	20
Objective 2.3: Ensure that curricula of degree programs at partner institutions address current challenges and emergent needs within the profession	22
Research Goal 3: Develop an exemplary capacity for scientific collaborations among partner institutions in the fields of marine and fisheries sciences	22
TAB funded Projects	23
Scholarly Productivity	29
Section II: Education and Outreach Activities	29
Section III: Success Stories	30
Section IV: Amendments to Award	32
Appendices	33

List of Tables

Table 1. Student recruited into LMRCSC from September 1, 2014 to February 28, 2015	12
Table 2. Students who received direct support during this reporting period	12
Table 3: Students who graduated during this reporting period	14
Table 4. Students who worked at NOAA or Center partners during this performance period	15
Table 5: Students who did not receive direct support but benefitted from the Center Programs	16
Table 6: Participation in career development activities including workshops and other training opportunities	17
Table 7a,b,c: Courses offered online at the LMRCSC in fall 2014, winter 2015 and spring 2015	21
Table 8. LMRCSC seminar series during the reporting period	22
Table 9: Research Projects Funded by the LMRCSC for 2014– 2015	22

List of Appendices

Appendix I: Partial list of NOAA NMFS scientists collaborating with LMRCSC scientists and students	33
Appendix II: Current leveraged funding from NOAA to LMRCSC institutions	34
Appendix III: Current leveraged funding to LMRCSC institutions from sources and agencies other than NOAA	35
Appendix IV: Presentations and Publications	36
Appendix V: Results of TAB Funded Projects (2014-2015)	45
Appendix VI: Acronyms and LMRCSC Links	58

Executive Summary

The mission of the Center is *"To develop exemplary academic and research collaborations that prepare a diverse student body for careers in marine and fisheries sciences"*. Established in October, 2001, the LMRCSC was created as a cooperative agreement between NOAA Educational Partnership Program (NOAA EPP), the University of Maryland Eastern Shore (UMES), Delaware State University (DSU), Hampton University (HU), Savannah State University (SSU), the University of Miami (UM/RSMAS) and the University of Maryland Center of Marine Biotechnology now known as University of Maryland Center for Environmental Science Institute of Marine and Environmental Technology (UMCES-IMET). Oregon State University (OSU) was added to the consortium in 2011. UMES is the lead institution of the consortium.

The mission of the LMRCSC is accomplished by addressing the following goals:

Goal 1: Prepare the future workforce for marine and fisheries sciences

Goal 2: Strengthen collaborations across universities to enhance academic programs in marine and fisheries sciences

Goal 3: Develop an exemplary capacity for scientific collaborations among partner institutions in the fields of marine and fisheries sciences

The Center continues to be guided by two management tracks, A) Administrative and B) Programmatic. The Administrative component includes the Center Director, Program Manager, Executive Committee, Center Core Administration and the Board of Visitors, whereas the Programmatic component includes the Technical Advisory Board that reviews proposals submitted annually to the Center for funding.

To accomplish Goal 1, the Center recruited 15 new students, and provided direct financial support to 83 students (17 Ph.D., 24 M.S., 42 B.S.) who received training in NOAA core science disciplines during this reporting period. In addition, 61 undergraduate and graduate students, who did not receive direct support from the Center, benefited from center programs and infrastructure. Nine (9) students graduated (3 BS, 4 MS, 2 Ph.D.) from the Center during this reporting period, and six (6) students interned at NOAA labs/facilities (NOAA J.J. Howard Lab, Sandy Hook, NJ; NOAA Panama City Lab; NOAA NWFSC, NOAA AFSC, and NOAA NOS Cooperative Oxford Lab, MD) or labs of LMRCSC partner institutions. Among the recent graduates of the LMRCSC are: Matthew Ramirez (M.S., OSU) who has enrolled for Ph.D. at OSU, Austin Flinn (MPS, RSMAS) who is working as a Research Assistant at NOAA, Rolando Santos (Ph.D., RSMAS) who is a Research Associate at Florida International University, and Jeanette Davis (Ph.D., UMCES-IMET) who is currently on Knauss Fellowship. Additionally, Chelsea Richardson (B.S., UMES) enrolled at UMES in the MEES master's program, and Courtney Pegus (M.S., SSU) enrolled in a Ph.D. degree program at the University of Washington, Seattle. Furthermore, the Center linked students to professional networks and employment opportunities in marine and fisheries science by providing support for them to attend scientific meetings such as the NOAA EPP Education and Science Forum, and the Association for the Science of Limnology and Oceanography (ASLO) where 109 presentations were made by center students. In order to maintain a pipeline of students into the marine sciences, the Center conducted several activities for grades K-12 which impacted 1000-1500 students.

To accomplish Goal 2, the Center used the Virtual Campus including the use of videoconferencing, Adobe Connect, Go-To-Meeting and Blackboard, for curriculum development and seminars and to offer courses to LMRCSC students, including a NOAA NEFSC contractor located in Woods Hole, MA enrolled in the Professional Science Master's (PSM) degree program at UMES. Seminars and several courses offered through the University of Maryland interactive video network (IVN) were made available to Center students during this reporting period. More than thirty-three (33) NOAA scientific and administrative personnel were engaged in LMRCSC education and outreach, scientific research and administrative functions, including the planning and execution of the NOAA EPP Education and Science Forum that was held at UMES in October 2014.

The LMRCSC continued its Seminar Series by featuring four presentations by scientists. These seminars were made available to students and scientists at the Center and its partner institutions using Adobe Connect.

In support of Goal 3, twelve (12) new projects were funded in 2014-2015, in addition to the 12 projects funded in 2013-2014 that are continuing. These collaborative projects address various aspects of NOAA's Next Generation Strategic Plan Goal (NGSG): *"Healthy Oceans - Marine fisheries, habitats, and biodiversity sustained within healthy and productive ecosystems"*, and objectives: (1) Improved understanding of ecosystems to inform resource management decisions, (2) Recovered and

sustained marine and coastal species, (3) Healthy habitats that sustain resilient and thriving marine resources and communities, and (4) Sustainable fisheries and safe seafood for healthy populations and vibrant communities. They also address some of the goals, objectives and priorities listed in NMFS 2007 Strategic Plan for Fisheries Research. Examples of research projects conducted by LMRCSC-funded scientists, students and NOAA collaborators include: resolving temporal population sub-structure in Chinook salmon by developing genetic markers; developing molecular techniques to identify planktonic food of Atlantic menhaden; and using RNA:DNA ratios of juvenile fish as indices of water quality in Chesapeake Bay tributaries. Additional examples are; investigating whether invasive green crabs are reservoirs for blue crab pathogens; determining the reproductive cycle of red deep-sea crabs and a new method for estimating crab age; and linking a habitat suitability model for black sea bass to fluctuating aquatic conditions and stable hard-bottom habitat sites.

In the current reporting period, LMRCSC students and faculty made 127 presentations (oral and poster) at scientific meetings (109 of which were made by students), and published 30 articles in refereed journals and books, 17 of which were authored or co-authored by students or graduates of LMRCSC. Through its research activities in living marine resources the Center is addressing NOAA Fisheries mission goal, to: *"protect, restore, and manage the use of coastal and ocean resources through an Ecosystem Approach to Management"*.

A total of ~\$1.9 million was collectively awarded in grants to the LMRCSC institutions during this reporting period, which has directly impacted and will continue to have positive impacts on Center activities. These funds enhanced LMRCSC research through support of its faculty and students and by development/enhancement of infrastructure.

The foregoing indicate that the LMRCSC educational, research and outreach activities are addressing three of the five essential activities NOAA has identified as being important for the success of its mission: (i) *"developing, valuing, and sustaining a world-class workforce"*, (ii) *"ensuring sound, state-of-the-art research"*, and (iii) *"promoting environmental literacy"*. Thus, the Center is making significant contributions to the training of a diverse body of students in NOAA related STEM disciplines that will help increase U.S. competitiveness in the global economy. The tables below summarize some of the LMRCSC accomplishments during this reporting period.

NOAA EPP Cooperative Science Centers (CSCs) Program's standardized Performance Measures:

- Number of students from underrepresented communities who were trained (# = 111; 22 Ph.D., 19 M.S., 70 B.S.) and graduated (# = 8; 2 Ph.D., 3 M.S., 3 B.S.) in NOAA-mission sciences in the past six months
- Number of students who were trained (# =143; 23 Ph.D., 36 M.S., 84B.S) and graduated (# =9; 2 Ph.D., 4 M.S/PSM, 3 B.S.) in NOAA-mission sciences in the past six months;
- Number of students who completed experiential opportunities at NOAA facilities (# =6);
- Number of EPP funded students who were hired by NOAA (# = 2), NOAA contractors (# = 0) and other environmental, natural resource, and science agencies at the Federal (# = 0), State, local and tribal levels, in academia (# = 2) and the private sector;
- Number of NOAA science and administrative personnel engaged in CSC Education and Outreach, Scientific Research, and Administrative functions (# = 33)
- Number of collaborative research projects undertaken between NOAA and MSI partners in support of NOAA operations (# = 12);
- Number of students (# = 2) and faculty (# = 0) who participated in and completed postdoctoral level research programs in support of the NOAA mission;
- Number of peer reviewed papers published in NOAA-mission sciences by scientists (faculty, postdoctoral fellows, and students) sponsored by NOAA EPP (# = 30);
- Funds leveraged with NOAA EPP funds (including student support) (# = ~\$1.9 million); and,
- Number of outreach participants engaged in NOAA mission relevant learning opportunities (2000-3000).

Summary of LMRCSC Performance Measures of Success (Education and Outreach Programs) for 2014 - 2015

	Proposed in the Implementation Plan 12 months	Accomplished (Sep. 1, 2014 – Feb. 28, 2015); 6 months	Accomplished (Mar. 1, 2015 – Aug. 31, 2015); 6 months	Accomplished (Sep. 1, 2014 – Aug. 31, 2015); 12 months
Activities/Programs	2014 – 2015	2014 - 2015	2014 - 2015	2014 - 2015
# K-12 Students participating in NOAA related science activities	1,000	1000-1500	n/a	n/a
# of students trained in NOAA related Sciences	90	143	n/a	n/a
# B.S. Students who graduate in NOAA core Sciences	24	3	n/a	n/a
# M.S. Students who graduate in NOAA core Sciences	11	4	n/a	n/a
# Ph.D. Students graduating in NOAA core Sciences	4	2	n/a	n/a
# of internships at NOAA/other labs.	33	6	n/a	n/a
# of Courses to be offered via Virtual Campus or online	5	18	n/a	n/a
Amount of leveraged funds (\$) for education and outreach	500K	>\$840K	n/a	n/a
# of student presentations at conferences	80	109	n/a	n/a
# of NOAA/LMRCSC Fisheries Cruises	1	0	n/a	n/a
# of student co-authored publications	18	17	n/a	n/a
# of individuals impacted by outreach activities	>1,000	2000-3000	n/a	n/a

Summary of LMRCSC Performance Measures of Success (Research Programs)

	Proposed in the Implementation Plan 12 months	Accomplished (Sep. 1, 2014 – Feb. 28, 2015) 6 months (this period)	Accomplished (Mar. 1, 2015 – Aug. 31, 2015) 6 months	Accomplished (Sep. 1, 2014 – Aug. 31, 2015) 12 months
Activities	2014 - 2015	2014 - 2015	2014 - 2015	2014 - 2015
1. Science Meeting date	March	October 31, 2014	n/a	n/a
2. # of TAB Proposals funded	10 to 16	12	n/a	n/a
4. # of proposals funded (leveraged funding)	12	23	n/a	n/a
5. # of scientific presentations at conferences	120 (80*)	127(109*)	n/a	n/a
6. # of theses & dissertations produced	12	3	n/a	n/a
7. # of peer-reviewed publications	15*-30	30(17*)	n/a	n/a
8. Amount of leveraged funds (\$)	\$3 million	\$1,908,514	n/a	n/a

*Number presented or co-authored by students (minimum)

INTRODUCTION

The Living Marine Resources Cooperative Science Center (LMRCSC) was established in October 2001 as a cooperative agreement between NOAA Educational Partnership Program, the University of Maryland Eastern Shore (UMES), lead institution, Delaware State University (DSU), Hampton University (HU), Savannah State University (SSU), the University of Miami, Rosenstiel School of Marine and Atmospheric Sciences (UM/RSMAS) and the University of Maryland Biotechnology Institute Center of Marine Biotechnology (UMBI-COMB), now known as the University of Maryland Center for Environmental Science Institute of Marine and Environmental Technology (UMCES-IMET). With the addition of Oregon State University in 2011, the LMRCSC now has seven partner institutions. The mission of the Center is *"To develop exemplary academic and research collaborations that prepare a diverse student body for careers in marine and fisheries sciences"*.

The following are the goals and objectives of the LMRCSC:

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

Objective 1.4: Link students to professional networks and employment opportunities in marine and fisheries sciences

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

Objective 2.1: Use state-of-the-art, 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

Research Goal 3. Develop an exemplary capacity for scientific collaborations among partner institutions in the 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: quantitative fisheries, essential fish habitat, fisheries socioeconomics, 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

SECTION I – STATUS OF AWARD TASKS (Goals and Objectives)

Summary

1. **Status of Goals/Objectives Accomplished As Defined in the Cooperative Science Center's Proposal:** This is provided below from page 11.

2. **Status of Benchmarks due during the performance period:** The LMRCSC is on target to meet or exceed most of the bench marks proposed for the 12 month period of 2014-2015, considering that the accomplishments reported during this period are for six months. Compared with the one year benchmarks indicated in the 2014-2015 implementation plan, the LMRCSC has accomplished or exceeded 50% of most of its performance measures of success of education and outreach programs, especially with regard to the numbers of students trained in NOAA related sciences (90 vs 137), Ph.D. students

graduated (4 vs 2), student presentations at professional meetings (80 vs 109), and numbers of journal articles co-authored by students (18 vs 17). However, the LMRCSC proposed to graduate 24 students with a B.S. degree and 11 with a M.S. degree, but graduated 3 and 4 students respectively. This is perhaps because most of the center's B.S. and M.S. degrees are earned during the spring than in the fall semester which falls within the reporting period.

3. **Status of Special Award Conditions (if applicable) Due During the Performance Period:** All special award conditions have been met or will be met by October 1, 2015.
4. **Identification of the NOAA-mission Research and Report on the Impact of the Research on NOAA's Mission. In addition, provide the planned and actual duration and status of the research activity that is in support of NOAA's mission.**
This is provided below under TAB funded projects from page 23 and Appendix V.
5. **Identification of All Collaborative Research Activities Undertaken During the Award Period:**
This is provided below under TAB funded projects on page 23 and Appendix V.
6. **Report on the Administrative and Research Meetings Conducted in Support of Activities Under this Award:**
Meetings conducted during this reporting period included monthly meetings of the Executive Committee, the science committee, and conference calls by CSC Directors. The annual science meeting and the EPP Biennial Forum on Science and Education were held in October 2014 after several planning meetings that included NOAA LMRCSC staff and faculty, and NOAA EPP staff.
7. **Status of Recruitment (including students, staff and post-doctorates):** During this period, Dr. Yeong Chi, Resource Economics Associate Professor was recruited at UMES. At RSMAS, Dr. Elizabeth A. Babcock took over as co-PI of the project from Dr. David Die. Dr. Die will remain as the RSMAS representative to the Scientific Committee. Fifteen (15) students were recruited to the center, three of which will begin their program in fall 2015 (Table 1).
8. **Status of Faculty/NOAA Staff Exchanges:** During this period, HU worked with Ronald B. Johnson and Howard Townsend of NOAA Cooperative Oxford Lab, MD.
9. **Progress on LMRCSC Student Development Plan (SDP) Implementation:** Students have been asked to complete student development plans in collaboration with their advisors. We are in the process of collecting those plans.

Enhance Academic/Educational Development of students. This will help to prepare the students to acquire knowledge and technical skills to develop NOAA mission-related portfolios, particularly in marine and fisheries sciences.

- a) **Offer rigorous courses in marine and fisheries science that include those considered essential for training fisheries scientists using the Centers virtual campus facility:** Several courses were offered to students at the center using the virtual campus facility (Tables 7a-c).

Provide students with research experiences on Center campuses: All LMRCSC students are expected to engage in research work at their home institutions during the academic year under the guidance of a faculty mentor and/or during the summer in the form of internships. Although summer internships and programs did not occur during this reporting period, six students participated in internships at NOAA labs or in the labs of partner institutions (see Table 4).

- b) **Organize seminars for faculty and students:** The LMRCSC has established a center-wide seminar series that is attended by center scientists and students. Presentations at these seminars have been by scientists from the center and other institutions. Graduate students, particularly those supported by NSF CREST-CISCEP Center, leveraged with LMRCSC funds, have also given presentations of their research work to faculty and students. Seminars given during this reporting period are listed in Table 8.

Enhance Professional/Career Development of students.

- a) **Train students to develop skills to teach, to co-mentor, to give and to receive feedback:**

Graduate students are actively engaged in teaching and mentoring undergraduates that work in partnership with them in their laboratories. Faculty mentors provide direction and feedback on these activities.

b) Create opportunities for students to teach, co-learn and mentor other students:

LMRCSC graduate students, particularly at UMES, are encouraged to teach at least one semester long lab session before they complete their degrees. Undergraduate students are required to attend tutorial sessions to serve as tutors to other students and/or to receive tutoring from other students. The LMRCSC **has multiple levels of mentoring** such that during the summer and academic year, high school and undergraduate students working in LMRCSC faculty research labs are co-mentored by graduate students, and high school students receive mentoring from undergraduate students.

At RSMAS, Ph.D. students are obliged to serve as TAs for one semester at a minimum; many do two semesters. All LMRCSC labs at SSU use a peer mentoring format in which undergraduates co-mentor each other and graduate students mentor undergraduates and peers. Some SSU students also learn to teach as GK12 fellows while others teach at Coast Camp or are graduate teaching assistants for undergraduate courses. Other opportunities to teach informally come from the Marine Science Outreach Coordinator, Mrs. Victoria Young. She brings in hundreds of youth each year who learn Common Core standards with Marine Science modules taught by LMRCSC and other Marine Sciences students. HU has instituted a Fall retreat for all students in the department, where the students are assigned mentors and mentees, gain training in team building and science communication. At IMET, all graduate students engage in peer mentoring to other graduate students in seminar courses and provide input on their proposal defense and thesis defense seminars.

Enhance student's skills in writing grant proposals and completing application forms for scholarships and fellowships: All graduate students in the LMRCSC write research proposals that are submitted to, and approved by the advisory committee before they can complete their degrees. Graduate students at the center are also required to take a Scientific Communications course or its equivalent that includes developing and writing a grant proposal. All IMET graduate students are required to write research proposals that are submitted to, and approved by their advisory committee before they advance to candidacy, submit 2-3 papers arising from their thesis research, submit abstracts to relevant meetings, apply for research and travel scholarships.

OSU student, LaTreese Denson participated in an intensive writing course early in the year that resulted in regular writing group sessions with OSU graduate students. At HU, a graduate student, Larry Redd, Jr. co-wrote sections on the TAB renewal that funds his research, and he writes the first draft of all TAB reports with intensive feedback from his advisors. Finally, two of the Concurrent Sessions available to all student attendees of the NOAA EPP Forum on Education and Science held in October 2014 addressed writing and communication skills:

CSS1: Professional Enhancement Panel Discussion – Finding and completing scholarship and graduate school applications; Identifying and applying for post-doctoral positions

CSS3: Student Development Panel – CV/resume building; transition from graduate school to work environment, etc.

c) Enable students to identify career opportunities and to develop interviewing and networking skills:

SSU has an Annual Research day and Graduate Career Fair that contribute to this end. Students who attend the Research Day are interviewed about their research during the poster competition. Often they are prepared for this experience by the co-mentoring mentioned previously. The Graduate Career Fair brings in private industry and representatives from NOAA who coach students on how to prepare for professional careers.

At HU, Larry Redd Jr. worked with his committee and the HU Career Counseling Center to prepare for his Knauss Fellowship interviews. Larry Redd Jr., Symone Gyles, Justin Shaifer, Renita Bostic, and Kenya Bynes attended either or both of the EPP Forum and ASLO (Feb. 2015), where they participated in the networking activities provided to students. As part of a DSU class requirement, Nivette Perez-Perez and Keith Leonard interviewed NOAA and LMRCSC scientists (Matthew Poach and Brad Stevens) and made a short movie based on these interviews. IMET and UMES students are encouraged to participate in the PROMISE Program. Maryland's Alliance for Graduate Education and the Professoriate (AGEP) is an NSF-funded, university system-wide effort for the state of Maryland to facilitate underrepresented STEM graduate student and postdoctoral professional development and pathways to careers. It provides professional development seminars and workshops as well as networking opportunities. UMB/UMBC lead the alliance (<http://promiseagep.wordpress.com>). IMET has established an Entrepreneurs Program with funding from the Philip E. and Carole R. Ratcliffe Foundation to help our young

scientists cultivate the leadership and business skills necessary to bring their bench research into practical applications in the areas of sustainable energy resources, environmental remediation and sustainable aquaculture.

Several of the Concurrent Sessions available to all student attendees of the NOAA EPP Forum on Education and Science addressed these topics:

CSS2: NOAA Professionals Panel – What does it take to join the professional workforce?

CSS3: Student Development Panel – CV/resume building; transition from graduate school to work environment, etc.

CSS5a: Successful Interviewing Skills

CSS5b: How to Begin your Professional Job Search

CSS5c: How to Successfully Secure a Private Sector Job

- a) **Create opportunities for students to develop collaborative leadership skills and to have leadership experiences:** LMRCSC students are included as co-moderators of sessions and as judges of posters and oral presentations during the annual university wide symposium at UMES, planned by the Graduate School collaboratively with the LMRCSC faculty. LMRCSC faculty and students are currently involved in the planning of the UMES research symposium that will be held in April 2015.

At HU, Symone Gyles is being formally trained in leadership through HU's Leadership Institute; she is obtaining a minor in leadership. Kenya Bynes and Rebecca Castro are gaining leadership experience by leading the Marine Science Club and facilitating departmental events.

At SSU, Students in the LMRCSC are given opportunities to lead class discussions in regular and "flipped" classrooms. In the Fall semester, undergraduate Conservation Biology and graduate Coastal Zone Management course were flipped (see <http://www.knewton.com/flipped-classroom/>). In this format, the students received lectures outside of class and discussed the concepts from the lectures within class. These 2 classes used the African American Oral History Project and Dr. Jolvan Morris' work in Harris Neck as a case study and helped develop a management plan with the Harris Neck Land Trust (see their work mentioned in this newspaper article: <http://savannahnow.com/news/2015-02-21/harris-neck-descendants-request-lease-refuge-land>).

IMET students assist in planning of events, including the UMCES Convocation and MEES Colloquium, participate in the Entrepreneurs Program, self-govern through active Graduate Student Association. Student representatives participate at Faculty Meetings and UMCES Graduate Council Meetings and have representation on the UMCES Presidential Scholarship Review.

- b) **Create opportunities for students to enhance their written and oral communication skills especially as it relates to translating discipline-based concepts, methods and practices in ways that experts from other fields will find understandable:** Several activities and programs have been held at the LMRCSC institutions to enhance students' oral and written communications skills, including LMRCSC sponsored seminars, symposia, conferences, and workshops. Written communication is enhanced through preparation of scientific reports as part of research experiences of undergraduates and writing of proposals. Students wrote research abstracts and made oral and poster presentations at scientific meetings. LMRCSC graduate students are also required to prepare and submit a manuscript to a journal before completing their degree programs.

At SSU, M.S. students who were admitted during the fall are required to write and defend their M.S. proposals by the first Monday of May each year. Additionally, Dr. Carla Curran initiated a journal club in which graduate students lead paper discussions, five of which were held during this period with two being led by LMRCSC students and staff. Several of the OSU LMRCSC students participated in PI Jessica Miller's lab meetings to review abstracts and evaluate practice talks and draft posters for scientific meetings. At IMET, through the REEF program, graduate students meet with and explain their work to entrepreneurs and members of the business community.

- c) **Create opportunities for students to learn budget management:** Budget developments and critiques are components of the Scientific Communications course that graduate students are required to take before completing their degrees. This course is taught at UMES in the fall. Graduate students are also encouraged to submit TAB proposals and manage their own budgets. Many students not supported by TAB projects are also asked to manage supply budgets for their projects. At IMET, through the REEF program, graduate students take accountancy modules and learn how to apply for industrial/agency partnership funds.

- d) **Create opportunities for students to participate in NOAA's mission and LMRCSC research-related seminars:** LMRCSC students participated in LMRCSC's seminar series, which is made available online via Adobe Connect. Opportunities to participate in NOAA sponsored seminars are communicated to students as they become available. During this period, LMRCSC students also participated heavily in the NOAA EPP Forum seminars and workshops.
- e) **Encourage students to participate in summer internships at NOAA labs and labs at LMRCSC partner institutions:** Internship opportunities available at NOAA labs, LMRCSC and at various agencies, particularly USFWS were made available to students.
- f) **Encourage students to make oral and/or poster presentations at professional meetings:** Several LMRCSC students made presentations at scientific meetings during this reporting period. A listing of their oral and poster presentations are listed in Appendix IV.
- g) **Provide opportunities for students to develop skills related to conflict and stress management:** Dionne Hoskins prepared a lecture entitled "Avoiding and Handling Conflict" for the graduate students during the fall as part of a special Directed Research class. At IMET graduate students are trained in conflict resolution management provided through the REEF program.
- h) **Guide students to develop professional profile on an established professional social networking site to document NOAA mission-relevant STEM career progress:** Students were encouraged to create accounts on linkedin.com. We are working to compile a list of student and alumni profiles. At HU, students take a 1 credit course where they develop their e-profile: CV, Research statement, 5 year plan, and graduate school/job search plan. All of these documents are then posted on the HU e-recruiting site. IMET students are encouraged to join Research Gate and/or Linked in. IMET's Associate Director, Dr. Nick Hammond, provides guidance on professional behavior and how to maintain an appropriate web presence.
- i) **Create opportunities for students to network:** Social interactions and development of LMRCSC students occurred during this period through the LMRCSC Facebook page and the Graduate Student Association at UMES. The NOAA EPP Forum presented a major networking opportunity for students during this period. Many of the activities were centered around network with peers, NOAA employees, and both academic and private sector professionals. At IMET, graduate students are encouraged to be active participants in the Graduate Student Association, and liaise with the GSA at UMB. LMRCSC students are supported to attend professional meetings, do field studies with other organizations, and participate in the University of Maryland System PROMISE program, <http://promiseagep.wordpress.com>.

1. Status of Goals/Objectives Accomplished as Defined in the LMRCSC's Proposal

For the period of **September 1, 2014 to February 28, 2015**, the following tasks were accomplished in support of the goals and objectives of the LMRCSC:

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

The **NOAA Education Strategic Plan (2009-2029)** assigns a high level of importance to the goal of developing a future workforce that reflects the diversity of the U.S. Collectively, the LMRCSC partner institutions offer a full range of degrees (bachelors, masters, and Ph.D.) in marine and fisheries sciences.

Objective 1.1: Recruit students from under-represented groups into marine and fisheries science disciplines - Our recruitment efforts advance specific workforce development outcomes identified in the NOAA Education Strategic Plan.

Activities and Accomplishments: - Recruitment into Marine Science Programs: Fifteen (15) students were recruited into the LMRCSC (Table 1). LMRCSC-IMET uses its summer undergraduate internship program as a pipeline for graduate students. Successes in the last year have been Rachel Banks, graduate of Hampton University, who was an intern with Dr. Tsetso Bachvaroff, and Erica Dasi who interned with Dr. Rose Jagus. Both these students have been admitted into the UMCES-MEES program for Fall 2015 to work with Dr. Bachvaroff and Jagus.

Table 1. Students recruited into LMRCSC from September 1, 2014 to February 28, 2015

	First Name	Last Name	Academic Institution	Degree Program	Expected Graduation Date
1	Keith	Leonard	DSU	M.S.	17-May
2	Valin	Booker	HU	B.S.	17-May
3	Kenya	Bynes	HU	B.S.	17-May
4	Rebecca	Castro	HU	B.S.	16-May
5	Michaela	McFarland	HU	B.S.	17-May
6	Monica	Robles	HU	B.S.	17-May
7	Justin	Shaifer	HU	B.S.	16-May
8	Nichelle	Smith	HU	B.S.	16-May
9	Jasmine	Pinto	SSU	BS	17-May
10	Chelsea	Parrish	SSU	MS	16-Dec
11	Chelsea	Richardson	UMES	M.S.	May-17
12	Jorge	Rodriguez	UMES	Ph.D.	May-17
13	Maryce	Alexander*	UMCES-IMET	Ph.D.	2020
14	Erica	Dasi*	UMCES-IMET	Ph.D.	2020
15	Rachel	Banks*	UMCES-IMET	Ph.D.	2020

*For entry in Fall 2015

Objective 1.2: Increase retention and degree completion rates for students in marine and fisheries sciences programs: Direct financial support is one key element in retaining students. But the LMRCSC also engages in instructional and student support practices that have been shown to increase retention rates. LMRCSC students are also highly involved in peer networks, on campus and across the nation, including regular involvement in national meetings of the American Fisheries Society.

Activities and Accomplishments: Students who received financial support from September 1, 2014 to February 28, 2015 are listed in Table 2. Those who graduated during this reporting period are presented in Table 3.

Table 2. Students who received direct support during the funding period (March 1, 2014 to Aug. 31, 2014).

	First Name	Last Name	Academic Institution	Degree	Type	Amount
1	Kevin	Coles ^u	DSU	B.S.	Stipend/registration	\$2,946.94
2	Chardonay	Elliott ^u	DSU	B.S.	Stipend/tuition/travel	\$3,560.60
3	Andrew	Kluge	DSU	B.S.	Tuition/travel	\$3,481.25
4	Aicha	Toure ^u	DSU	B.S.	Tuition/travel	\$3,725.12
5	Hillary	Dean ^u	DSU	M.S.	Tuition/stipend/travel	\$10,847.52
6	Keith	Leonard	DSU	M.S.	Tuition/stipend	\$11,503.00
7	Nivette	Perez-Perez ^u	DSU	M.S.	Tuition/stipend/travel	\$14,132.12
8	Symone	Gyles ^u	HU	B.S.	Stipend/EPP Forum Travel	\$3,830.00
9	Valin	Booker ^u	HU	B.S.	Stipend	\$1,000.00
10	Kenya	Bynes ^u	HU	B.S.	Scholarship/EPP Travel	\$5,580.00

11	Rebecca	Castro ^u	HU	B.S	Scholarship	\$5,000.00
12	Michaella	McFarland	HU	B.S	Stipend	\$2,000.00
13	Monica	Robles ^u	HU	B.S	Stipend	\$2,000.00
14	Justin	Shaifer ^u	HU	B.S	Scholarship/EPP Travel	\$5,080.00
15	Nichelle	Smith ^u	HU	B.S	Stipend	\$3,750.00
16	Marisa	Tukpah ^u	HU	B.S	Stipend	\$3,750.00
17	Renita	Bostic ^u	HU	M.S.	EPP Forum Travel	\$500.00
18	Larry	Redd Jr ^u	HU	M.S.	Stipend/Tuition/EPP Forum travel	\$10,855.00
19	Jessica	Andrade ^u	OSU	M.S.	Stipend	\$12,000.00
20	Latreese	Denson ^u	OSU	M.S.	Tuition, stipend	\$22,000.00
21	Chante	Davis ^u	OSU	Ph.D.	Tuition, stipend	\$24,000.00
22	Marisa	Litz ^u	OSU	Ph.D.	GRTSP	\$22,000.00
23	Smit	Vasquez Cabellero ^u	OSU	Ph.D.	Tuition, stipend	\$24,000.00
24	Chiara	Pacini ^u	RSMAS	M.S.	stipend	\$4030.00
25	Karlissa	Calwood ^u	RSMAS	Ph.D.	stipend/travel	\$14,568.00
26	Dominique	Lazarre ^u	RSMAS	Ph.D.	stipendnd/travel	\$15,000.00
27	Rolando	Santos ^u	RSMAS	Ph.D.	Stipend/tuition	\$10,110.00
28	Shaneese	Mackey ^u	SSU	B.S.	Travel	\$504.66
29	Darius	Sanford ^u	SSU	B.S.	Travel	\$897.32
30	Emma	Schultz	SSU	B.S.	Travel/Stipend	\$11,885.86
31	Jennifer	Gut	SSU	M.S.	Travel	\$504.66
32	Keya	Jackson ^u	SSU	M.S.	Travel	\$504.66
33	Chelsea	Parrish	SSU	M.S.	Travel	\$504.66
34	Tiffany	Ward ^u	SSU	M.S.	Travel	\$504.66
35	Erica	Dasi ^u	UMCES- IMET	B.S.	Salary, Fringe, Supplies, BAS Lab, Travel	\$12,603.44
36	Rachel	Banks ^u	UMCES- IMET	B.S.	Salary, Fringe, Supplies, BAS Lab, Travel	\$1,768.00
37	Shanai	Brown ^u	UMCES- IMET	B.S.	Salary, Fringe, Supplies, BAS Lab, Travel	\$1,573.25
38	Kevia	DeLorme ^u	UMCES- IMET	B.S.	Salary, Fringe, Supplies, BAS Lab, Travel	1,768.00
39	Taylor	Kline ^u	UMCES- IMET	B.S.	Salary, Fringe, Supplies, BAS Lab, Travel	\$32.00
40	Jonathan	Peake	UMCES- IMET	B.S.	Salary, Fringe, Supplies, BAS Lab, Travel	\$62.50
41	Shadaesha	Green ^u	UMCES- IMET	M.S.	Travel	\$1,746.50
42	Jeanette	Davis ^u	UMCES- IMET	Ph. D	Salary, Fringe, tuition, Supplies, BAS Lab, Travel	\$5,436.97
43	Kathleen	Gillespie ^u	UMCES- IMET	Ph. D	Salary, Fringe, Supplies, BAS Lab, Travel	\$14,664.61
44	Shadaesha	Green ^u	UMCES- IMET	Ph. D	Salary, Fringe, tuition, Supplies, BAS Lab, Travel	\$18,214.31
45	Ammar	Hanif ^u	UMCES- IMET	Ph. D	Salary, Fringe, tuition, Supplies, BAS Lab, Travel	\$12,802.72
46	David	Marsan ^u	UMCES- IMET	Ph. D	Salary, Fringe, tuition, Supplies, BAS Lab, Travel	\$23,913.59

47	Jan	Vicente ^u	UMCES- IMET	Ph. D	Salary, Fringe, Supplies, BAS Lab, Travel	\$533.01
48	David	Billups ^u	UMCES- IMET	B.S.	Salary, Fringe, Supplies, BAS Lab, Travel	\$32.00
49	Manuel	Olmeda ^u	UMCES- IMET	B.S.	Salary, Fringe, Supplies, BAS Lab, Travel	\$1,768.00
50	John	McCants ^u	UMES	B.A.	Salary	\$2,278.00
51	Esther	Akinsoyinou ^u	UMES	B.S.	Salary	\$3,400.00
52	Consuelo	Barton ^u	UMES	B.S.	Salary	\$1,000.00
53	Reneice	Buchanan ^u	UMES	B.S.	Travel	\$50.00
54	Kenya	Bynes ^u	UMES	B.S.	Travel	\$85.00
55	Noman	Choudry	UMES	B.S.	Salary	\$335.75
56	Spencer	Davis ^u	UMES	B.S.	Salary and Tuition	\$4,879.50
57	Austin	Durham ^u	UMES	B.S.	Travel	\$619.00
58	Wyntin	Goodman ^u	UMES	B.S.	Salary and Tuition	\$6,579.00
59	Cloee	Grainger ^u	UMES	B.S.	Tuition	\$3,643.50
60	Mario	McGhee ^u	UMES	B.S.	Salary and Tuition	\$3,949.50
61	Alexa	McLeod ^u	UMES	B.S.	Tuition	\$1,979.00
62	Ariana	Uwaibi ^u	UMES	B.S.	Tuition	\$1,979.00
63	Marcus	Hughes ^u	UMES	B.S.	Travel	\$1,874.50
64	Veronica	Pereira ^u	UMES	B.S.	Travel	\$287.84
65	Chelsea	Richardson ^u	UMES	B.S.	Salary and Tuition	\$7,451.50
66	Abdalfaz	Ahemedaltayb	UMES	M.S.	Stipend	\$8,294.94
67	Derik	Burton ^u	UMES	M.S.	Stipend, Tuition and Travel	\$12,718.23
68	Wilmelie	Cruz-Marrero ^u	UMES	M.S.	Stipend, Tuition and Travel	\$13,979.37
69	Mason	King	UMES	M.S.	Salary and Travel	\$970.00
70	Hector	Malagon ^u	UMES	M.S.	Stipend	\$10,200.13
71	Audy	Peoples ^u	UMES	M.S.	Stipend, Tuition and Travel	\$12,388.95
72	Jorge	Rodriguez ^u	UMES	M.S.	Stipend	\$861.22
73	Justin	Wilson ^u	UMES	M.S.	Stipend, Tuition and Travel	\$12,438.94
74	Susan	Kelly	UMES	P.S.M	Travel	\$444.74
75	Daniel	Sweeney	UMES	P.S.M	Tuition	\$1,874.00
76	Laura	Almodovar- Acevedo ^u	UMES	Ph.D.	Stipend, Tuition and Travel	\$12,101.76
77	Tedra	Booker ^u	UMES	Ph.D.	Stipend	\$5,995.28
78	Stephanie	Martinez-Rivera ^u	UMES	Ph.D.	Stipend, Tuition and Travel	\$13,759.86
79	Cara	Schweitzer ^u	UMES	Ph.D.	Stipend, Tuition and Travel	\$11,786.60
80	Tiana	Jones ^u	UMES	B.S.	Salary and Tuition	\$4,833.50
81	Anjene	Parker ^u	UMES	B.S.	Tuition	\$811.00

^uUnderrepresented minority

Table 3. Students who graduated from Sept. 1, 2014 to Feb. 28, 2015.

	First Name	Last Name	Academic Institution	Degree	Date	Post-Graduation Information
1	Kevin	Coles ^u	DSU	B.S.	Dec. 14	

2	Matt	Ramirez ^u	OSU	M.S.	15-Dec	Ph.D. at OSU
3	Austin	Flinn ^u	RSMAS	M.P.S.	14-Dec	Research Assistant. NOAA
4	Rolando	Santos ^u	RSMAS	Ph.D.	14-Dec	Research Associate. Florida International University
5	Isaac	McClellan ^u	SSU	B.S.	14-Dec	Looking for graduate program
6	Brigette	Brinton	SSU	M.S.	14-Dec	Teaching at AASU, SSU
7	Courtney	Pegus ^u	SSU	M.S.	14-Dec	In Ph.D. program at Univ. Washington
8	Chelsea	Richardson ^u	UMES	B.S.	Dec-14	MEES Master's Program at UMES
9	Jeanette	Davis ^u	UMCES	Ph.D.	Dec.14	Knauss Fellowship Intern

^uUnderrepresented minority

Retention and degree completion rates are higher in academic programs that engage students in collaborative research with faculty members. Projects funded by LMRCSC involve both undergraduate and graduate students as active research participants. Students work as research collaborators with faculty and scientists at NOAA facilities. During the academic year, students participate in research projects at their home institutions. Table 4 shows six students who worked at NOAA labs or LMRCSC partner institution labs.

Table 4. Students who worked at NOAA labs or LMRCSC partner institution labs (Sept. 1, 2014 to Feb. 28, 2015)

	First Name	Last Name	Institution	Degree	Facility	Time Period	Activity or Title of Research Project
1	Nivette	Perez-Perez	DSU	M.S.	NMFS Sandy Hook	Monthly Project	Deep Sea Red Crab
2	Hillary	Dean	DSU	M.S.	NMFS Panama City	Sept.14-Feb.15	Sturgeon research/boat time
3	Marisa	Litz	OSU	Ph.D.	NOAA NWFSC	Fall 2014	Development of a bioenergetics model to evaluate the effects of climate change on juvenile Chinook salmon growth
4	Jessica	Andrade	OSU	M.S.	NOAA AFSC	Fall 14 to Winter 15	Flatfish behavioral responses to predatory threat under elevated carbon dioxide concentrations
5	Derek	Burton	UMES	M.S.	NOAA Oxford Lab	Sept. 1, 2014 – Feb. 28, 2015	RNA/DNA Ratios as Indicators of Ecosystem Health; metrics to determine the impact of land use on fish habitat
6	Audy	Peoples	UMES	M.S.	NOAA Oxford Lab	Sept. 1, 2014 – Feb. 28, 2015	Analysis of Stranding Demographics and Contaminants in Marine animals from Coastal Maryland and the Chesapeake Bay

Sixty-two (62) undergraduate and graduate students, who did not receive direct support from the LMRCSC, benefited from the programs offered by the Center and/or infrastructure established by the LMRCSC during this reporting period. Names of the students are listed in Table 5.

Table 5. Students who did not receive direct support but benefited from the program offered or infrastructure established by the LMRCS.

	First Name	Last Name	Institution	Degree
1	Alex	DiJohnson	DSU	M.S.
2	Matthew	Stone	DSU	M.S.
3	Malik	Breland ^u	HU	B.S.
4	Krista	Kraskura	HU	B.S.
5	Joshua	Miller	HU	B.S.
6	George	Wenn ^u	HU	B.S.
7	Austin	Flinn	RSMAS	M.P.S.
8	Michael	Blankenship	SSU	B.S.
9	Isaac	McClellan	SSU	B.S.
10	Mone't	Murphy	SSU	B.S.
11	Sanya	Compton	SSU	M.S.
12	Courtney	Pegus	SSU	M.S.
13	Crystal	Smith	SSU	M.S.
14	Jessica	Thompson	SSU	M.S.
15	Shanai	Brown ^u	UMCES	B.S.
16	Danielle	Brittingham	UMES	B.S.
17	Tyler	Bullock ^u	UMES	B.S.
18	Danielle	Burbank ^u	UMES	B.S.
19	Isaac	Carter ^u	UMES	B.S.
20	Malek	Dennard ^u	UMES	B.S.
21	Austin	Durham ^u	UMES	B.S.
22	August	Fuller	UMES	B.S.
23	Najja	Gay ^u	UMES	B.S.
24	Chareema	Harris ^u	UMES	B.S.
25	Shurell	Hester ^u	UMES	B.S.
26	Evantae	Hunter ^u	UMES	B.S.
27	Nathaniel	Jones ^u	UMES	B.S.
28	Mario	McGhee ^u	UMES	B.S.
29	Natan-El	Mensah-Sowah ^u	UMES	B.S.
30	Christian	Mobley ^u	UMES	B.S.
31	Samantha	Pearl ^u	UMES	B.S.
32	Veronica	Pereira ^u	UMES	B.S.
33	Keilon	Robinson Jr. ^u	UMES	B.S.
34	Alexis	Sturm	UMES	B.S.
35	Jermill	Thompson-James ^u	UMES	B.S.
36	Kendra	Wood ^u	UMES	B.S.
37	Addis	Bedane ^u	UMES	B.S.

38	Dwight	Collins-Nixon ^u	UMES	B.S.
39	Cloee	Grainger ^u	UMES	B.S.
40	Samir	Karim ^u	UMES	B.S.
41	Mathew	Maxwell ^u	UMES	B.S.
42	Iheoma B.	Ngoka ^u	UMES	B.S.
43	Gaelle	Njampou ^u	UMES	B.S.
44	Kingsley	Nkeng ^u	UMES	B.S.
45	Chelsea	Richardson ^u	UMES	B.S.
46	Kennard	Roy ^u	UMES	B.S.
47	Mohammed	Saleh ^u	UMES	B.S.
48	Abdalfaziz	Ahemedaltayb	UMES	M.S.
49	Dana	McNair ^u	UMES	M.S.
50	Origoheye	Omatseye ^u	UMES	M.S.
51	Rebecca	Peters	UMES	M.S.
52	Detbra	Rosales ^u	UMES	M.S.
53	Baruch	Volkis	UMES	M.S.
54	Blessing	Edje ^u	UMES	Ph.D.
55	Bernadette	Ezeabiakwa ^u	UMES	Ph.D.
56	Dev	Gurung	UMES	Ph.D.
57	Kristen	Lycett ^u	UMES	Ph.D.
58	Ejiroghene	Mayor ^u	UMES	Ph.D.
59	Efeturi	Oghenekaro ^u	UMES	Ph.D.
60	Ozeum	Oseji ^u	UMES	Ph.D.
61	Wyntin	Goodman ^u	UMES	B.S.
62	Ijeoma F.	Ngoka ^u	UMES	B.S.

^uUnderrepresented Minority

Examples of How Students Benefitted from the LMRCSC: Research advisors of some of the students are also LMRCSC supported faculty. LMRCSC supported faculty are involved in teaching and advising PSM students. Some of the students also use instrumentation, software, and supplies as well as facilities provided by the LMRCSC, or participate in workshops paid for and organized by the LMRCSC.

Career Development Assistance: Eight students participated in nine different career development activities during this period. Details of the activities are listed in Table 6.

Table 6: Participation in career development activities including workshops and other training opportunities

Name	workshop
LaTreese Denson	Thesis writing workshop
Jessica Andrade	Led graduate student seminar on fish behavior
LaTreese Denson	Stock assessment short course (OSU and UW)
Ejiroghene Mayor	Primer v6 professional workshop for Multivariate Data Analysis from Sept 15-Sept 19, 2014 at the Weedon Island Preserve in St. Petersburg Florida.
Baruch Volkis	Microscopic and Imaging Facility, Medical School of George Washington University. Performing measurements of coated samples by microscope Zeiss LSM 510 equipped with software Zen 2009.

Oseum Oseji	Primer v6 professional workshop for Multivariate Data Analysis from Sept 15-Sept 19, 2014 at the Weedon Island Preserve in St. Petersburg Florida.
Hector Malagon	Primer v6 professional workshop for Multivariate Data Analysis from Sept 15-Sept 19, 2014 at the Weedon Island Preserve in St. Petersburg Florida.
Wilmelie Cruz	Fish and Wildlife finding a job in US gov. Workshop
Rehab A Elfadul	Graduate Assistant Workshop

Build strong peer networks through student collaboration: Students at HU participated in a peer mentoring workshop at the VA Aquarium as part of the annual recruitment and retention student retreat. LMRCS students attended and presented at NOAA-EPP Forum, held at UMES, and the 2nd International Symposium on Sponge Microbiology held at IMET, Baltimore, Maryland; MEES Colloquium, Chesapeake Biological Lab Solomons, MD; Association for the Sciences of Limnology and Oceanography Aquatic Sciences Meeting, Grenada, Spain; and PROMISE-AGEP Research Symposium & Professional Development Conference, College Park, MD.

Continually assess student performance and progress toward degree completion

- **LMRCSC Exit Evaluation:** No exit evaluations were received during this period.
- **LMRCSC Cruise Evaluation:** No cruise took place during this period.
- **Evaluation Forms for interns and mentors:** No internship evaluation forms were received during this period.

Objective 1.3: Assess the value-added outcomes of degree programs in marine and fisheries sciences at the partner institutions: Involvement in scientific research, participation in internships at NOAA facilities, and engagement with the “essential curriculum” for marine and fisheries sciences have prepared LMRCS graduates to enter the scientific and environmental management workforce. Participation in LMRCS activities adds significant value to students’ educational experiences, and prepares them to make important contributions to the scientific profession.

Activities and Accomplishments: The following are examples of what the Center did during the current reporting period to link students to professional networks and employment opportunities in marine and fisheries sciences. Students attended various scientific meetings including NOAA EPP Forum and ASLO. Their presentations are listed in Appendix IV.

Monitoring student progress: LMRCS utilizes the online Student Tracker database as prescribed by NOAA for tracking student progress and outcomes. The Center maintains a series of online evaluation forms for the LMRCS program overall, which graduating students are requested to submit, and for specific recurring activities such as the LMRCS research cruise. We are also in the process of implementing the Student Development Plan, which students complete in collaboration with their advisors each semester in order to help track their progress.

Post Graduate Tracking: Efforts are on-going to provide up-to-date graduate tracking information.

Scholarship: The following students received awards or scholarships during this reporting period:

- Chante Davis (OSU): Frances Dancy Hicks Award; NOAA EPP GRTSP
- Symone Gyles (HU): NOAA EPP Scholarship
- Justin Shaifer (HU): NOAA EPP Scholarship
- Keya Jackson (SSU): GK12 Fellowship

Objective 1.4: Link students to professional networks and employment opportunities in marine and fisheries sciences

Activities and Accomplishments: The following are examples of what the Center did during the current reporting period to link students to professional networks and employment opportunities in marine and fisheries sciences.

- Students and faculty from all of the partner institutions participated in the NOAA EPP Science and Education Forum held in Oct. 2014 at UMES.

- Emma Schultz was funded to attend the Southeast Regional Sea Turtle Meeting on Jekyll Island, February 4-7, 2015.
- Three faculty and eight students from SSU attended the Southern Division meeting of AFS in Savannah, Jan 29-Feb 1, 2015.
- Students were encouraged to become members of professional organizations including the National Shellfisheries Association, American Fisheries Society, American Indian Science and Engineering Society, American Society of Agronomy, and Association for the Sciences of Limnology and Oceanography.

Other Activities

- J. Davis: Scholarship Ministry at Empowerment Temple Methodist Church, Wilmington, DE.
- J. Davis: Raise funds to assist students in the city of Baltimore with college tuition and assist with SAT prep and the college application process, September 2014 – present.
- J. Davis: Help raise awareness about Marine Sciences through tours and presenting graduate research and experiences to local high school students, September 2014.
- J. Davis: Assisted in “Ask a scientist” events during Star Spangle Banner Spectacular celebration, Baltimore, MD, September 2014.
- K. Gillespie: Assisted in “Ask a scientist” outreach event during Star Spangle Banner Spectacular celebration, Baltimore, MD.
- K. Gillespie: Speaker to high school students regarding graduate studies/science via SciTech program.
- A. Hanif: Working with Towson State University Scitech program teachers and administrators on refreshing the field guide used for identifying organisms on biofilm disks used in their Baltimore Inner Harbor biofilm education module.
- J. Vicente: assisted in “Ask a Scientist” outreach event during Star Spangle Banner Spectacular celebration, Baltimore, MD. Helped promote research projects from the Institute of Marine and Environmental Technology to the public during the 200 year celebration of the Star Spangle Banner.

Special achievement

- Jeanette Davis successfully defended her Ph.D. dissertation and will graduate in Spring 2015. Ms. Davis was selected as a Knauss Fellow and has started her Fellowship at NOAA to work on Hawaiian Sea Turtle project.
- Shadaesha Green: Awarded Outstanding Graduate Student Poster Presentation, February 2015, PROMISE-AGEP Research Symposium & Professional Development Conference
- Shanai Brown (IMET intern from Morgan State Univ.): awarded first prize undergraduate oral presentation in Healthy Oceans at NOAA-EPP Forum.
- David Marsan: awarded first prize graduate poster presentation in Healthy Oceans at NOAA-EPP Forum

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

Activities and Accomplishments:

Center Faculty and Staff Positions:

- Dr. Horodysky (HU), Assistant Professor, is now on tenure track in Fish Physiology.
- Dr. Aurea Rodrigues (HU) was hired as a Research Assistant Professor in Zooplankton Genetics.
- Dr. Indu Sharma (HU) has become an integral part of our LMRCSC by advising students and building collaborations with B. Stevens, S. Chung, R. Jagus, and the VT Aquaculture facility on the emerging collaborative network between institutions on the study of deep sea red crabs.
- Dr. Yeong Chi (UMES) was hired as Associate Professor of Resource Economics

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

Activities and Accomplishments: Leveraging significant intellectual capital at partner institutions to advance educational programs and inform curriculum development:

Through the LMRCS C collaboration, students have access to a broader range of curricular and research experiences. They have opportunities to take courses and engage in research with faculty at other LMRCS C partner institutions, and with NOAA scientists who serve as adjunct faculty, thesis or dissertation committee members, and professional mentors.

CSC Directors had several conference calls during the reporting period during which potential collaborative research and educational programs were discussed and developed. To ensure that students and faculty are informed about current research within LMRCS C, the Center uses Adobe Connect to make its Seminar Series available to students and faculty at all partners via the web. Members of UMES and UMCES-IMET faculty have participated in the University of Maryland System-wide effort to update/improve the MEES Graduate Program and curriculum development. IMET faculty under the leadership of Dr. Sook Chung have developed a 4-credit MEES course entitled Marine Biotechnology.

Ensuring that curricula delivered at each partner institution are highly coordinated with the “essential curriculum” for marine and fisheries sciences, as identified by NOAA-NMFS: Extensive collaboration between LMRCS C faculty and NOAA scientists ensures that curriculum development is informed by the current challenges and emergent needs in the marine and fisheries sciences. This level of collaboration extends to having NOAA scientists teach courses with LMRCS C faculty, and serve on dissertation committees. Internship experiences at NOAA laboratories and field research also ensure that students participate in a curriculum that is highly aligned with the needs of NOAA-NMFS.

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

Activities and Accomplishments: The Virtual Campus was used to provide courses to students through videoconferencing and in an online format, hold student committee meetings, Executive Committee meetings, and thesis and dissertation defenses. Eleven (11) courses were offered in Fall 2014, an intensive Ecosystem Modeling course was offered in winter 2015, and 6 courses are currently being offered via IVN, Go-to-Meeting, Adobe-Connect or Blackboard.

University of Maryland Interactive Video Network (IVN) courses:

Table 7a. Courses offered at the LMRCS C during Fall Semester 2014

Course number	Course Title	Instructor	Students (online)
MEES 608L	Marine Microbial Ecology	Chen, F and Hill, RT - IVN Course	Detbra Rosales (UMES), Sabrina Klick (UMES)
FW 599/699	Numerical Methods In Fisheries and Natural Resources	Andre Punt and Brandon Chasco	LaTree Denson
MEES 611	Estuarine Systems Ecology	Testa, J, Kemp, W – IVN Course	Kristen Lycett (UMES), Becca Peters (UMES), Cara Schweitzer (UMES), Long Jiang (UMES)
MEES 621	Biological Oceanography	Hood, R., O’Neil, J. and Plough, L. – IVN Course	Jorge Rodriguez (UMES), Blessing Onajite Edje (UMES)
MEES 610	Land Margin Interactions	Harris, Castro, and Fisher	Mason King (UMES)
MEES 608D	Seminar in Scientific Writing and Communication	Dr. Elizabeth North	Laura Almodóvar-Acevedo (UMES), Wilmelie Cruz-Marrero (UMES), Stephanie Martinez (UMES), Justin Wilson (UMES), Mason King

			(UMES), Detbra Rosales (UMES), Sabrina Klick (UMES), Miaohua Mao (UMES), Long Jiang (UMES)
MEES 608E	Spatial Ecology	Hongsheng B and Bailey, H- IVN Course	Rebecca Peters (UMES)
MEES 698Y	Science for Environmental Management	Dennison, B and Boesch, D – IVN Course	Rebecca Peters (UMES), Sabrina Klick (UMES), Detbra Rosales (UMES), Cara Schweitzer (UMES)
MEES 712	Advanced Population Dynamics and Stock Assessments	Wilberg, M – IVN course	Rebecca Peters (UMES), Wilmelie Marrero-Cruz(UMES), Laura Almodovar-Acevedo (UMES), Stephanie Martinez-Rivera (UMES), Justin Wilson (UMES)
MEES 682	Fisheries Science and Management	Secor, David & Wilberg, Michael-IVN	Wilmelie Cruz(UMES), Stephanie Maritnez(UMES), Laura Almodovar(UMES), Justin Wilson(UMES)
MEES 606	Cell and Molecular Biology For Environmental Scientists	Place, A.R. & Jagus, R.	Sabrina Klick (UMES), Robert Sabo (UMCES_AL)

Table 7b. Course Offered at the LMRCS during Winter Semester 2015

Course number	Course Title	Instructor	Students (Offered at UMES)
MEES 688S	Ecosystem Modeling for Fisheries: Intro to Ecopath with Ecosim	Howard Townsend	Nivette Perez-Perez (DSU), Keith Leonard (DSU), Alex DiJohnson (DSU), Matthew Stone (DSU), Rebecca Peters (UMES)

Table 7c. Course Offered at the LMRCS during Spring Semester 2015

Course number	Course Title	Instructor	Students (online)
MEES 642	Fishery Population Dynamics	Chigbu, P. and Alade L	Emma Schultz (SSU), Sean Yeckley(SSU), Nicholas Castellane (SSU), Brigitte Brinton (SSU), Daniel Sweeney (UMES), Xinyi Kang (UMES), Miaohua Mao (UMES)
MEES 712	Advance population dynamics & assessment	Wilberg, Michael	Wilmelie Cruz, Laura Almodovar-Acevedo, Stephanie Martinez-Rivera, Justin Wilson, Rebecca Peters
MEES 611	Estuarine Systems Ecology	Testa, J and Kemp, M	Rebecca Peters (UMES), Kristen Lycett (UMES), Long Jiang (UMES), Cara Schweitzer (UMES)
MEES 698Y	Science for Environmental Management	Dennison, B and Boesch, D – IVN Course	Rebecca Peters (UMES), Sabrina Klick (UMES), Detbra Rosales (UMES), Cara Schweitzer (UMES)
MEES 688	Bayesian Statistics for Marine Scientists	Elizabeth Babcock	Michele Traver (UMES)
MEES 498T	Marine and Environmental Biotechnology	Chung, J.S. course organizer, IMET faculty	Sabrina Klick (UMES), Detbra Rosales (UMES)

Seminars: Seminars presented to students and faculty are presented in Table 8.

Table 8. LMRCSC Seminar Series (Sep. 1, 2014 to Feb. 28, 2015)

Date	Presenter	Title
21-Jan-15	Drs. Carol Pride, Amanda Kaltenberg, Matthew Gilligan	Faculty Research
28-Jan-15	Drs. Sue Ebanks, Carla Curran, Chris Hintz	Faculty Research
11-Feb-15	Nicole Abdul (Ph.D candidate)	Younger Dryas Sea Level and Meltwater Pulse 1B recorded in Barbados Reef-Crest Coral <i>Acropora palmata</i>
18-Feb-15	Dr. Xaymarra Serrano (LMRCSC Alumna)	Connectivity in Caribbean reef corals: Identifying potential sources of recruitment following disturbance

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

Engage undergraduate and graduate students in cutting-edge research experiences in marine and fisheries sciences, including learning experiences at NOAA facilities with NOAA mentors: One of the defining characteristics of the student academic experience at LMRCSC is extensive participation in scientific research. Undergraduate and graduate students work alongside faculty as collaborators on a range of research projects related to NOAA-NMFS priorities. Many of the projects involve student research at NOAA facilities under the guidance of NOAA mentors. Six (6) students worked at NOAA labs other agencies during this reporting period (Table 4).

Research Goal 3: Develop an exemplary capacity for scientific collaborations among partner institutions in the fields of marine and fisheries sciences -

The Center's research is grouped into the four key thematic areas, associated with NOAA's research priorities. This research agenda is implemented collaboratively among faculty and students across the seven partnering institutions. LMRCSC research undergoes a rigorous scientific review process. Each year, LMRCSC convenes a Technical Advisory Board (TAB) to guide the Center in its research agenda. The TAB reviews and provides recommendations on the Center's research plan, and ensures that LMRCSC research is of high quality and aligned with NOAA-NMFS research priorities. Each year, LMRCSC issues a Request for Proposal (RFP) within the Center institutions, which seeks proposals for research projects that will be funded by the Center. Proposals are evaluated by the TAB, based on scientific merit, congruence with NOAA-NMFS research priorities, and level of involvement of students in the proposed research. An average of 12 research projects is selected for funding each year.

Activities and Accomplishments:

12 projects were funded in 2014-2015 and are currently being conducted (Table 9).

Table 9. Funded TAB Projects for the Period of 2014 - 2015

Project No.	PI Name	Title	Theme
15-01	Michael Banks (OSU)	Microsatellite Markers Isolation (EST-SSR's) for Association Tests of Reproductive Phenotypes (GnRH, FSH and LH) in the Context of Environmental Variability for Chinook Salmon.	AC
15-02	Jennifer Güt (SSU)	Potential Impacts of the Savannah Harbor Expansion Project (SHEP) on the temporal and spatial patterns of fish assemblages near the mouth of the Savannah River, Georgia	EFH
15-03	Ammar Hanif (UMCES/IMET)	Analyzing diets of Atlantic menhaden using metabarcoding	EFH
15-04	Andrij Horodysky (HU)	Comparison of NOAA Montlake meal and Otohime feed performance in aquacultured pompano: feed ration, feed frequency, feed conversion ratio, and feed efficiency.	AC
15-05	Andrea Johnson (UMES)	RNA-DNA Ratios as Indicators of Ecosystem Health; metrics to determine the impact of land-use on fish habitat	EFH

15-06	Andrea Johnson (UMES)	Analysis of Stranding Demographics and Contaminants in Marine Mammals from Coastal Maryland and the Chesapeake Bay	QF
15-07	Jessica Miller (OSU)	Ocean acidification effects on ecology of juvenile northern rock sole	EFH
15-08	Jolvan Morris (Savannah State U.)	Place Attachment and Traditional Ecological Knowledge in the Sea Islands: A Case Study of Endangered Culture	FSE
15-09	Eric Schott (UMCES/IMET)	Searching the coastal bay food web for reservoirs of a virus lethal to blue crab <i>Callinectes sapidus</i>	EFH
15-10	Bradley Stevens (UMES)	Improving management of deep-sea red crabs, <i>Chaceon quinqueedens</i> , Year 2: Reproductive biology, maturity, and age estimation	QF
15-11	Bradley Stevens (UMES)	Augmenting the Black Sea Bass, <i>Centropristis striata</i> , Stock Assessment, Year 3: Assessing the importance of fixed and fluid estuarine habitats	EFH
15-12	Leigh Torres (OSU)	Integrating habitat, prey and predators over space and time to assess distributional responses to environmental variability and climate change: California sea lions and their pelagic prey off Oregon and Washington	QF

LMRCSC TAB Project Summaries

Summaries of the LMRCSC TAB funded projects are presented below. More detailed reports of the projects and results to date are presented in Appendix V.

Project Year: 2015

Project #: 15-01

Project Title: Microsatellite Markers Isolation (EST-SSR's) for Association Tests of Reproductive Phenotypes (GnRH, FSH and LH) in the Context of Environmental Variability for Chinook Salmon.

PI Name: Michael Banks (OSU)

NOAA Collaborator: Peter Lawson (NOAA/NWFSC)

Other Collaborators: Andrij Horodysky (Hampton Univ)

Research Students: Chante Davis (PhD Student, OSU)

Thematic Area: Quantitative Fisheries

Funding: \$49,094

Start Date: September 2014

End Date: August 2015

Abstract:

Chinook salmon is a culturally important and economically valuable fish. These anadromous and semelparous fish express diverse life histories that are characterized by the season of their return migration (called a "run") to spawning habitat. Prior research identified four spatially distinct subpopulations: 'Drift Creek', 'Spring', 'Fall', and 'Summer'. We plan to better resolve temporal population substructure by developing genetic markers that are linked to the regulation of gamete maturation. Traditionally, Spring run Chinook salmon migrate farther upriver with gonads that are less mature than the later Fall run. The timing of gamete maturation is synchronous with the arrival of fish on spawning habitat. The main hormone responsible for gamete maturation is Gonadotropin-releasing Hormone (GnRH). Our development of functional candidate markers that are associated with GnRH regulation may resolve temporal population substructure among the spatially separated subpopulations and enable future application for identifying environmental variables that contribute to population genetic structure.

Project #: 15-02**Project Title: Potential Impacts of the Savannah Harbor Expansion Project (SHEP) on the temporal and spatial patterns of fish assemblages near the mouth of the Savannah River**

PI Name: Jennifer Güt (SSU)
NOAA Collaborator: John Manderson (NOAA/NEFSC)
Other Collaborators: Andrea Johnson (UMES)
Research Students: Jennifer Güt (MS Student, Savannah State U.)
Thematic Area: Essential Fish Habitat Funding: \$51,863
Start Date: September 2014 End Date: August 2015

Abstract:

Over half of the commercial Atlantic catches are species that are dependent upon estuaries at some point during their life cycles. The recently approved Savannah Harbor Expansion Project will result in the deepening of the Savannah River shipping channel. Outcomes may be increased salt water intrusion and lower dissolved oxygen levels, which could negatively impact fishes of commercial and recreational importance that utilize the Savannah River estuary. The objectives of this proposal are to: 1) Determine the temporal and spatial patterns of fish assemblages near the mouth of the Savannah River before and after the deepening; 2) Determine fish health through gonadal histology; and 3) Publish a K-12 activity geared toward the effects of anthropogenic impacts on the marine environment.

Project #: 15-03**Project Title: Analyzing diets of Atlantic menhaden using metabarcoding**

PI Name: Ammar Hanif (UMCES/IMET)
NOAA Collaborator: Kevin Friedland (NOAA/NEFSC)
Other Collaborators: Al Place (UMCES/IMET); Bradley Stevens (UMES)
Research Students: Ammar Hanif (PhD Student, UMCES/IMET)
Thematic Area: Essential Fish Habitat Funding: \$43,628
Start Date: September 2014 End Date: August 2015

Abstract:

Atlantic menhaden is a key forage species that serves as a trophic link between the plankton and predator fishes and birds. Identification of food organisms is difficult because the prey organisms are small and fairly easily digested such that traditional microscopic identification of stomach contents is somewhat limited potentially excluding insights into the predator-prey interactions of these forage fishes. As a result the understanding of larger scale processes such as food web interactions and energy flow through an ecosystem can be biased. This project is to develop and verify molecular techniques, based on cox1 DNA, as a tool to identify species in stomach contents of these fish and to compare them with those found in plankton. Existing molecular databases (National Center for Biotechnology Information and Barcode of Life) will be utilized for identification of gut and plankton species. Identification by barcoding will also be verified by traditional microscopic methods.

Project #: 15-04**Project Title: Comparison of NOAA Montlake meal and Otohime feed performance in aquacultured pompano: feed ration, feed frequency, feed conversion ratio, and feed efficiency.**

PI Name: Andrij Horodysky (Hampton Univ)
NOAA Collaborator: Ronald Johnson (NOAA/NWFSC)
Other Collaborators: Deidre Gibson (Hampton Univ); Michael Schwarz (VA Tech)
Research Students: Larry Redd, Jr. (MS Student, Hampton U.)
Thematic Area: Aquaculture Funding: \$48,759
Start Date: September 2014 End Date: August 2015

Abstract:

As the demand for Florida pompano continue to increase aquaculture practices must be refined to optimize growth to satisfy a growing market. This project investigated the gastric evacuation of aquacultured juvenile Florida pompano fed three different diets at three temperatures to direct production of young life stages. Juvenile pompano were fed diets of frozen mysid shrimp, NOAA Montlake meal, and Otohime EP2 fish pellets at 20°C, 25°C, and 30°C. During the experiment, three fish were randomly sampled from the total population every 60 min and euthanized in MS-222 solution. Fish were then weighed (g), measured (SL), and frozen immediately for a period of 24-48h prior to dissections. The stomach and its contents were then emptied, patted dry, and weighed. A pilot gastric evacuation study was conducted January 21, 2014 using commercial Otohime EP2 fish meal; results indicated gastric evacuation was completed with an 11-12h time period after initial feed. A follow-up pretrial study was then conducted testing commercial EP2 fish meal to frozen mysid on March 12, 2014. Results from the March study indicated that juvenile pompano fed the frozen mysid diet completed gastric evacuation within a 6h time period. However, juvenile pompano fed Otohime EP2 fish pellets completed gastric evacuation at the 10h time period. Due to different growth rates according to diet, pompano fed NOAA Montlake and Otohime EP2 pellets have had gastric evacuation experiments conducted at 30°C, 25°C, and 20°C thus far. Results have indicated that the Otohime EP2 diet leads to faster gastric evacuation of juvenile pompano at 30°C, 25°C, and 20°C; however, anecdotal observations indicated that pompano fed NOAA Montlake diet on a higher average body weight and size compared to pompano fed the Otohime EP2 diet. Results from this study indicate that 30°C is an optimum temperature for pompano evacuation independent of the diet tested. If funded, an additional growth study will be conducted to formally compare the growth rates of juvenile pompano fed Otohime EP2 compared to NOAA Montlake meal.

Project #: 15-05

Project Title: RNA-DNA Ratios as Indicators of Ecosystem Health; metrics to determine the impact of land-use on fish habitat

PI Name: Andrea Johnson (UMES)

NOAA Collaborator: Lonnie Gonsalves (NOAA/NOS-Oxford)

Other Collaborators: James Uphoff (MD-DNR)

Research Students: Derek Burton (MS Student, UMES)

Thematic Area: Essential Fish Habitat Funding: \$27,500

Start Date: September 2014 End Date: August 2015

Abstract:

Land development within the Chesapeake Bay watershed induces a suite of environmental stressors that negatively impact fish habitat and aquatic animal health. These effects degrade the ability of bay tributaries to serve as valuable nursery habitats for larval and juvenile fish which impacts fisheries production. The proposed study seeks to utilize RNA:DNA ratios as a bioindicator of larval and juvenile fish condition as a metric of fish habitat quality. The impact of variable land use patterns on fish habitat will be examined to further illustrate potential trade-offs between development on land and protection of habitats that provide a major socioeconomic and ecological contribution to coastal communities.

Project #: 15-06

Project Title: Analysis of Stranding Demographics and Contaminants in Marine Mammals from Coastal Maryland and the Chesapeake Bay

PI Name: Andrea Johnson (UMES)

NOAA Collaborator: Lonnie Gonsalves (NOAA/NOS-Oxford)

Other Collaborators: Cindy Driscoll (MD-DNR)

Research Students: Audy Peoples (MS Student, UMES)

Thematic Area: Quantitative Fisheries Funding: \$19,500

Start Date: September 2014 End Date: August 2015

Abstract:

Contaminants and disease pose a serious risk to marine mammal health. The Marine Mammal Stranding Network offers a unique opportunity to examine the marine mammal health through the necropsy of stranded animals. Scientists from the Maryland Department of Natural Resources have compiled a long-term data set monitoring contaminant levels, observed incidence of disease, and overall health. This study will provide a robust analysis of this long-term data set that will examine the extent of contaminant exposure in marine mammals, the demographics of strandings, and the role of contaminants and disease in exacerbating stranding frequency. This information will be used to further guide analysis of the likely health impacts of chemical contaminants on marine mammal health. The proposed study intends to further the understanding of how humans impact the health and sustainability of marine mammal populations.

Project #: 15-07

Project Title: Ocean acidification effects on ecology of juvenile northern rock sole

PI Name: Jessica Miller (OSU)

NOAA Collaborator: Thomas Hurst (NOAA/AFSC)

Other Collaborators: Carla Curran (SSU)

Research Students:

Thematic Area: Essential Fish Habitat Funding: \$37,469

Start Date: September 2014 End Date: August 2015

Abstract:

Research on the effects of ocean acidification (OA) on marine resource species has focused on the physiological effects on growth and development. However, recent research suggests that for many fish species, the primary action pathway of this aspect of climate change is the disruption of sensory and behavioral responses critical for survival. Specifically, several studies have found diminished behavioral sensitivity to predation cues at high CO₂. We will describe the responses of juvenile northern rock sole to visual and olfactory predation cues and determine the extent to which elevated CO₂ levels alter these intrinsic behavioral responses. This work will significantly improve our understanding of the diversity of impacts of OA to the productivity of critical marine fishery species.

Project #: 15-08

Project Title: Place Attachment and Traditional Ecological Knowledge in the Sea Islands: A Case Study of Endangered Culture

PI Name: Jolvan Morris (Savannah State Univ.)

NOAA Collaborator: Patricia Clay (NOAA/SERO)

Other Collaborators: Dionne Hoskins (SSU); Michael Jepson (NOAA/SERO)

Research Students:

Thematic Area: Fisheries Socio-Economics Funding: \$9,760

Start Date: September 2014 End Date: August 2015

Abstract:

For centuries, Gullah-Geechee communities along the coastal Sea Islands of South Carolina and Georgia maintained their own way of life through a thriving economy based on ecology without compromising the natural environment. Proximity to the sea fostered an early tradition of seafood harvesting, ranging from cast netting to small-scale commercial shrimp boats (Blount, 2007). Harris Neck is a Sea Island community of cultural and ecological significance in the region. While place attachment has been researched extensively in the social and behavioral sciences, little research has been conducted on historic communities of color. The objective of this project is to quantify place attachment and describe traditional ecological knowledge between Gullah-Geechee communities in the Sea Islands.

Project #: 15-09

Project Title: Searching the coastal bay food web for reservoirs of a virus lethal to blue crab *Callinectes sapidus*

PI Name: Eric Schott (UMCES/IMET)

NOAA Collaborator: Linda Stehlick (NOAA/NEFSC)

Other Collaborators: Gulnihal Ozbay (Delaware State Univ.); Joe Pitula (UMES)

Research Students: Kristen Lycett (PhD student, UMES); Matthew Stone (MS student, DESU).

Thematic Area: Essential Fish Habitat

Funding: \$40,086

Start Date: September 2014

End Date: August 2015

Abstract:

Blue crabs are a key link between benthic and pelagic food webs and support a commercial harvest of over \$180 million. Fluctuations in abundance are not well understood, and there is an increasing appreciation for the potential role of disease in natural mortality. The 2013 Chesapeake Bay Stock Assessment Committee listed scarce information on disease-related mortality as a critical data gap. Our studies have shown that prevalence of a virus lethal to blue crab (RLV) can be as high as 78%, with an average of 20% across the Chesapeake and the Northeast. RLV can be transmitted to blue crabs by consumption of infected conspecifics. To investigate the possibility that other crustacean species may be a reservoir for RLV, students will look for RLV in green crabs, grass shrimp, and other crustaceans in the coastal bays of MD, DE, and NJ. Crustaceans and corresponding environmental data will be collected from coastal bays by students from UMES and DSU in the spring and summer of 2015. Samples will be analyzed for RLV using qPCR methodology at IMET. Students will investigate the potential for other species to serve as hosts to RLV by conducting controlled infections. Preliminary studies demonstrated the ability to transmit RLV to green crabs (*Carcinus maenas*) by injection. This finding will be reconfirmed, and extended by an attempt to transmit the virus by feeding. Improved understanding of disease-related mortality of blue crab will be valuable demonstration to NOAA's efforts to understand natural mortality of other fishery species.

Project #: 15-10

Project Title: Improving management of deep-sea red crabs *Chaceon quinque-dens*, Year 2: Reproductive biology, maturity, and age estimation

PI Name: Bradley Stevens (UMES)

NOAA Collaborator: Chris Long (NOAA/AFSC), Matt Poach (NOAA/NEFSC), Rich McBride (NOAA/NEFSC)

Other Collaborators: J. Sook Chung (UMCES/IMET)

Research Students: Stephanie Martinez-Rivera (MS Student, UMES); Justin Wilson (MS Student, UMES); Shadaesha Green (MS Student, UMCES/IMET); Nivette Perez-Perez (MS Student, DESU)

Thematic Area: Quantitative Fisheries

Funding: \$59,784

Start Date: September 2014

End Date: August 2015

Abstract:

Deep sea red crabs support a small but valuable federally-managed fishery along the US Atlantic coast, but lack of information about their biology, abundance, growth, age, or reproduction prohibits adequate management. Preliminary data collected during LMRCSC cruises aboard NOAA Research Vessels in 2011-2013 indicates that female red crabs have a biennial reproductive cycle, and size of sexual maturity (SM50) of about 61 mm CL but male SM50 could not be determined. In 2013, students began verifying this information by histological analysis of gonad tissues. In 2014-15 we conducted sampling from the commercial fishery to determine seasonality of reproduction, fecundity, and age analysis. Samples from previous cruises were processed to estimate size of oocytes and spermatophores. Eyestalks and gastric mills were prepared to determine age of crabs. This information is critical for management and conservation of red crab populations.

Project #: 15-11

Project Title: Augmenting the Black Sea Bass, *Centropristis striata*, Stock Assessment, Year 3: Assessing the importance of fixed and fluid estuarine habitats

PI Name: Bradley Stevens (UMES)

NOAA Collaborator: Howard Townsend (NOAA/NOS/CBO)

Other Collaborators:

Research Students: Laura Almodovar-Acevedo (MS Student, UMES)

Thematic Area: Essential Fish Habitat

Funding:

Start Date: September 2014

End Date: August 2015

Abstract:

Black sea bass (BSB, *Centropristis striata*) support important commercial and recreational fisheries in the Mid Atlantic Bight. Adults live offshore, but juveniles depend on reef and hard bottom habitats in estuaries in the summer and early fall. We hypothesize that BSB recruitment is associated with the availability of oyster reefs in the Chesapeake, and annual variability in temperature, precipitation and salinity. In Year 1, we began developing a habitat suitability model to determine preferred habitats of BSB in the Chesapeake, and test the model by sampling a variety of known and unknown habitats. In Year 3 we wish to expand the range of sampling and determine when sonic tagged fish leave Chesapeake Bay. This proposal addresses two of the LMRCSC research themes including "Quantitative Fisheries" and "Essential Fish Habitat", as well as several NOAA Strategic Goals.

Project #: 15-12

Project Title: Integrating habitat, prey and predators over space and time to assess distributional responses to environmental variability and climate change: California sea lions and their pelagic prey off Oregon and Washington

PI Name: Leigh Torres (OSU)

NOAA Collaborator: Rich Brodeur (NOAA/NWFSC)

Other Collaborators: Tara Cox (SSU); Bryan Wright (OR DFW)

Research Students: Caren Barcelo (PhD Student, OSU)

Thematic Area: Quantitative Fisheries

Funding: \$45,478

Start Date: September 2014

End Date: August 2015

Abstract:

Although distributional responses of marine predator populations to temporal and environmental variability have been demonstrated, these studies did not account for predator-prey relationships and therefore lacked an element of realism. This project will generate species distribution models of California sea lions and their prey items off the Oregon and Washington coasts to (1) describe and compare habitat use patterns, (2) predict distribution patterns under various temporal and climate change scenarios, and (3) evaluate the ecological and management implications of overlap or mismatch between predator and prey. This collaboration involves four agencies and two universities, aims to train under-represented students in spatial analysis, oceanographic, and science communication skills, and will deliver novel results to assist ecosystem based management.

Activities and Accomplishments:

- Monthly meetings and discussions of the LMRCSC Research Committee were held during this reporting period. CSC-CSC joint research projects were discussed and the LMRCSC annual Science meeting took place in October 2014 was planned.
- Several collaborative research projects between scientists at LMRCSC MSIs and scientists at Research Intensive institutions (RSMAS, IMET, OSU) are on-going.

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

Activities and Accomplishments:

- Monthly meetings and discussions of the LMRCSC Research Committee were held during this reporting period. CSC-CSC joint research projects were discussed and the LMRCSC annual Science meeting was held in October 2014.
- Several collaborative research projects between scientists at LMRCSC MSIs and scientists at Research Intensive institutions (RSMAS, IMET, OSU) are on-going.

Leverage multiple sources of funding to support the Center's research agenda:

Activities and Accomplishments:

- Leveraged funds during this reporting period totaled \$1,908,514 (Appendices II and III)

Provide supportive networks and mentoring for early-career faculty, including faculty from underrepresented groups:

- LMRCSC provides a strong intellectual community for scholars in the marine and fisheries sciences. Faculty connections across institutions are important not only for research collaboration, but also for career support and mentoring. Among the early-career faculty who received funding from the LMRCSC for 2014 - 2015 to conduct research are: Eric Schott (UMCES-IMET), Jolvan Morris (SSU), Andrij Horodysky (HU), and Leigh Torres (OSU).

NOAA LMRCSC Scientific and Educational cruise aboard the NOAA Ship Delaware II

No LMRCSC research cruise was conducted in this period.

SCHOLARLY PRODUCTIVITY

In the current reporting period, LMRCSC students and faculty made 127 presentations at scientific meetings, and published 30 articles in refereed journals (Appendix IV).

Grantsmanship: A total of \$1,908,514 (Appendix II and III) was collectively awarded to the LMRCSC partner institutions during the current reporting period which directly or indirectly impacted Center activities. Of the total amount of funds awarded to LMRCSC, \$193,038 came from NOAA, whereas \$1,715,476 was obtained from other agencies. The funds provided by these agencies were used to support faculty and students and develop/enhance infrastructure.

SECTION II – EDUCATION AND OUTREACH ACTIVITIES

1. **How many students and faculty were recruited to participate in academic programs, training, workshops, conferences or seminars?** Fifteen (15) students were recruited to the center during this period. Two new faculty members were hired: Dr. Aurea Rodriguez, Research Assistant Professor, HU and Dr. Yeong Chi, Resource Economics Associate Professor, UMES
2. **What are the new education programs (degree certificate programs, etc.)?** HU instituted its new undergraduate curriculum to ensure that the students are trained for competitive graduate programs. IMET established the Ratcliffe Environmental Entrepreneurs Fellowship Program (REEF) using an award from the Ratcliffe Family Foundation.
3. **Students receiving direct and indirect support from the LMRCSC.** One hundred and forty-three (143) students were supported. Of those, 83 were supported directly while 62 were supported indirectly.
4. **What outreach activities (e.g. workshops, conferences, seminars) have the Cooperative Science Center coordinated as part of the project?**

- HU's leveraged NOAA Sea Grant program embarked on the Newport News, Moton Community Center, Aquaponics system for the food desert community.
- RSMAS hosted the meeting of the International Commission for the Conservation of Atlantic Tunas Stock Assessment Methods Working Group, February 16-20, 2015.
- At SSU, Dr. Sue Ebanks coordinated the 2014 Ocean Sciences Educators' Retreat at the Coastal Georgia Center that was sponsored by the Consortium of Ocean Leadership. Drs. Gilligan and Hoskins were present.
- All partners contributed to the planning and execution of the 7th Biennial NOAA EPP Education and Science Forum held at UMES, October 26-29.
- IMET held an "Ask a scientist" outreach event during Star Spangle Banner Spectacular celebration, Baltimore, MD September 2014

K-12 Education and Outreach Programs:

- SSU hosted the annual GIS day on Nov. 19, 2014 and the Georgia-South Carolina Regional competition of the NOSB on February 7, 2015.
- Planning has begun for the HU's Marine Science Kayak camp for summer 2015.
- **CREST CISCEP Student Enrichment and Experiential Learning (SEEL):** This program is funded by NSF and was leveraged with LMRCSF funds. Planning has started for the summer 2015 program. LMRCSF faculty will host and mentor 7 high school students from Worcester, Wicomico and Somerset county public schools in Maryland for 7 weeks during summer of 2015. Students will conduct research alongside their mentors, LMRCSF graduate students and REU undergraduates and produce posters and Powerpoint presentations of their results which will be presented at a symposium in August 2015.
- **Teacher Development Workshop:** This is another component of the CREST CISCEP program funded by NSF and leveraged with LMRCSF funds for which planning is underway. UMES will offer a workshop for K-12 science teachers in July, 2015, designed to provide hands on lessons in lab and field research in marine and environmental science, which can be infused into existing K-12 science curricula. Eight teachers will conduct research projects under the guidance of Drs. Paulinus Chigbu, Pat Goslee and other UMES faculty and produced a lesson plan for use in the classroom.
- **Research Experiences for Undergraduates in Marine and Estuarine Sciences:** The LMRCSF is a site of an REU program funded by NSF, and with additional support from the LMRCSF. A proposal for renewal for this funding was submitted during this period and funding for summer 2015 is pending. Upon approval, in summer 2015 thirteen (13) interns (8 supported with NSF funds; 5 with LMRCSF funds) will participate in various activities such as research, seminars, workshops, and field trips. The critical mass of scientists with expertise in NOAA related sciences recruited and supported by the NOAA LMRCSF made it possible to establish in 2010 at UMES this REU site. Some students (e.g. Nivette Perez, MS student at DSU) have enrolled in graduate programs at LMRCSF institutions after participating in the internship program.
- **Geosciences Bridge Program:** The LMRCSF worked collaboratively with other NOAA Cooperative Science Centers, CSCs (NCAS, CREST and ECSC) and established a summer geosciences bridge program at UMES. Eighteen (18) students will participate in the program in summer 2015. They will be exposed to the various areas of geosciences via hands-on activities and field trips. In addition, they will take a college level math class as well as freshman orientation class.
- **Website:** The LMRCSF web site (www.umes.edu/lmrcsc) is continuing to be updated. The site highlights linkage with NOAA and Center accomplishments and makes them more accessible to the user. The site includes biographical information for faculty and graduate students at each Center partner. Each of the LMRCSF partner institutions also has its own website that is directly linked to the LMRCSF main web page

Facebook: LMRCSF Technical Monitor Jeanine Cody created an LMRCSF page on Facebook which went live on July 20, 2009. It provides students and others a forum to network and discuss marine and fisheries issues, job and funding opportunities, current events in marine science, etc. Four hundred eleven (411) individuals, including many students, have signed up as 'fans' of the site. Partner institutions also maintain Facebook pages. At SSU, daily posts are made by the outreach coordinator.

SECTION III – SUCCESS STORIES (SCIENTIFIC AND STUDENT ACCOMPLISHMENTS)

- Chante Davis, Ph.D. student at OSU received NOAA GRTSP Award.

1. What specific contributions have the projects made to the Center, NOAA and partners?

The LMRCSC educational, research and outreach activities have resulted in several contributions during this reporting period. One hundred forty-three (143) students from B.S. to doctoral levels were trained in NOAA core sciences. Nine (9) students graduated (2 Ph.D., 4 M.S., 3 B.S). Twelve (12) projects funded through the TAB for 2014-2015 are being completed, and \$1,908,514 in external funding is supporting Center-related activities.

2. How many students participated in Center projects or activities? 143 students participated in the Center projects. The names of some of the students, their research projects and presentations they made during this reporting period are presented in Appendix IV. 1000-1500 K-12 students participated in the Center educational and outreach activities.

3. What specific benefits were accrued to students, faculty members and the institution(s) by participating in the program? Students benefited from their participation in the projects through hands-on research experience, completion of theses in partial fulfillment of their degree requirements, stipend, and travel awards to conferences. Besides, some students secured employment after completion of their degree programs, or received scholarships for graduate studies.

Students are:

- gaining valuable research experience through Center REU programs
- gaining year-long research at HU
- attending specific workshops at HU and the EPP Forum
- traveling to local and international conferences

Faculty are:

- receiving funding to mentor LMRCSC students and are getting talented student researchers in their labs
- receiving funds for research supplies
- creating and maintaining research collaborations with Center partners and outside partners
- traveling to local and international conferences and workshops

Partner institutions are:

- receiving IDC from this grant
- receiving enhanced research facilities
- receiving trained students that are prepared for graduate school or the workforce
- benefiting from faculty collaboration across schools and departments
- receiving the benefit of potential recruitment from the LMRCSC Marine Science Summer Camp

Students who Received Employment as a Result of their Work at the Center:

- George Wenn (HU) is now employed at Virginia Tech. AREC.
- Larry Redd, Jr. (HU) is currently interviewing for a NOAA Knauss Fellowship
- Dr. Rolando Santos (RSMAS) received a job as a research associate at Florida International University immediately after he finished his dissertation at RSMAS.

Students who Received Scholarships for Graduate Degree Programs as a Result of their Work at the Center:

- Chante Davis (OSU), received NOAA EPP GRTSP
- Kenneth Scaboo has been offered a fellowship to pursue his Ph.D. at University of Delaware after he completes his MS thesis early in summer 2015.
- Shadaesha Green (IMET) was awarded 2-year Louis Stokes Alliances for Minority Participation Fellowship (LSAMP)

Students who received Training at NOAA Laboratories or at Center Institutions: 6 students conducted research at NOAA labs (Table 4).

4. To what extent have the projects or activities enhanced and improved outreach, education, training and NOAA related research at the institutions? Students supported under the LMRCSC have access to tools and training they would not have had were it not for the LMRCSC. 62 students at the Center institutions who were not directly funded by the LMRCSC benefitted from the infrastructure and equipment made available to the institutions by the LMRCSC. The LMRCSC has secured leveraged funding (~\$1.9 million) that has enabled the Center institutions to recruit and support more students than they would otherwise be able to support.

LMRCSC activities and infrastructure have created a model upon which other outreach and training programs have been built. Other marine science outreach programs at SSU feed into the Coast Camp. SSU Coast Camp has become the testing ground for K12 modules. Faculty have been able to apply for other base funding for research fellowships because of the prior funding provided by the LMRCSC. Finally, travel and research funding from the LMRCSC that allowed students to travel to NOAA labs helped publicize the quality of LMRCSC faculty and students, thereby improving our collaborative and recruitment success.

5. Did students participate in experiential research at, site visits to, or seminars at/with NOAA laboratories and/or facilities? Yes, names of student participants are in Table 4.

6. In what specific NOAA science, service or stewardship activities (e.g. NOAA research cruises; weather forecast modeling, etc.) were students involved?

This period, students were involved in research in the following areas;

- Marine Biotechnology: Red Crab study
- Aquaculture/Fisheries
- Marine science related engineering
- Fisheries Modeling
- Oyster reef monitoring

7. What significant impact(s) does the LMRCSC research, education and outreach, and administrative functions have university-wide, for the local community, and at the local, state, regional or national level?

- **University-wide-** The LMRCSC has provided infrastructure for research conferences at SSU via faculty, student research, and poster boards. It has also provided the fellowship mentoring model and the postdoctoral fellow development model. Students are active in student organizations and government on their campuses. For example Marisa Litz serves as the Secretary for the Hatfield Student Organization at OSU, and Jessica Andrade is also an active member. Smit Fasquez-Cabellero serves as the treasurer for the OSU Society for Advancement of Hispanics/Chicanos and Native Americans in Science (SACNAS).
- **Local Community & Region-** SSU hosts regional NOSB competition and GIS Day. Dr. Hoskins (SSU) used a coastal and land management simulation to increase stakeholder engagement while working with 34 participants on the Institute for Georgia Environmental Leadership program on Sapelo Island (GA) September 16-18, 2014. HU's leveraged NOAA Sea Grant program embarked on the Newport News, Moton Community Center, Aquaponics systems for the food desert community.
- **Fisheries Habitat Workgroup:** As a past member of the Maryland Oyster Advisory Commission, Eric Schott has joined the Fisheries Habitat Workgroup, chaired by Jim Gracie (of the MD DNR Sport Fisheries Advisory Commission) and facilitated by MD DNR (Margaret McGinty). This group is working to define and meet goals to preserve and restore the last remaining fish habitat in both tidal and non-tidal waters of MD.
- **MD Watermen's Expo.** Dr. Eric Schott and Dr. Sook Chung attended the 2015 Watermen's Expo in Ocean City, January 16-17, taking several IMET graduate students. They exchanged ideas on blue crab reproduction, health and disease with watermen and other visitors to the IMET booth and discussed crab health with DNR managers (Brenda Davis and Lynn Fegley).
- **Phillips Wharf Environmental Center.** Eric Schott is a member of the board of the Phillips Wharf Environmental Center, and serves on its governance committee. PWEC is a nonprofit environmental education organization with a

mission to bring together watermen, scientists, and others interested in the health and productivity of the Chesapeake Bay. www.pwec.org.

- **National-** LMRCSC students have travelled nationally to conduct research and to present the results of that research to national labs and conferences. The LMRCSC is increasing the number of students especially those belonging to underrepresented minority groups who are trained in NOAA related science disciplines, thereby positively impacting the future workforce.

SECTION IV – REVISIONS TO TASKS AS DESCRIBED IN GRANT AWARD AMENDMENTS AND THE IMPACT TO THE AWARD: There were no amendments to the award.

APPENDICES

Appendix I: Partial List of NOAA NMFS Scientists Who Collaborated with LMRCSC Scientists and Students during this reporting period (Sept. 2014 – Feb. 2015)

NOAA Scientists	NOAA Lab	Role at the LMRCSC
Bill Peterson	NOAA NWFSC, Newport, OR	Adjunct faculty, committee member
Thomas Hurst	NOAA AFSC, Newport, Oregon	Adjunct faculty, committee member, mentor at OSU
Chris Liese	NOAA SEFSC	M.S. Committee Member (Keya Jackson) at SSU
Dan Holland	NOAA NQFSC	Committee member
Dr. Brent Stoffle	NOAA SEFSC	NMFS mentor to MPS student, Austin Flinn at RSMAS
Dr. John Walter	NOAA SEFSC	Dissertation Committee, Matt Nuttall
Dr. Michael Schirripa	NOAA SEFSC	Dissertation Committee, Holly Perryman
Ed Wirth	NOAA, Charleston, SC	Provided advice on MS project (APeoples' work)
Howard Townsend	NOAA Cooperative Oxford Cooperative Lab	Collaborator on TAB with Brad Stevens (UMES), and HU; Taught Ecosystem modeling course in spring 2015 at UMES; serves on thesis committee of H. Malagon (UMES)
Jeffrey Seminoff	NOAA SEFSC, Beaufort, NC	Adjunct faculty, mentor
Kristy Wallmo	NOAA Headquarters, SST	M.S. Committee Member (Muhammad Cochran)
Larisa Avens	NOAA SWFSC, La Jolla, CA	Adjunct faculty, committee member
Lisa Marie Carrubba	Caribbean Field Office	M.S. Committee Member (Emma Schultz)
Lonnie Gonsalves	NOAA Oxford Cooperative Lab	DSU research projects, Advising MS project (A. Peoples' work); serves on thesis committee of M.S. student at UMES
Matthew Poach	NOAA NEFSC, J.J. Howard, NJ	Nivette Perez-Perez committee (DSU), Collaborates with Sook Chung (IMET) on red crab project

Peter Lawson	NOAA NWFSC	Committee member
Porter Hoagland	NEFSC	M.S. Committee Member (Sanya Compton)
Ronald B. Johnson	NWFSC	Collaborator on TAB
Stephania Bolden	NMFS Southeast	Hilary Dean's M.S. thesis committee (DSU)
Tom Minello	Galveston	M.S. Committee Member (Tiffany Ward, SSU)
Wayne McFee	NOAA NOS Charleston, SC	Provided advice on A. Peoples' MS thesis project (SSU)
Dr. Steve Morton	NOAA NOS Charleston, SC Marine Biotoxins Program	Collaborates with Sook Chung (IMET)
Gretchen Messick	NOAA-NCCOS, Oxford, MD	Collaborates with Sook Chung and Eric Schott (IMET) on several projects including blue crab health and disease
Linda Stehlik	NOAA NMFS, J.J. Howard Lab.	Collaborates with Eric Schott investigating potential reservoirs of blue crab virus in crustaceans of Atlantic Coastal Bays
Kevin Friedland	NOAA NEFSC	Serves on thesis committee of Ammar Hanif, Ph.D. student at IMET; collaborates with AI Place on menhaden project
Robert Goldberg	NOAA Milford Lab, CT	Collaborates with Eric Schott on a project "Assembling a program to monitor the prevalence of pathogens of the blue crab (<i>Callinectes sapidus</i>) in the Northern limit of its range"
James Morris	NOAA Center for Coastal Fisheries	Collaborates with AI Place and E. Schott (IMET)
Jose A. Rivera	NOAA NMFS, Miami, FL	Committee member of J. Vincente (Ph.D. student) at IMET
Jim Sullivan	NOAA Headquarters, Silver Spring, MD	Collaborates with F. Chen (IMET); serves of thesis committee of D. Marsan (IMET)
Fran Van Dolah	NOAA NCCOS	Collaborates with R. Jagus and AI Place (IMET) on Oceans and Human Health project
Gary Wikfors and Diane Kapareiko	NOAA Milford Lab	Collaborate with E. Schott and H. Schreier (IMET) on the project: Understanding Interaction of Probiotic and Pathogenic Bacteria in Oyster Larvae Hatchery Culture
Laurie Weitkamp	NOAA NWFSC, Newport, Oregon	Committee member of graduate student
Richard Brodeur	NOAA NWFSC, Newport, Oregon	NOAA GRTS mentor for M. Litz Ph.D. student at OSU

Appendix II. Current leveraged funding from NOAA to LMRCS institutions

Author	Funding Agency	Title of Project	Start/End Date	Amount	Current 6 month period
Cuker, B	NOAA MD Sea Grant	ASLOMP Supplement	10/1/14-2/28/15	\$36,000	\$36,000

Gibson, D. & Horodysky, A. (HU)	NOAA VA Sea Grant	Sustainable Fisheries and Aquaculture Outreach, Education and Training for Under-Represented Groups and Aquaculture Producers	6/1/13 - 1/31/15	\$76,763	\$5,000
Dionne Hoskins	NOAA/NMFS	NOAA CMER	Jan 2000-continuing	~\$100k	\$40,000
Babcock, E. A.	NOAA via CIMAS	Evaluation of fishery ecosystems	10/2011-9/2015	\$531,985	\$97,470
Babcock, E. A. & Matt Nuttall	NOAA/Sea Grant	Population Dynamics Fellowship: The Influence of Environmental and Ecological Processes on the Dynamics of Gulf Menhaden (<i>Brevoortia patronus</i>) within the Gulf of Mexico	6/2014-4/2017	\$96,248	\$14,568
				Total	\$193,038

Appendix III. Current leveraged funding to LMRCS institutions from sources and agencies other than NOAA (*Students)

Author	Funding Agency	Title of Project	Start/End Date	Amount	Current 6 month period
Cuker, B (HU)	NSF	Multicultural Diversity in the Aquatic Sciences	8/1/13-7/31/18	\$936,000	\$93,600
Horodysky, A., Gibson, D., Cuker, B. (HU)	NSF	Educational Partnerships in Climate Change and Sustainability	11/1/11-10/31/15	\$300,000	\$50,000
Shen K, Hintz C. (SSU)	DoD	Acquisition of a Raman Microscope for Interdisciplinary Research and Training	12/2014 – 12/2015	\$331,997	\$165,999
Hoskins D, Young V (SSU)	Ocean Leadership	NOSB Regional Site	12/1/14 – 6/30/15	\$10,000	\$5,000
Salina Parveen, P. Chigbu, G. Osby (UMES/DSU)	USDA-NIFA	A rapid, user friendly method for detection of total vibriionaceae as an indicator of pathogenic <i>Vibrio</i> species in oysters and seawater.	9/1/14 - 8/31/17	\$479,672	\$79,945.33
Jiang, Li, Lee, Chen, Ozbay, G. (DSU)	USDA-AFRI	Inactivation of enteric foodborne viruses in high risk foods by non-thermal Processing technologies.	2/1/2011 - 1/31/2016	\$2,000,000	\$200,000
Chigbu, P., J. Pitula, E. May, M. Mitra, & A. Johnson (UMES)	NSF	CREST Center for the Integrated Study of Coastal Ecosystem Processes and Dynamics	8/1/10 – 7/31/15	~\$5,000,000	~\$500,000
Chigbu, P. & E.B. May (UMES)	NSF	University of Maryland Eastern Shore REU in Marine and Estuarine Science	6/1/12 – 5/31/15	\$262,000	\$43,667

Chigbu, P. (UMES), A. Ishaque (UMES) R. Khambilvardi (CREST)	NSF	A Network of CSCs and High Schools for Training Students in Geosciences	9/1/12 – 8/31/15	\$500,000	\$83,333
Chen, F. (IMET)	CCEMC	An innovative and highly efficient microalgae-based carbon sequestration system to reduce CO2 emission and produce biofuels in all climates	04/01/14-04/30/16	\$500,000	\$125,000
Chung, J.S. (IMET)	NSF	Functional Roles of a Novel Crustacean Female Sex Hormone in Sex Differentiation and Developing Secondary Sex Features of Crustaceans	05/01/12-04/30/16	\$435,507	\$54,438
Chung, J.S. (IMET)	EPA	Uptake and Effects of Dispersed Oil Droplets and Emulsified Oil by Estuarine Crustacea	05/01/12-04/30/16	\$139,393	\$17,424
Schott, E. (IMET)	EPA	Linking science and community to enhance the Mill Corridor, a forgotten gem in the Patapsco watershed	7/1/2014 - 6/30/15	\$12,824	\$12,824
Chen, F. (IMET)	IMET	Transformation of Virus-mediated Dissolved Organic Matter via Natural Microbial Community	7/1/2014 - 6/30/15	\$50,000	\$50,000
Jagus, J. (IMET)	MSG	Diet and feeding of menhaden using barcoding identification based on cox1 sequences to enable the linking of primary productivity to fisheries	5/28/2013 - 5/27/15	\$59,646	\$29,823
Jagus, J. (IMET)	NIH	Translation regulation of gene expression in toxic dinoflagellates (NIH portion)	9/1/2012 - 7/31/17	\$644,111	\$64,411
Jagus, J. (IMET)	NSF	Translation regulation of gene expression in toxic dinoflagellates (NSF portion)	12/1/2012 - 1/31/18	\$1,341,516	\$111,793
Place, A. R. (IMET)	NIEH	Combining bioavailability assays with modeling to predict PCBs in fish after remediation.	09/21/11-07/31/15	\$225,750	\$28,219
Total					\$1,715,476

Appendix IV: Presentations and Publications

Oral Presentations (*Students)

[DSU: 1 Presentations, 1 student presenter](#)

Perez-Perez*, N., Poach, M., Stevens, B., Smith, S., Ozbay, G., Effects of diet and temperature on the development of larval stages of the red deepsea crab (*Chaceon quinquegens*) in laboratory conditions Presented at NOAA EPP 7th Biennial Education and Science Forum, UMES, MD, October 2014.

[HU: 1 presentations, 1 student presenter](#)

Redd, I.*, Schwarz, M. H., Urick, S, Breland, M*, Horodysky, A.Z. (2015). Effects of temperature and feed type on gastric evacuation of aquacultured Pompano (*Trachinotus carolinus*). Presented at ASLO, Granada, Spain, February 2015.

OSU: 7 presentations, 6 student presenter

- Davis*, C.D., & Banks, M.A. (2014). Development of microsatellite markers to differentiate Chinook salmon migratory runs. NOAA Educational Partnership Program (EPP) conference, October 2014.
- Denson* L.S. and Sampson D.B. (2014). The effects of spatial assumptions and data availability on stock assessment results in the presence of a changing environment: A simulation. 7th Biennial NOAA EPP Education and Science Forum, University of Maryland Eastern Shore, Princess Anne, MD. October 2014.
- Litz*, M.N.C., Miller, J.A., and Copeman, L.A. (2015). The prey quality hypothesis: effects of dietary fatty acids on salmon growth, biochemistry, and aerobic performance. 28th Annual Biology Graduate Student Symposium, Newport, OR
- Litz*, M.N.C., Miller, J.A., and Copeman, L.A. (2015). Effect of dietary fatty acids on juvenile Chinook salmon (*Oncorhynchus tshawytscha*) growth, lipid composition, and swimming performance. 11th Annual Research Advances in Fisheries, Wildlife and Ecology, Corvallis, OR (oral presentation).
- Litz*, M.N.C., Miller, J.A., and Copeman, L.A. (2015). Characterizing dietary variability of juvenile salmon using fatty acids and stable isotopes. 2015 NOAA-NWFSC Ocean Ecology Annual Meeting, Newport, OR
- Miller, J.A., Peterson, W.T., Morgan, C.A., and Litz, M.N.C.* (2014). Seasonal variability in the composition and biochemistry of the copepod community within the Northern California Current. 61st Annual Eastern Pacific Ocean Conference, Timberline Lodge, OR.
- Vasquez-Caballero*, S. (2014). Modeling Spatial-Temporal Fishing Effort of the West Coast Salmon Fishery. NOAA EPP Education and Science Forum, Princess Anne, Maryland. October 28, 2014.

RSMAS: 5 presentations, 4 student presenters

- Flinn*, A. (2014). The socioeconomic importance of fishing in Port Salerno, Florida. Presented at NOAA EPP Forum. UMES.
- Lazarre*, D. (2014). Re-creating the lionfish invasion by simulation to test initial invasion scenarios and evaluate metapopulation connectedness. Presented at NOAA EPP Forum. UMES.
- Nuttall*, M. (2014). Identification of environmental and ecological drivers that influence the dynamics of Gulf Menhaden (*Brevoortia patronus*) within the Gulf of Mexico. Presented at NOAA EPP Forum. UMES.
- Perryman*, H. and Babcock, E. A. (2015). Generalized Additive Models predicting distribution of fish species within the Gulf of Mexico. Presented at 2015 Gulf of Mexico Oil Spill and Ecosystem Science Conference, Houston, Feb. 2015.
- Serrano, X. (2014). Horizontal vs. vertical patterns of gene flow in the Caribbean brooding coral *Porites astreoides*. Presented at NOAA EPP Forum. UMES.

SSU: 15 Presentations, 9 student presenters

- Brinton* C. (2015). Fine scale movements of the Atlantic Stingray: a tidal or diel pattern? Presented at the Southern Division of the American Fisheries Society Meeting, Savannah GA. January 29- February 1, 2015
- Brinton*, B. and Curran, MC (2014). Does the bopyrid parasite *Probopyrus pandalicola* affect the predation preferences of mummichogs by altering the behavior and/or camouflage of the grass shrimp *Palaemonetes pugio*? 7th Biennial NOAA EPP Science and Education Forum, Princess Anne, MD. Oct 25-29, 2014
- Brinton* C. (2015). Movement patterns of the Atlantic Stingray *Dasyatis sabina* in tidal creeks near Savannah, Georgia Southeastern Research Society Meeting, Carolina Beach, NC. November 4-6, 2015
- Curran C. (2015). The Value of Long-Term Data Sets: Seasonal Flatfish Abundance Patterns in a Shallow Estuarine Creek in Georgia. Presented at the Southern Division of the American Fisheries Society Meeting, Savannah GA. January 29- February 1, 2015
- Gut* J. (2015). Identifying fish assemblages near the mouth of the Savannah River, Georgia before the Savannah Harbor Expansion Project. Presented at the Southern Division of the American Fisheries Society Meeting, Savannah GA. January 29- February 1, 2015
- Hoskins, DL. (2015). Tales of Landings and Legacies: African Americans in Georgia's Coastal Fisheries" 26Feb15, Woods Hole Black History Month 2015 Invited Speaker. NOAA Press release: http://www.nefsc.noaa.gov/press_release/pr2015/news/nr1503/
- Hoskins, DL. (2014). Strategies for Building Ocean Science Diversity, Ocean Leadership Ocean Science Educators Retreat. SSU Coastal Georgia Center, 25Sept14
- Hoskins D. (2014). Tales of landings and legacies: African Americans in Georgia's coastal fisheries. 7th Biennial NOAA EPP Science and Education Forum, Princess Anne, MD. Oct 25-29, 2014

- Jackson* K. (2014). A qualitative and quantitative approach to assessing the impact of black gill on commercial shrimp trawlers in Georgia. 7th Biennial NOAA EPP Science and Education Forum, Princess Anne, MD. Oct 25-29, 2014
- Johnson, O. Hoskins, DL, and Terez, J. (2014). Coastal Citizens: Where Ecology, Culture, & Politics Intersect (2014) The Fall Distinguished Professor Lecture 14 Oct 14 Available online:
<http://savannahstate.libguides.com/content.php?pid=634454&sid=5261133>
- Morris JT. (2014). Identity, place, and traditional knowledge in African-American fishing communities: a case study from Harris Neck, Georgia (USA) 7th Biennial NOAA EPP Science and Education Forum, Princess Anne, MD. Oct 25-29, 2014
- Ramsden*, S. (2015). Effect of Season on the Residency and Distribution Patterns of the Atlantic Stingray in Two Georgia Creek Systems, Presented at the Southern Division of the American Fisheries Society Meeting, Savannah GA. January 29- February 1, 2015
- Ramsden*, S and Curran MC (2015). Seasonal residency and distribution patterns of the Atlantic Stingray *Dasyatis sabina* in two tidal creeks near Savannah, Georgia, Department of Marine and Environmental Sciences, Savannah, Southeastern Research Society Meeting, Carolina Beach, NC. November 4-6, 2015
- Ward*, T. (2014). Evaluation of biological and physical parameters of natural and restored oyster reefs in Georgia. 7th Biennial NOAA EPP Science and Education Forum, Princess Anne, MD. Oct 25-29, 2014
- Ward*, T, Hoskins DL, Ogburn M. (2014). The evaluation of natural and restored intertidal oyster reefs in coastal Georgia. 7th Biennial NOAA EPP Science and Education Forum, Princess Anne, MD. Oct 25-29, 2014

UMES: 12 Presentations, 11 student presenters

- Almodóvar-Acevedo*, L., Hasan, M., Townsend, H., and Stevens, B. (2014). Assessing available habitat for black sea bass (*Centropristis striata*) in the Chesapeake Bay through a Habitat Suitability Model. Presented at the NOAA EPP Forum, Princess Anne, MD, October 2014.
- Almodóvar-Acevedo*, L., Hasan, M., Townsend, H., and Stevens, B. (2015). Assessing available habitat for black sea bass (*Centropristis striata*) in the Chesapeake Bay through a Habitat Suitability Model. Presented at the Aquatic Sciences Meeting (ASLO), Granada, Spain, February 2015.
- Dennis*, M., Mulineaux, L. and Mills, S. (2014). Analysis of hydrothermal vent communities' succession after an eruption on the Eastern Pacific Rise (EPR). Presented at the NOAA EPP Forum, Princess Anne, MD, October 2014
- King*, M., Hughes, L., Buda, A., Hashem, F., Bryant, R., Allen, A., and May, E. (2015). Urea production by saturated coastal plain drainage ditch sediments. Presented at Penn State University for the Agriculture and Environment Center's Science for Solutions Seminar Series, State College, PA, January, 2015.
- Lycett*, K., Pitula, J. (2014). Protecting the blue crab through molecular biology. Presented at the PROMISE Research Symposium, College Park, MD, February 2015.
- Lycett*, K., Pitula, J. (2014). Disease ecology and fisheries management of the blue crab and its parasite *Hematodinium perezii* in the Maryland Coastal Bays (MCBs). Presented at the NOAA EPP Forum Princess Anne, MD, October 2014.
- Martinez-Rivera*, S. and Stevens, B.G. (2014). Sexual maturity of the red deep-sea crabs (*Chaceon quinquegens*) in the Mid-Atlantic Bight. Presented at the NOAA Educational Partnership Program -Seventh Biennial Education and Science Forum, UMES Princess Anne, MD, October, 2014.
- Mayor, E*, Chigbu, P. (2014). Life history and Ecology of mysids in the Coastal Bays of Maryland. Presented at the NOAA Educational Partnership Program -Seventh Biennial Education and Science Forum, UMES Princess Anne, MD, October, 2014.
- Oghenekaro*, E., Oseji*, O.F., and Chigbu, P. (2014). Drivers of Mesozooplankton dynamics in the Maryland Coastal Lagoons. Presented at the NOAA EPP Forum, Princess Anne, MD, October 2014.
- Oseji, O.F.*, Chen, N., Chigbu, P. and Waguespack, Y. (2014). Phytoplankton Dynamics in Maryland Coastal Bays as Revealed by Pigment Biomarkers. Presented at the NOAA Education Partnership Program (EPP), UMES October 26-29, 2014.
- Morales-Nunez, A. and Chigbu, P. (2014). First record of the genus *Apolochus* Hoover & Bousfield, 2001 (Crustacea: Amphipoda: Amphilochidae) in Maryland Coastal Bays, Mid-Atlantic region, USA. Presented at the NOAA EPP Forum, Princess Anne, MD, October 2014.
- Volkis*, B.S., Park*, So-Jin, Nwaeze, D.I., Volkis, V., and Chigbu, P. (2014). Probing Polymeric Blends with Natural Extracts from Sponge, Algae, Berries and Herbs for Antifouling Protection against Barnacles and other Fouling Factors. Presented at the Aronia Research Day, UMES, November 18, 2014.

UMCES: 6 Presentations, 5 student presenters

- *Brown, S., Flowers, E.M., Schott, E.J. 2014. The evolution of a virus lethal to Blue Crabs. NOAA-EPP Forum, UMES, Princess Anne, MD. 26-29 October, 2014. [First prize undergraduate oral presentation in Healthy Oceans].
- Flowers, E.A., Simmonds, K., Messick, G.A., Schott, E.J. March 2-6, 2015: Eastern Fish Health Workshop. Charleston, SC. Spatially and Temporally Variable Prevalence of a Virus Fatal to the Blue Crab, *Callinectes sapidus*.
- *Green, S., Chung, J.S., Stevens, B. Understanding the reproductive endocrinology of the deep sea red crab, *Chaceon quinque-dens*: identification of reproductive regulators and vitellogenin. 2015 ASLO Aquatic Sciences Meeting, Granada Spain February 2015.
- *Hanif, A., Jagus, R., Place, A.R. Characterizing the gut microbiome of two menhaden species using metabarcoding. NOAA-EPP Forum, UMES, Princess Anne, MD. 26-29 October, 2014. Oral presentation
- *Jones, G. D., Bachvaroff, T. R, Place, A. R., and Jagus, R. 2014 Role of dinoflagellate eIF4E family members in translational regulation of gene expression. The 16th International Conference on Harmful Alga. Wellington, New Zealand October 27-31.
- Place, A.R., Williams, E., Jagus, R., and Bachvaroff, T. R. 2014 Fatty Acid Synthesis and Amphidinol Synthesis are Metabolically Linked in Amphidinium carterae. The 16th International Conference on Harmful Alga. Wellington, New Zealand October 27-31.
- *Vicente, J., L. Blasiak and R. T. Hill. 2014. Exploring diversity and function of bacterial symbionts in a two-sponge symbiosis. 2nd International Symposium on Sponge Microbiology. Baltimore, Maryland.

Poster Presentations (*Students)

DSU: 4 posters, 4 student presentations

- Coles*, K., McIntosh, D. (2014). Production of Mummichogs (*Fundulus heteroclitus*) Using Biofloc Technology. Presented at NOAA EPP 7th Biennial Education and Science Forum, UMES, MD, October 2014.
- Dean*, H., Willett, N. (2014). Utilization of a fine-scale telemetry array to assess movement patterns of Gulf sturgeon in Choctawhatchee Bay, Florida. Presented at NOAA EPP 7th Biennial Education and Science Forum, UMES, MD, October 2014.
- Elliott*, C., Gonsalves, L., Lamb, M., Smith, S. (2014). Stable isotope signatures suggest different feeding strategies for Atlantic and Gulf menhaden. Presented at NOAA EPP 7th Biennial Education and Science Forum, UMES, MD, Oct. 2014.
- Toure*, A., Elavarthi, S., Smith, S. (2014). Ghana IUU fishing practices poison coastal waters, economy with carbide, DDT. Presented at NOAA EPP 7th Biennial Education and Science Forum, UMES, MD, October 2014.

HU: 9 posters, 9 student presenters

- Bostic*, R., Walker, I., Horodysky, A. (2014). A study of the sea-surface temperature induced recruitment patterns for striped bass in the Chesapeake Bay Ecosystem. Presented at NOAA EPP Forum, October 2014.
- Bynes*, K.; Malagon, H.; Alvarez, J.; Chigbu, P. (2014). Environmental factors affecting the abundance and distribution of juvenile spot (*Leiostomus xanthurus*) in Maryland Coastal Bays. Presented at NOAA EPP Forum, October 2014.
- Bynes, K*, Malagon, H.; Alvarez, J.; Chigbu, P. (2015). Environmental factors affecting the abundance and distribution of juvenile spot (*Leiostomus xanthurus*) in Maryland Coastal Bays. Presented at ASLO, Granada, Spain, February 2015
- Gibson, D., Green, S.*, Leandre, M., Walters, T., Elliott, D., (2015). Doliolid Blooms "What are the Driving Variables?" Past, Present, and Future. Presented at ASLO, Granada, Spain, February 2015.
- Gyles*, S. A.; Perryman, W. (2014). Can near-term pregnant Gray Whales (*Eschrichtius robustus*) be distinguished from other southbound Gray Whales in vertical aerial photographs based on shape? Presented at NOAA EPP Forum, October 2014.
- Gyles, S. A.*; Perryman, W. (2015). Can near-term pregnant Gray Whales (*Eschrichtius robustus*) be distinguished from other southbound Gray Whales in vertical aerial photographs based on shape? Presented at ASLO, Granada, Spain, February 2015
- Redd*, I., Schwarz, M. h., Urick, S, Breland, M, Horodysky, A.Z. (2014). Effects of Temperature and Feed Type on Gastric Evacuation of Aquacultured Pompano (*Trachinotus carolinus*). Presented at NOAA EPP Forum, October 2014.

- Rodriguez, A., Otero, E. (2015). An Evaluation of Zooplankton Entrainment by the Cooling Water Intake System Operated by EcoElectrica, LP. Presented at ASLO, Granada, Spain, February 2015
- Shaifer, J. (2014). Using content analysis to explore communication of coastal resilience indicators. Presented at NOAA EPP Forum, October 2014.

[OSU: 4 posters, 3 student presenters](#)

- Andrade*, J.F., Hurst, T.P., Miller, J.A., Heppell, S.A. (2014). Flatfish behavioral responses to predatory threat under elevated carbon dioxide concentrations. 9th International Flatfish Symposium, Cle Elum, WA. November 2014.
- Davis*, C. D. and Banks, M. (2015). Resolving temporal substructure of Chinook Salmon (*Oncorhynchus tshawytscha*) of the Siletz River in Oregon. Aquatic Sciences Meetings, Grenada. February 2015.
- Litz*, M.N.C., Miller, J.A., and Copeman, L.A. (2014). Effect of dietary fatty acids on juvenile Chinook salmon (*Oncorhynchus tshawytscha*) growth, lipid composition, and swimming performance. 7th Biennial NOAA-EPP Education and Science Forum, Salisbury, MD.
- Miller, J. A., Copeman, L., Peterson, W., Morgan, C. A., and Litz*, M. C. N. (2014). Seasonal variability in the composition and biochemistry of the copepod community within the Northern California Current. NOAA Educational Partnership Program (EPP) conference, October 2014.

[RSMAS: 1 poster, 1 student presenters](#)

- Callwood*, K (2014). Connectivity, condos, and catch: Analyzing the State of the Bahamian Spiny lobster fishery. Poster at NOAA EPP Forum. UMES.

[SSU: 3 posters, 3 student presenters](#)

- Fitzgerald*, K. and Kaltenberg, A. (2015) Temporal Influences on estuarine mesozooplankton and fish in the Savannah River Estuary System. Presented at the Southern Division of the American Fisheries Society Meeting, Savannah GA. January 29- February 1, 2015
- Gut*, J. (2014). Characterization of the fish assemblages near the mouth of the Savannah River, Georgia. 7th Biennial NOAA EPP Science and Education Forum, Princess Anne, MD. Oct 25-29, 2014.
- Mackey*, S. (2014). Comparison of extraction methods for microbial extracellular polymeric secretions in coastal Georgia sediments. 7th Biennial NOAA EPP Science and Education Forum, Princess Anne, MD. Oct 25-29, 2014.

[UMES: 40 posters, 36 student presenters](#)

- Booker*, T., May, E. and Ishaque, A. (2014). The use of biomarkers to assess intersex characteristics of white perch (*Morone americana*) due to exposure to endocrine disruptors in six tributaries of the Chesapeake Bay watershed. Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014.
- Buchanan*, R., Klick*, S. and Pitula, J. (2014). *Hemtodinium perezi* in sediments and the microbial community that co- exist with this pathogen of Blue Crabs (*Callinectes sapidus*). Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014.
- Bynes*. K., Malagon*, H., Alvarez*, J. and Chigbu, P. (2014). Environmental factors affecting the abundance and distribution of juvenile spot (*Leiostomus xanthurus*) in Maryland Coastal Bays. Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014.
- Chen, N., Chigbu, P., Ishaque, A., May, E. and Duan, S. (2014). Evaluation of groundwater discharge to the Maryland Coastal Bays using dissolved barium. Presented at NOAA EPP Forum. University of Maryland Eastern Shore, Oct. 2014.
- Chigbu, P. (2015). Climate variability, phytoplankton biomass, and water quality dynamics during winter in Newport Bay, Maryland, USA. Presented at the Association for the Sciences of Limnology and Oceanography conference, Granada, Spain, February 2015.
- Cruz-Marrero* W. and Stevens, B.G. (2015). *In-situ* habitat characterization of the Mid-Atlantic offshore wind sites. Presented at the Association for the Sciences of Limnology and Oceanography, Granada, Spain, February 2015.
- Edje*, B., Bryant, R., May, E. and Allen, A. (2014). Downstream movement of Urea in Manokin Watershed. Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014.

- Elfadul*, R. A., Jesien, R., May, E. and Ishaque, A. (2014). Vitellogenin (Vtg) in Male Striped killifish (*Fundulus majalis*) and Mummichog (*Fundulus heteroclitus*): Biomarker for Exposure to Contaminant of Emerging Concerns (CECs) in Maryland Coastal Bays (MCBs). Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014.
- Elmahdi*, S., Jahncke, M., White, C., Crocker, H., Gray, S., Bowers, J. and Parveen, S. (2014). Evaluation of high salinity relaying as a post-harvest-processing method to reduce the abundance of *Vibrio* bacteria in Chesapeake Bay Oysters (*Crassostrea virginica*). Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014.
- Gardner, W., May, E. and Deshpande, A. (2014). Concentrations of polychlorinated biphenyls in the muscle of striped bass (*Morone saxatilis*) from the US mid-Atlantic coast, near Cape Hatteras, North Carolina: Effects of lengths with relevance to the fish consumption advisories. Presented at NOAA EPP Forum. University of Maryland Eastern Shore, Oct. 2014.
- Goodman*, W., Valsangikar, T., Gurung*, D. and Chen, N. (2014). Kinetic study of exoenzymatic alkaline phosphatase activity in the Maryland Coastal Bays. Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014.
- Grainger*, C., Malagon*, H., Alvarez*, J. and Chigbu, P. (2014). Density-dependent growth and mortality of juvenile spot (*Leiostomus xanthurus*) in Maryland Coastal Bays. Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014.
- Gurung*, D.P., Chen, N. and Waguespack, Y. (2014). Evaluation of sorption/desorption of phosphorus in sediments of the Maryland Coastal Bays. Presented at the NOAA Educational Partnership Program (EPP), 7th Biennial Education and Science Forum, University of Maryland Eastern Shore, MD, October 26-29, 2014.
- Henry*, X., Nagchaudhuri, A. and Mitra, M. (2014). Integrated Inland Culture of White Shrimp and *Gracilaria* species for Food and Bioenergy Production. Presented at NOAA EPP forum. University of Maryland Eastern Shore, October 2014.
- Jones*, T. (2014). Development of a Strategic Plan for Fostering Better Relationships with Native American Tribes for Environmental Conservation. Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014.
- Hughes, L., King*, M. D., Allen, A. L., Hashem, F. M., May, E. B., Bryant, R. B., Buda, A. R., Kleinman, P. J. A., & Kibet, L. C (2014). Elevated levels of urea nitrogen exist in coastal waters: A study of sources and causes. Nutrients and Environmental Quality: I poster session at ASA, CSSA, & SSSA 2014 International Annual Meeting. Long Beach, California.
- Klick*, S. and Pitula, J. (2014). The effect of interactions between the bacterial community structure and *Hematodinium perezii* in the Chincoteague Bay on the blue crab, *Callinectes sapidus*. Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014.
- Lycett*, K., Pitula, J. (2014). Disease ecology and fisheries management of the blue crab and its parasite *Hematodinium perezii* in the Maryland Coastal Bays (MCBs). Presented at the MEES Graduate Program Colloquium Solomon's Island, MD, October 2014.
- Malagon*, H. and Chigbu, P. (2014). Recruitment, growth and loss rates of young-of-the-year Summer Flounder (*Paralichthys dentatus*) in the Maryland Coastal Bays (MCBs). Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014.
- Malagon*, H., Mayor*, E. and Chigbu, P. (2014). Using GIS to map the spatial distributions and abundance of summer flounder and its major prey organisms in the Maryland Coastal Bays. Sixth International Symposium on GIS/ Spatial Analyses in Fishery and Aquatic Sciences, Tampa, Florida, August 2014.
- Martinez-Rivera*, S. and Stevens, B.G. (2014). Reproduction and sexual maturity of the red deep-sea crabs (*Chaceon quinque-dens*) in the Mid-Atlantic Bight. Presented at the MEES Graduate Program Colloquium Solomon's Island, MD, October 2014.
- May, E.B., Allen, A. and Bryant, R. (2014). An Examination of the autochthonous sources of urea in watersheds. Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014.
- Maxwell*, M., Booker, T., and May, E.B. (2014). Determination of vitellogenin in White Perch as a biomarker of exposure to estrogenic compounds. Presented at the National Oceanic Atmospheric Association-Educational Partnership Program Conference (NOAA-EPP, University of Maryland Eastern Shore Oct. 21st-26th, 2014)
- McCants*, J., Partker, A. and Gong, T. (2014). A qualitative study of the socioeconomic factors affecting entry-stay-exit behavior of the Blue Crab Watermen in Maryland. Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014.
- Ngoka*, N., Richardson, C., Abass, R., Ishaque, A., Jesien, R. (2014). Vitellogenin (VTG) as a biomarker for Contaminants of Emerging Concern in Maryland Coastal Bays. Presented at the 17th Annual Undergraduate Research Symposium in the Chemical and Biological Sciences, UMBC. October 2014.

- Oghenekaro, E.* Acheampong, A.O.* and Chigbu, P. (2015). Life History and reproductive biology of marine podonids (*Evadne nordmanni* and *Pseudevadne tergestina*) in Maryland Coastal lagoons. Presented at the Association for the Sciences of Limnology and Oceanography conference, Granada, Spain, February 2015.
- Pereira*, V. and Sexton, M. (2014). Salinity tolerance of *Chrysaora quinquecirrha*. Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014. 2nd place, undergraduate poster in Healthy Oceans.
- Pereira*, V. and Sexton, M. (2014). Salinity tolerance of *Chrysaora quinquecirrha*. Presented at SACNAS Los Angeles, CA October 2014.
- Richardson*, C., Ngoka*, I., Abass, R. and Jesien, R. (2014). Determination of Contaminants of Emerging Concern (CECs) in Maryland Coastal Bays. Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014.
- Rosales*, D, Lycett*, Kristen and Pitula, J. (2014). Molecular techniques in detecting harmful dinoflagellates in the Maryland Coastal Bays. Presented at MEES colloquium Chesapeake Biological Laboratory, October 24-25 2014.
- Rosales*, D, Lycett*, Kristen and Pitula, J. (2014). Molecular Techniques in Detecting Harmful Dinoflagellates In the Maryland Coastal Bays. Presented at the NOAA EPP 7th Biennial education and Science forum October 26-29 2014.
- Rubacalva, K.*, Alvarez, J.*, Malagon, H.* and Chigbu, P. (2015). Inter-annual variations in the recruitment of spot in the Maryland Coastal Bays. Presented at the Emerging Researchers National (ERN) Conference in STEM, February 19-21, 2015, Washington, D.C.
- Rubacalva, K.*, Alvarez, J.*, Malagon, H.* and Chigbu, P. (2014). Inter-annual variations in the recruitment of spot in the Maryland Coastal Bays. Presented at the 2014 SACNAS National Conference, October 16-18, 2014, Los Angeles, CA.
- Schweitzer*, C. and Stevens, B. (2014). Disturbance of marine benthic ecosystems by commercial trap fishing. Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014.
- Sturn*, A., Booker*, T. and May, E. (2014). Oocyte Development in White Perch (*Morone americana*). Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014.
- Thornton*, R., Henry*, X., Charles, R., Love, S., Mitra, M. and Waguespack, Y. (2014). Urea's Impact on *Gracilaria* growth in the Delmarva Coastal Bays. Presented at NOAA EPP forum. University of Maryland Eastern Shore, October 2014.
- Volkis*, B.S., Park*, So-Jin, Nwaeze, D.I., Volkis, V., Chigbu, P. (2014). Probing polymeric blends with natural extracts from sponge, algae, berries and herbs for antifouling Protection against Barnacles and other fouling factors. Presented at the NOAA EPP 7th Biennial education and Science forum October 26-29 2014.
- Wood*, K., Booker*, T. and May, E. (2014). The Use of vitellogenin as a biomarker in White Perch (*Morone americana*). Presented at NOAA EPP Forum. University of Maryland Eastern Shore, October 2014.

[UMCES: 19 posters, 19 student presenters](#)

- *Dasi, E., Jones G.D., Place, A.R. & Jagus, R. Regulation of gene expression in the toxic dinoflagellate *Amphidinium carterae*: Using a yeast eIF4E knockout strain to assess the function of dinoflagellate eIF4Es. NOAA-EPP Forum, UMES, Princess Anne, MD. 26-29 October, 2014.
- *Davis, J. J. *Vicente and R. T. Hill. Photosynthetic sea slug *E. crispata* harbors similar bacterial communities in two geographically distinct Caribbean locations. NOAA-EPP Forum, UMES, Princess Anne, MD. 26-29 October, 2014.
- *Davis, J. J. *Vicente and R. T. Hill. 2015. Photosynthetic sea slug *E. crispata* harbors similar bacterial communities in two geographically distinct Caribbean locations. Association for the Science of Limnology and Oceanography Aquatic Sciences Meeting. Grenada, Spain.
- *Davis, J., N. F. Montalvo, J. *Vicente, J. Ravel and R. T. Hill. 2014. Integration of culture-based and molecular analysis of a complex sponge-associated bacterial community. 2nd International Symposium on Sponge Microbiology. Baltimore, Maryland.
- *Gillespie, K., *Dasi, E. & Jagus, R. Functional characterization of Class I and Class II eIF4E family members in zebrafish. NOAA-EPP Forum, UMES, Princess Anne, MD. 26-29 October, 2014.
- *Gillespie, K., *Dasi, E. & Jagus, R. Functional characterization of Class I and Class II eIF4E family members in zebrafish. MEES Colloquium. Chesapeake Biological Lab Solomons, MD. 2014. Poster session.
- *Green, S., Chung, J.S., Stevens, B. Understanding the reproductive endocrinology of the deep sea red crab, *Chaceon quinqueedens*: identification of reproductive regulators and vitellogenin. 2015 ASLO Aquatic Sciences Meeting, Granada Spain February 2015.

- *Green, S., Chung, J.S., Stevens, B. Understanding the reproductive endocrinology of the deep sea red crab, *Chaceon quinque-dens*: identification of reproductive regulators and vitellogenin. PROMISE-AGEP Research Symposium & Professional Development Conference, College Park, MD February 2015.
- *Green, S., Chung, J.S., Stevens, B. Understanding the reproductive endocrinology of the deep sea red crab, *Chaceon quinque-dens*: identification of reproductive regulators and vitellogenin. NOAA-EPP Forum, UMES, Princess Anne, MD. 26-29 October, 2014.
- *Green, S., Chung, J.S., Stevens, B. Understanding the reproductive endocrinology of the deep sea red crab, *Chaceon quinque-dens*: identification of reproductive regulators and vitellogenin. MEES Colloquium 2014, Solomons, MD October 2014.
- *Hanif, A., Jagus, R., Place, A.R. Characterizing the gut microbiome of two menhaden species using metabarcoding. NOAA-EPP Forum, UMES, Princess Anne, MD. 26-29 October, 2014. Oral presentation
- *Hanif, A., Jagus, R., Place, A.R. 2014. Characterizing the gut microbiome of two menhaden species using metabarcoding. MEES Colloquium. Chesapeake Biological Lab Solomons, MD. 2014. Poster session
- *Hanif, A., Jagus, R., Place, A.R. 2014. Characterizing the gut microbiome of two menhaden species using metabarcoding. Maryland Sea Grant site review. University of Maryland, College Park 2014. Poster session
- *Marsan, D. & Chen, F. 2014. Nutrient responses of a Chesapeake Bay picocyanobacterium unveiled through gene expression. NOAA-EPP Forum, UMES, Princess Anne, MD. 26-29 October, 2014. [First prize graduate poster presentation in Healthy Oceans].
- *Marsan, D. & Chen, F. Nutrient responses of a Chesapeake Bay picocyanobacterium unveiled through gene expression. MEES Colloquium. Chesapeake Biological Lab Solomons, MD. 2014.
- *Vicente, J., N. Silbiger and R. T. Hill. 2014. Impact of ocean acidification on the process of silica biomineralization by the invasive Hawaiian sponge *Mycale grandis*. 2nd International Symposium on Sponge Microbiology. Baltimore, Maryland.
- *Vicente, J., N. Silbiger and R. T. Hill. 2014. Impact of ocean acidification on the process of silica biomineralization by the invasive Hawaiian sponge *Mycale grandis*. NOAA-EPP Forum, UMES, Princess Anne, MD. 26-29 October, 2014.
- *Vicente, J., L. Blasiak and R. T. Hill. 2014. Exploring diversity and function of bacterial symbionts in a two-sponge symbiosis. 2nd International Symposium on Sponge Microbiology. Baltimore, Maryland.
- Zhang, F., *J. Vicente and R. T. Hill. 2014. Temporal changes in the diazotrophic bacterial communities associated with Caribbean sponges *Ircinia strobilina* and *Mycale laxissima*. 2nd International Symposium on Sponge Microbiology. Baltimore, Maryland.

Publications (*Students)

[DSU: 2 publications, 2 student co-authors](#)

Haponski, A.E., Dean*, H., Blake, B.E., Stepien, C.A. (2014). Genetic History of Walleyes Spawning in Lake Erie's Cattaraugus Creek: Comparison of pre- and post-stocking. *Transactions of the American Fisheries Society* 143(5): 1295-1307.

Janiak, * C.R., McIntosh, Dennis. (2014). Performance of two egg collector designs for use with Mummichogs *Fundulus heteroclitus*. *North American Journal of Aquaculture* 76(4):399-406.

[HU: 3 publication, 0 student co-authors](#)

Braun, C.D., M.B. Kaplan, A.Z. Horodysky, and J.K. Llopiz. Satellite telemetry reveals physical processes driving billfish behavior. *Animal Biotelemetry* 3(2): 1-16.

Graves, J.E. & A.Z. Horodysky. (In Press) The challenges of estimating post-release mortality of istiophorid billfishes caught in the recreational fishery. *Fisheries Research*.

Kalinowski, M., A. Hirons, A. Horodysky, & R. Brill. (2014). Spectral sensitivity, luminous sensitivity, and temporal resolution of the visual systems in three sympatric coastal shark species: *Carcharhinus plumbeus* (sandbar shark), *Mustelus canis canis* (smooth dogfish), and *Squalus acanthias* (spiny dogfish). *Journal of Comparative Physiology – A: Neuroethology, Sensory, Neural, and Behavioral Physiology*. 200(12): 997-1013.

[OSU: 3 publications, 2 student co-authors](#)

- Bond*, M.H., Miller, J.A., and Quinn, T.P. 2015. Beyond dichotomous life histories in partially migrating populations: Cessation of anadromy in a long-lived salmonid. *Ecology*.
- Hart, L. M., Bond, M. H., May-McNally, S. L., Miller, J. A., and Quinn, T. P. 2015. Use of otolith microchemistry and stable isotopes to investigate the ecology and anadromous migrations of Northern Dolly Varden from the Egegik River, Bristol Bay, Alaska. *Environmental Biology of Fishes*.
- Miller, J. A., DiMaria*, R. A., Hurst, T.P. 2015. Patterns of larval source distribution and mixing in early life stages of Pacific cod (*Gadus macrocephalus*) in the southeastern Bering Sea Deep-Sea Research II. <http://dx.doi.org/10.1016/j.dsr2.2014.12.012>
- [RSMAS: 5 publications, 2 student co-authors](#)
- Babcock, E. A., Harford, W. J., Coleman, R., Gibson, J., Maaz, J., Foley, J. & Gongora, M. (2015). Bayesian depletion model estimates of spiny lobster abundance at two marine protected areas in Belize with or without in-season recruitment. *ICES Journal of Marine Science*. doi: 10.1093/icesjms/fsu226
- Harford, W. J., C. Ton*, C. & Babcock, E. A. (2015). Simulated mark-recovery for spatial assessment of a spiny lobster (*Panulirus argus*) fishery. *Fisheries Research* 165:42-53. doi: 10.1016/j.fishres.2014.12.024
- Karnauskas, M. & Babcock, E.A. (2014). An analysis of indicators for the detection of effects of marine reserve protection on fish communities. *Ecological Indicators* 46:454-465. doi:10.1016/j.ecolind.2014.07.006
- Lirman, D, Thyberg, T., Santos*, R., Drury, C., Schopmeyer, S., Bellmund, S., Serafy, J., & Collado, L. (2014). Status and trends of SAV communities along the western shoreline of Biscayne Bay, Miami, Florida, US: Human and natural drivers of seagrass and macroalgae abundance and distribution. *Estuaries and Coasts* DOI 10.1007/s12237-014-9769-6
- Santos,* R., Lirman, D., & Pittman, S. (In press). Long term dynamics in vegetated seascape: fragmentation and habitat loss in a human-impacted subtropical lagoon. *Marine Ecology*.

[SSU: 3 publications, 1 student co-authors](#)

- Sherman* M and Curran MC. 2015. Sexual Sterilization of the Daggerblade Grass Shrimp *Palaemonetes pugio* (Decapoda: Palaemonidae) by the Bopyrid Isopod *Probopyrus pandalicola* (Isopoda: Bopyridae). *J. Parasitol.* 2015 Feb 29;101(1):1-5. Epub 2014 Oct 29.
- Pertree RM, Kovacs CJ, and Cox TM (2014) Standardization and application of metrics to quantify human-interaction behaviors by the bottlenose dolphin (*Tursiops* spp.) *Marine Mammal Science* 30(4):1320-1334
- Gerido, L. and Curran MC. (2014) Enhancing science instruction through student-created PowerPoint Presentations. *The American Biology Teacher* 76(9):627-631.

[UMES: 4 publications, 4 student co-authors](#)

- Meng Xia, Long Jiang* (2014). Related wind forcing to the bottom dissolved oxygen/hypoxia at a shallow northern Gulf of Mexico bay estuary: A numerical based process studies "*Ocean Dynamics*" (In Press).
- Qianru Niu¹, Meng Xia, Edwards Rutherford, Doran Mason, Eric J. Anderson, David J. Schwab (2014), The dynamics of Lake Erie circulation using a Finite Volume Coastal Ocean Model "*Journal of Geophysical Research-Ocean*" (In Press)

[UMCES-IMET: 12 publications, 10 student co-authors](#)

- *Davis J, WF Fricke, MT Hamann, PC Dorrestein, E Esquenazi, and RT Hill. 2013. Characterization of the bacterial community of the chemically defended Hawaiian sacoglossan *Elysia rufescens*. *Appl. Environ. Microbiol.* 79:7073-7081
- *Davis J and RT Hill. 2014. Draft genome sequence of Hawaiian sea slug symbiont *Vibrio* sp. strain ER1A. *Genome Announc.* 2(4):00820-14.
- *Jones, G. D., Williams, E. P., Place, A. R., Jagus, R., and Bachvaroff, T. R., (2015). The alveolate translation initiation factor 4E family reveals a custom toolkit for translational control in core dinoflagellates *BMC Evoln Biol* 15(1) 301.
- *Marsan D, Wommack KE, Ravel J, Chen F. 2014. Draft genome sequence of *Synechococcus* sp. strain CB0101, isolated from the Chesapeake Bay estuary. *Genome Announc.* 2(1):e01111-13. doi:10.1128/genomeA.01111-13.
- *Marsan, D., Rigaud, S., and Church, T. 2014. Natural Radionuclides 210Po and 210Pb in the Delaware and Chesapeake Estuaries: Modeling scavenging rates and residence times. *Journal of Environmental Radioactivity.* Vol 138, 447-455.

- *Montalvo NF, *Davis J, J *Vicente, R Pittiglio, J Ravel, and RT Hill. 2014. Integration of culture-based and molecular analysis of a complex sponge-associated bacterial community. PLoS ONE 9(3): e90517. doi:10.1371/journal.pone.0090517 (co-first author)
- Rigaud, S., Stewart, G., Baskaran, M., *Marsan, D., Church, T. 2014. 210Po and 210Pb distribution, dissolved-particulate exchange rates, and particulate export along the North Atlantic US GEOTRACES GA03 section. Limnology and Oceanography. In press.
- Schreier, H. J., & Schott, E. J. (2014). Draft Genome Sequence of the Shellfish Bacterial Pathogen *Vibrio* sp. Strain B183. *Genome Announcements*, 2(5), e00914–14. doi:10.1128/genomeA.00914-14
- Schreier HJ, Schott EJ. (2014). Draft Genome Sequence of the Oyster Larval Probiotic Bacterium *Vibrio* sp. Strain OY15. *Genome Announcements*. 2(5), e01006-14. doi: 10.1128/genomeA.01006-14.
- W. Thongda, J. Sook Chung, N. Tsutsui, N. Zmora, *A. Katenta* (2015). Seasonal variation in the reproductive activity of the blue crab, *Callinectes sapidus*: vitellogenin expression and levels of vitellogenin in the hemolymph during ovarian development. CBP 23535 -Molecular and Integrative Physiology A 2014 Sep 10. pii: S1095-6433(14)00181-0. doi: 10.1016/j.cbpa.2014.08.019.
- Zhang, F., J. *Vicente and R. T. Hill. 2014. Temporal changes in the diazotropic bacterial communities associated with Caribbean sponges *Ircinia strobilina* and *Mycale laxissima*. Front. Microbiol. doi: 10.3389/fmicb.2014.00561
- *Vicente, J., S. Zea, R. J. Powell, J. R. Pawlik and R. T. Hill. 2014. New epizootic symbioses between sponges of the genera *Plakortis* and *Xestospongia* in cryptic habitats of the Caribbean. Mar. Biol. doi: 10.1007/s00227-014-2546-z

Appendix V: TAB Funded Reports for the Period of 2014 - 2015

Project Number: 15-01

Project Title: Microsatellite Markers Isolation (EST-SSR's) for Association Tests of Reproductive Phenotypes (GnRH, FSH and LH) in the Context of Environmental Variability for Chinook Salmon.

Project Abstract:

Chinook salmon is a culturally important and economically valuable fish. These anadromous and semelparous fish express diverse life histories that are characterized by the season of their return migration (called a "run") to spawning habitat. Prior research identified four spatially distinct subpopulations: 'Drift Creek', 'Spring', 'Fall', and 'Summer'. We plan to better resolve temporal population substructure by developing genetic markers that are linked to the regulation of gamete maturation. Traditionally, Spring run Chinook salmon migrate farther upriver with gonads that are less mature than the later Fall run. The timing of gamete maturation is synchronous with the arrival of fish on spawning habitat. The main hormone responsible for gamete maturation is Gonadotropin-releasing Hormone (GnRH). Our development of functional candidate markers that are associated with GnRH regulation may resolve temporal population substructure among the spatially separated subpopulations and enable future application for identifying environmental variables that contribute to population genetic structure.

Thematic Area: Quantitative Fisheries

Lead Scientist: Michael Banks (OSU)

NOAA Collaborator: Peter Lawson (NOAA/NWFSC)

Other Collaborators: Andrij Horodysky (Hampton Univ)

Research Students: Chante Davis (PhD Student, OSU)

Start Date: September 2014

End Date: August 2015

Results of Project to Date: To better resolve substructure, novel functional candidate markers were identified within the Gonadotropin-releasing Hormone (GnRH) gene. GnRH is the main hormone responsible for gamete maturation therefore our development of microsatellite markers that are associated with the regulation of this gene may enable resolution of temporal population substructure.

Fluorescent markers were ordered for the six primer pairs that were confirmed following work that occurred during the prior quarter. These markers were not polymorphic and therefore we began a new marker search targeting a new set of genes.

The genes that I am targeting are the genes responsible for the regulation of the reproductive hormones. I redesigned a code using R programming that would generate a new list of potential Expressed Sequence Tag (EST), however a manual method resulted in better designed primers. A new set of primers will be ordered at the end of the month and I will be testing them for their ability to amplify regions of interest in the coming months.

Presentations at regional, national, or international meetings:

Davis, C. D. and M.A. Banks. Resolving temporal substructure among Chinook salmon (*Oncorhynchus tshawytscha*) population in Siletz River, OR Granada Spain, Feb 23-28 2015.

Davis, C.D., & Banks, M.A. Development of microsatellite markers to differentiate Chinook salmon migratory runs. NOAA Educational Partnership Program (EPP) conference, October, 26 – 29, 2014.

How will results be incorporated into NOAA Fisheries operations?

Management at broad multi-basin scales characterizes Pacific salmon restoration planning; however, the finer-scale genetic variability that may be present within individual basins is currently not part of recovery planning. This fine-scale variability may be a critical component for long-term population resilience in this dynamic landscape. It is the goal of my research to assess Chinook salmon population structure in a small coastal river system using microsatellite markers and candidate loci. I work with local managers and tribal stakeholders so that my research may address both the needs of my local community in addition to that of NOAA. My current research has presented evidence for substantial interaction among physical, environmental, and biological variables that created complex subpopulation structure of the Chinook within the Siletz River (Davis and Banks *in prep*). The results provided a useful context for the future application of theoretical modeling approaches in riverscape genetics to elucidate a better understanding of what environmental variables are contributing to the maintenance of subpopulation structure. The management implications of my research may allow NOAA scientists to track the contribution of subpopulations within the Siletz watershed to the coastal oceanic salmon fishery. Once population structure within the river is identified, these subpopulations can be compared to regional Chinook populations.

How will results be incorporated into LMRCSC research and curriculum?

Research, analysis, presentation and write-up experience and knowledge exchanged between the students and faculty participating in this project will contribute to LMRCSC research and curriculum through exposing participants to advances in riverscape genetics with population genomics.

Project Number: 15-02

Project Title: Potential Impacts of the Savannah Harbor Expansion Project (SHEP) on the temporal and spatial patterns of fish assemblages near the mouth of the Savannah River, Georgia

Project Abstract:

Over half of the commercial Atlantic catches are species that are dependent upon estuaries at some point during their life cycles. The recently approved Savannah Harbor Expansion Project will result in the deepening of the Savannah River shipping channel. Outcomes may be increased salt water intrusion and lower dissolved oxygen levels, which could negatively impact fishes of commercial and recreational importance that utilize the Savannah River estuary. The objectives of this proposal are to: 1) Determine the temporal and spatial patterns of fish assemblages near the mouth of the Savannah River before and after the deepening; 2) Determine fish health through gonadal histology; and 3) Publish a K- 12 activity geared toward the effects of anthropogenic impacts on the marine environment.

Thematic Area: Essential Fish Habitat

Lead Scientist: Jennifer Güt (SSU)

NOAA Collaborator: John Manderson (NOAA/NEFSC)

Other Collaborators: Andrea Johnson (UMES)

Research Students: Jennifer Güt (MS Student, Savannah State U.)

Start Date: September 2014 **End Date:** August 2015

Results of Project to Date:

Presentations at regional, national, or international meetings:

How will results be incorporated into NOAA Fisheries operations?

How will results be incorporated into LMRCSC research and curriculum?

Project Number: 15-03

Project Title: Analyzing diets of Atlantic menhaden using metabarcoding

Project Abstract:

Atlantic menhaden is a key forage species that serves as a trophic link between the plankton and predator fishes and birds, but identification of food organisms by traditional microscopic methods is extremely difficult, limiting insights into the predator-prey interactions of these fish. In this project, we have developed molecular techniques, based on *cox1* DNA, to identify phytoplankton and microbiome species in stomach contents of these fish and to compare them with those found in plankton. We have also begun to look for barcode sequences targeting eukaryotic organisms and detrital material in the diet using a primer set targeting the V4-V5 region of the 18S rRNA gene as described in Hugerth *et. al.* 2014, and high-throughput sequencing using Illumina's MiSeq platform. This work demonstrates that menhaden are constantly sampling the microbial environment, and do not distinguish between detrital and prey items, thus their stomach microbiome reflects the water column due to flocculent aggregation, and may include pathogens and fecal bacteria. Our results suggest that menhaden can be used as indicators of ecosystem health and such data should become a part of management decisions.

Thematic Area: Essential Fish Habitat

Lead Scientist: Ammar Hanif (UMCES/IMET)

NOAA Collaborator: Kevin Friedland (NOAA/NEFSC)

Other Collaborators: Al Place (UMCES/IMET); Bradley Stevens (UMES)

Research Students: Ammar Hanif (PhD Student, UMCES/IMET)

Start Date: September 2014

End Date: August 2015

Results of Project to Date:

Upon completion of the 16S sequencing results to look at the microbiome and photosynthetic prey items we sought to look further in the diets of menhaden by using a different barcode targeting eukaryotic organisms. This will allow us to identify various prey items as well as look into the composition of the detrital material that makes up most of the gut material. Unlike prokaryotes, less emphasis has been placed on finding a universal DNA barcode for eukaryotes until recently. Given that the diet of menhaden consists mainly of phytoplankton and zooplankton, a suitable barcoded needed to be developed in order to detect these groups. After a literature search we decided to use a primer set targeting the V4-V5 region of the 18S rRNA gene as described in Hugerth *et. al.* 2014. We have successfully amplified the menhaden samples with this primer set and are now ready for high-throughput sequencing using Illumina's MiSeq platform.

Given that menhaden are filter feeders, they are constantly sampling the microbial environment. The amount of detrital material found in their stomachs show that menhaden do not distinguish between detrital and prey items. Therefore it has been postulated that the menhaden stomach microbiome will reflect that of the water column despite the fact that some organisms are too small to be filtered via their gill rakers. This may come as a result of bacteria aggregating on appropriately sized debris. By using bioinformatics and molecular techniques we are looking for bacterial indicators of aquatic and ecosystem health, such as pathogens and fecal bacteria. The results from this can show that menhaden can be used as indicators of ecosystem health and possibly become a part of management decisions.

Upon closer evaluation of sample data sheet we realize that the current samples were not Atlantic menhaden but rather Gulf menhaden. They were collected in two locations in the Apalachicola bay of the Gulf of Mexico. Gulf menhaden are very closely related to Atlantic menhaden in that similar work has been done on both species. They both share the same economic and ecological importance in their respective locations. That being said, the resulting implications from these experiments would most likely apply to Atlantic menhaden. Over the 2014 year we did collect several Atlantic menhaden whose diet and microbiome will be analyzed using similar techniques as the Gulf menhaden samples for comparison studies.

Presentations at regional, national, or international meetings:

- Ammar Hanif, Rosemary Jagus, Allen Place. Characterizing the gut microbiome of two menhaden species using metabarcoding. NOAA Educational Partnership Program 7th Biennial Education and Science Forum. University of Maryland, Eastern Shore Princess Anne, MD. 2014. Oral presentation

- Ammar Hanif, Rosemary Jagus, Allen Place. Characterizing the gut microbiome of two menhaden species using metabarcoding. MEES Colloquium. Chesapeake Biological Lab Solomons, MD. 2014. Poster session
- Ammar Hanif, Rosemary Jagus, Allen Place. Characterizing the gut microbiome of two menhaden species using metabarcoding. Maryland Sea Grant site review. University of Maryland, College Park 2014. Poster session

How will results be incorporated into NOAA Fisheries operations?

Through a better description of the dietary items used by menhaden, management can make better decisions on when or where to close the fishery.

How will results be incorporated into LMRCS research and curriculum?

In MEES 606 Cell and Molecular Biology for Environmental Scientists we have added a lecture on microbiome production and analysis. This will be expanded in the future in actual analysis of the primary data.

Project Number: 15-04

Project Title: Comparison of NOAA Montlake meal and Otohime feed performance in aquacultured pompano: feed ration, feed frequency, feed conversion ratio, and feed efficiency.

Project Abstract:

As the demand for Florida pompano continue to increase aquaculture practices must be refined to optimize growth to satisfy a growing market. This project investigated the gastric evacuation of aquacultured juvenile Florida pompano fed three different diets at three temperatures to direct production of young life stages. Juvenile pompano were fed diets of frozen mysid shrimp, NOAA Montlake meal, and Otohime EP2 fish pellets at 20°C, 25°C, and 30°C. During the experiment, three fish were randomly sampled from the total population every 60 min and euthanized in MS-222 solution. Fish were then weighed (g), measured (SL), and frozen immediately for a period of 24-48h prior to dissections. The stomach and its contents were then emptied, patted dry, and weighed. A pilot gastric evacuation study was conducted January 21, 2014 using commercial Otohime EP2 fish meal; results indicated gastric evacuation was completed with an 11-12h time period after initial feed. A follow-up pretrial study was then conducted testing commercial EP2 fish meal to frozen mysid on March 12, 2014. Results from the March study indicated that juvenile pompano fed the frozen mysid diet completed gastric evacuation within a 6h time period. However, juvenile pompano fed Otohime EP2 fish pellets completed gastric evacuation at the 10h time period. Due to different growth rates according to diet, pompano fed NOAA Montlake and Otohime EP2 pellets have had gastric evacuation experiments conducted at 30°C, 25°C, and 20°C thus far. Results have indicated that the Otohime EP2 diet leads to faster gastric evacuation of juvenile pompano at 30°C, 25°C, and 20°C; however, anecdotal observations indicated that pompano fed NOAA Montlake diet on a higher average body weight and size compared to pompano fed the Otohime EP2 diet. Results from this study indicate that 30°C is an optimum temperature for pompano evacuation independent of the diet tested. If funded, an additional growth study will be conducted to formally compare the growth rates of juvenile pompano fed Otohime EP2 compared to NOAA Montlake meal.

Thematic Area: Aquaculture

Lead Scientist: Andrij Horodysky (Hampton Univ)

NOAA Collaborator: Ronald Johnson (NOAA/NWFSC)

Other Collaborators: Deidre Gibson (Hampton Univ); Michael Schwarz (VA Tech)

Research Students: Larry Redd, Jr. (MS Student, Hampton U.)

Start Date: September 2014

End Date: August 2015

Results of Project to Date:

A pilot trial consisting of 105 juvenile pompano was conducted using Otohime EP2 feed (a common feed for this species) at 27°C on January 21, 2014 and completed on February 2, 2014. Results indicated that gastric evacuation was completed at approximately hours 11-12 after initial feeding. The longer-than-expected duration may have been due to incomplete evacuation before the experimental feeding, thus a second pilot trial was planned. The second pilot trial was conducted with 100 juvenile pompano divided into two groups of 50. Group 1 was fed Otohime EP2 and Group 2 was fed frozen mysids until

satiation. The results of the second pilot trial indicated that juvenile pompano have a faster rate of digestion and assimilation of the frozen mysid shrimp diet than the commercially prepared Otohime EP2 diet. Juvenile pompano fed frozen mysid shrimp showed complete gastric evacuation at approximately the 6 hour time-point; whereas, fish fed the Otohime EP2 diet completed gastric evacuation at hour 10. The combined results confirm both the initial pilot trial (EP2 timelines are similar), as well as literature observations (mysid evacuation is similar to short digestion time for actual prey items in pompano). Experimental results of pilot trials refined the protocol for the three treatments used in this study.

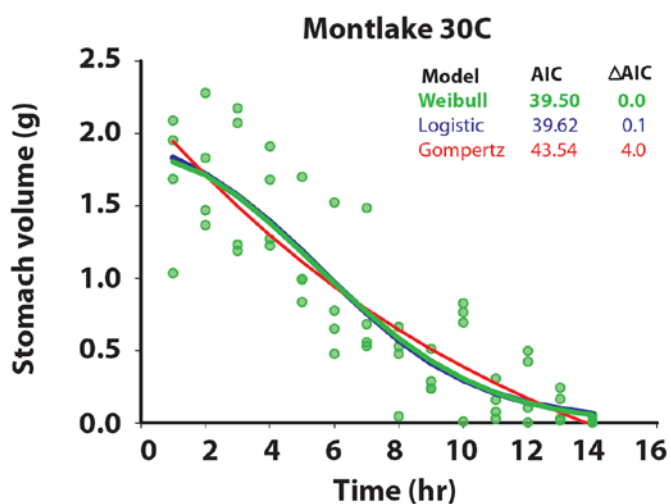
The experimental population of pompano (1600 individuals) were ordered from Troutlodge in late February and delivered in early March. Fish were very undersized (mean: 0.2g) relative to the expected 0.5g. Fish were divided equally into experimental tanks and fed individual diets until reaching the appropriate range to conduct the study at each temperature. The gastric evacuation of juvenile pompano (mean: 23.9-24.5g) at 30°C was conducted June 30, 2014 and completed on July 1, 2014. The results indicated that pompano fed the NOAA Montlake diet completed gastric evacuation approximately at hour 14; however, pompano fed the Otohime EP2 diet completed gastric evacuation at approximately hours 13-14 after initial feeding. The gastric evacuation of juvenile pompano (mean: 23.2-25.9g) at 25°C was conducted July 14, 2014 and completed July 18, 2014. The results indicated pompano fed the NOAA Montlake diet approximately at hours 15-16 after initial feeding; however, pompano fed the Otohime EP2 diet completed gastric evacuation at hour 14. On July 28, 2014 the gastric evacuation of juvenile pompano (22.1-32.5g) was conducted and completed on August 1, 2014 at 20°C. The results indicated pompano fed the NOAA Montlake diet approximately at hours 15-16 after initial feeding; however, pompano fed the Otohime EP2 diet completed gastric evacuation at hours 14-15. The results of the experimental procedure confirmed that gastric evacuation rates are affected by temperature. Additionally volumetric experiments were conducted on the juvenile pompano of both NOAA Montlake and Otohime EP2 diets at 30°C, 25°C, and 20°C testing the relationship of fish mass (g) to volume of water displaced (ml). The results indicate that there is strong positive linear relationship between fish mass (g) and water displaced (ml), thus displacement can be used as a nonlethal proxy for evacuation.

Pompano fed the frozen mysid diet encountered very slow growth indicating the mysid diet would not be sustainable financially or from a productivity standpoint for aquaculture of juvenile pompano. On August 27, 2014 pompano on the frozen mysid diet were weighed with the average pompano ranging 4.08-4.46g. The gastric evacuation experiments for mysid fed pompano were conducted at two temperatures 30°C & 20°C. Results indicated pompano fed mysid shrimp evacuated approximately at hour 12 after initial feeding at 30°C. Additional results indicated pompano fed mysid shrimp evacuated approximately at hours 8-9 after initial feeding at 20°C.

Beginning in January 2015 linear and nonlinear modeling of the gastric evacuation data commenced. Seven base models were fitted to the data with model fit assessed by Akaike's Information Criterion for each diet and temperature (lower AIC value=better fit). Results have indicated that Weibull model fits the data best for 30°C and 20°C for the Montlake and Otohime diet. Additional modeling will be conducted for both the Montlake and Otohime diets at 25°C. Furthermore, in March 2015 we will begin to use Kimura's (2008) information theoretic model building approach to examine the significance of temperature and diet covariates. Additionally, a comparative growth study of Florida pompano fed NOAA Montlake meal vs. Otohime EP2 is scheduled to begin 5/12/2015. Pompano fry (n=1,000) were originally expected in Jan, but the vendor (Troutlodge) lost the entire first spawn of 2015 season due to a disease outbreak in early Jan. Fry from the second spawn are scheduled to arrive on March 12, 2015 weighing approximately 0.2g.

Presentations at regional, national, or international meetings:

This project was presented at the NOAA Educational Partnership Program 7th Biennial Education and



Science Forum in October 2014 at the University of Maryland Eastern Shore. Additionally, this work was presented internationally at the 2015 Aquatic Sciences Meeting in Granada, Spain in late February.

study will be conducted to formally compare the growth rates of juvenile pompano

How will results be incorporated into NOAA Fisheries operations?

We are working with Dr. Ronald Johnson, Acting Program Manager, Environmental and Fisheries Sciences division, NOAA NWFSC. The results from this study will provide the first data on the performance of NOAA's Montlake feed on aquacultured Florida pompano, a rapidly growing candidate species for aquaculture. There is great potential for the refinement of the feed through this work. Further, if growth on Montlake feed is superior to other commercial (Otohime) or frozen (mysis) feeds (as anecdotally suggested by our results), there is the potential for Montlake feed (or its formulation and macronutrient component ratios) to be designated as an optimal feed for the culture of the species. Lastly, the development of protocols for feed type and temperature may serve as standards for culture of pompano, and temperature-specific evacuation may be used to inform/develop feed frequency protocols for the species.

How will results be incorporated into LMRCSC research and curriculum?

Dr. Horodysky used the data from this project in his departmental elective Ichthyology lecture (Spring 2014) and will do so in future semesters of his departmental required Biometry course (Spring semesters).

Project Number: 15-05

Project Title: RNA-DNA Ratios as Indicators of Ecosystem Health; metrics to determine the impact of land-use on fish habitat

Project Abstract:

Land development within the Chesapeake Bay watershed induces a suite of environmental stressors that negatively impact fish habitat and aquatic animal health. These effects degrade the ability of bay tributaries to serve as valuable nursery habitats for larval and juvenile fish which impacts fisheries production. We used RNA:DNA ratios as a bioindicators of larval and juvenile fish condition as a metric of fish habitat quality. The impact of variable land use patterns on fish habitat will be examined to further illustrate potential trade-offs between development on land and protection of habitats that provide a major socioeconomic and ecological contribution to coastal communities. To date, our research demonstrates significant differences in RNA:DNA ratios between two sampled rivers, which indicates significantly better conditions in the natural, pristine environment of Nanjemoy Creek, compared to the suburban environment of Mattawoman creek.

Thematic Area: Essential Fish Habitat

Lead Scientist: Joe Pitula (UMES)

NOAA Collaborator: Lonnie Gonsalves (NOAA/NOS-Oxford)

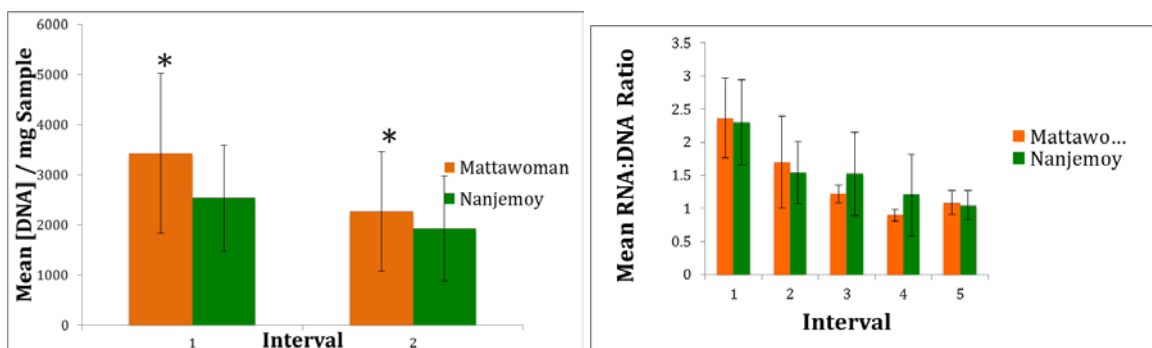
Other Collaborators: James Uphoff (MD-DNR)

Research Students: Derek Burton (MS Student, UMES)

Start Date: September 2014 **End Date:** August 2015

Results of Project to Date:

Results assessing juvenile fish development, as based on RNA:DNA ratio and DNA/mg of sample, were generated from 623 yellow perch larvae, collected between March –May of 2014. Figure 1 shows that the DNA/ mg of sample is significantly higher in the Mattawoman creek; indicating conditions are not as good compared to the Nanjemoy. ANCOVA test shows that there is a significant difference among the two rivers ($p < 0.001$). Figure 2 shows the average RNA:DNA ratio for each river based on Interval Dates. This representation shows no significant difference between each river. We conclude that there is an impact of land use on ecosystem health. Conditions are favorable in the natural, pristine environment (Nanjemoy Creek) compared to the suburban environment (Mattawoman).



Presentations at regional, national, or international meetings:

D. Burton, L. Gonsalves, J. Uphoff, C. Hoover, A. Park, and J. Pitula. Analysis of RNA and DNA as an indicator of Ecosystem Health. Presented at American Fisheries Society Meeting, Tidewater Chapter, March 5-7 2015.

How will results be incorporated into NOAA Fisheries operations?

We will use the approaches described here and apply them to a study ongoing in Choptank River. This is part of a larger initiative by NOAA to understand the dynamics of the Choptank River, as there is currently an oyster restoration project occurring in the Choptank. This site was chosen because of moderate salinities that favor good reproduction and also do not promote diseases (such as Dermo) that are favored in higher salinities.

How will results be incorporated into LMRCSC research and curriculum?

The results will be a test case for how a degraded ecosystem impacts larval development of yellow perch, and its impact on growth rates. Indirectly, this provides a snapshot of the ecosystem, and how other species may also be affected. It can be presented both in MEES seminar courses and in Fish Ecology courses.

Project Number: 15-06

Project Title: Analysis of Stranding Demographics and Contaminants in Marine Mammals from Coastal Maryland and the Chesapeake Bay

Project Abstract:

Contaminants and disease pose a serious risk to marine mammal health. The Marine Mammal Stranding Network offers a unique opportunity to examine the marine mammal health through the necropsy of stranded animals. Scientists from the Maryland Department of Natural Resources have compiled a long-term data set monitoring contaminant levels, observed incidence of disease, and overall health. This study will provide a robust analysis of this long-term data set that will examine the extent of contaminant exposure in marine mammals, the demographics of strandings, and the role of contaminants and disease in exacerbating stranding frequency. This information will be used to further guide analysis of the likely health impacts of chemical contaminants on marine mammal health. The proposed study intends to further the understanding of how humans impact the health and sustainability of marine mammal populations.

Thematic Area: Quantitative Fisheries

Lead Scientist: Andrea Johnson (UMES)

NOAA Collaborator: Lonnie Gonsalves (NOAA/NOS-Oxford)

Other Collaborators: Cindy Driscoll (MD-DNR)

Research Students: Audy Peoples (MS Student, UMES)

Start Date: September 2014 **End Date:** August 2015

Results of Project to Date:

Presentations at regional, national, or international meetings:

How will results be incorporated into NOAA Fisheries operations?

How will results be incorporated into LMRCSC research and curriculum?

Project Number: 15-07

Project Title: Ocean Acidification Effects on Ecology of Juvenile Northern Rock Sole

Project Abstract:

Flatfishes support important U.S. commercial fisheries in both the Atlantic and Pacific. Research on a range of species has suggested that the elevated CO₂ levels associated with ocean acidification (OA) can disrupt fishes' sensory biology and behavioral response to critical environmental stimuli, but no studies have yet examined these effects in any flatfish species. This work will examine if the behavioral sensitivity of juvenile flatfishes is impacted with a series of laboratory experiments rearing juvenile fish at elevated CO₂ and examining foraging behavior of these fish following exposure to various levels of predator threat. We originally planned to use northern rock sole for this project, but were unable to collect them in 2014, so will work with English sole and speckled sand dab. Work to date has focused on determining the strength of anti-predator responses to olfactory cues of predator threat. The responses observed in these species appear less strong than responses in cryptic and shelter-seeking reef species. This work will compliment studies of the direct physiological effects of OA on the growth and survival of egg and larval stages and improve our understanding of how the effects of OA will be manifest in complex ecosystems.

Thematic Area Addressed: Essential Fish Habitat

Lead Scientist(s): Dr. Jessica Miller, Oregon State University

NOAA Collaborator(s): Dr. Thomas Hurst, Alaska Fisheries Science Center

LMRCSC Collaborator(s): Dr. M. Carla Curran, Savannah State University

LMRCSC Research Student(s): Jessica Andrade (MS)

Start Date: 1 Sept 2014 **End Date:** 31 August 2015

Results of project to date: An apparent weak recruitment of northern rock sole in 2014 resulted in the inability to collect northern rock sole for this project. Therefore we have chosen to conduct experiments on two other species which are locally abundant in Pacific Northwest estuaries and coastal regions: English sole and speckled sand dab. Work to date has focused on determining the strength of anti-predator responses to olfactory cues of predator threat. The responses observed in these species appear less strong than responses in cryptic and shelter-seeking reef species. Future work will refine these patterns and evaluate the impact of OA on behavior.

Presentations at regional, national, or international meetings:

Andrade, J.F., T.P. Hurst, J.A. Miller, and S.A. Heppell. Flatfish behavioral responses to predatory threat under elevated carbon dioxide concentrations (Poster).

How will results be incorporated into NOAA Fisheries operations?

The results from this work will be directly incorporated into broader efforts of NOAA to identify and evaluate the magnitude of OA-induced effects on fisheries and marine ecosystems. A recent evaluation of the risks of OA to Alaskan communities did not consider the potential impacts of sensory/behavioral effects on population productivity (Mathis et al. 2014). If these effects are shown to be significant in flatfishes, they will be included in subsequent refinements of these semi-quantitative risk assessments as well as quantitative models of ecosystem responses (e.g. Busch et al. 2013).

How will results be incorporated into LMRCSC research and curriculum?

This project involves a graduate student from OSU and will include an undergraduate intern from SSU in Summer 2015. It will also serve as the foundation for a research collaboration between those institutions and the Alaska Fisheries Science Center. In addition this project stimulated the development of a graduate seminar course on relevant aspects of fish physiology and behavior for OSU students, including two LMRCSC students. This will serve as a model for engaging NOAA researchers into the curriculum of LMRCSC programs.

Project Number: 15-08

Project Title: Place Attachment and Traditional Ecological Knowledge in the Sea Islands: A Case Study of Endangered Culture

Project Abstract:

For centuries, Gullah-Geechee communities along the coastal Sea Islands of South Carolina and Georgia maintained their own way of life through a thriving economy based on ecology without compromising the natural environment. Proximity to the sea fostered an early tradition of seafood harvesting, ranging from cast netting to small-scale commercial shrimp boats (Blount, 2007). Harris Neck is a Sea Island community of cultural and ecological significance in the region. While place attachment has been researched extensively in the social and behavioral sciences, little research has been conducted on historic communities of color. The objective of this project is to quantify place attachment and describe traditional ecological knowledge between Gullah-Geechee communities in the Sea Islands.

Thematic Area: Fisheries Socio-Economics

Lead Scientist: Jolvan Morris (Savannah State U.)

NOAA Collaborator: Patricia Clay (NOAA/SERO)

Other Collaborators: Dionne Hoskins (SSU); Michael Jepson (NOAA/SERO)

Research Students:

Start Date: September 2014

End Date: August 2015

Results of Project to Date:

Presentations at regional, national, or international meetings:

How will results be incorporated into NOAA Fisheries operations?

How will results be incorporated into LMRCSC research and curriculum?

Project Number: 15-09

Project Title: Searching the coastal bay food web for reservoirs of a virus lethal to blue crab *Callinectes sapidus*

Project Abstract:

Blue crabs are a key link between benthic and pelagic food webs and support a commercial harvest of over \$180 million. Fluctuations in abundance are not well understood, and there is an increasing appreciation for the potential role of disease in natural mortality. The 2013 Chesapeake Bay Stock Assessment Committee listed scarce information on disease-related mortality as a critical data gap. Our studies have shown that prevalence of a virus lethal to blue crab (RLV) can be as high as 78%, with an average of 20% across the Chesapeake and the Northeast. RLV can be transmitted to blue crabs by consumption of infected conspecifics. To investigate the possibility that other crustacean species may be a reservoir for RLV, students will look for RLV in green crabs, grass shrimp, and other crustaceans in the coastal bays of MD, DE, and NJ. Crustaceans and corresponding environmental data will be collected from coastal bays by students from UMES and DSU in the spring and summer of 2015. Samples will be analyzed for RLV using qPCR methodology at IMET. Students will investigate the potential for other species to serve as hosts to RLV by conducting controlled infections. Preliminary studies demonstrated the ability to transmit RLV to green crabs (*Carcinus maenas*) by injection. This finding will be reconfirmed, and extended by an attempt to transmit the virus by feeding. Improved understanding of disease-related mortality of blue crab will be valuable demonstration to NOAA's efforts to understand natural mortality of other fishery species.

Thematic Area: Essential Fish Habitat

Lead Scientist: Eric Schott (UMCES/IMET)
NOAA Collaborator: Linda Stehlick (NOAA/NEFSC)
Other Collaborators: Gulnihal Ozbay (Delaware State Univ.); Joe Pitula (UMES)
Research Students: Kristen Lycett (PhD student, UMES); Matthew Stone (MS student, DESU).

Start Date: September 2014 **End Date:** August 2015

Results of Project to Date:

- The academic schedules of students (Lycett and Stone) and faculty precluded the collection of samples in the fall of 2014. Water temperatures cool rapidly in October and crabs were not expected to be active after November 1.
- The principal investigators and NOAA collaborator held a conference call on November 4, 2014. The feasibility of obtaining November crab samples was discussed and it was decided the focus energy on spring and summer sampling.
- Schott investigated the possibility of obtaining green crabs from bait dealers in the NJ and DE areas, and learned that green crab harvesting ceases at the end of October. Schott also reconfirmed that a collaborator in NJ (Paul Jivoff, Rider University) had also ceased field activity in the NJ coastal bays near the Rutgers Marine Station.
- Schott, Ozbay and Pitula also met at the 2014 NOAA-EPP conference (Oct. 26-29) at UMES and discussed logistics for summer sampling.

Presentations at regional, national, or international meetings:

Schott, E.J. January 16-17, 2015. Maryland Watermen's Expo. Ocean City, MD. Informal discussions with crab fishermen on the existence of RLV virus, its potential impacts on soft shell crab production and the potential for it to be spread by discarding dead crabs into creeks and on fishing grounds.

Flowers, E.A., Simmonds, K., Messick, G.A., **Schott, E.J.** March 2-6, 2015: Eastern Fish Health Workshop. Charleston, SC. "Spatially and Temporally Variable Prevalence of a Virus Fatal to the Blue Crab, *Callinectes sapidus*".

Brown, S., Flowers, E.M., Schott, E.J. 2014. "The evolution of a virus lethal to Blue Crabs". National Oceanic and Atmospheric Administration – Educational Partnership Program Conference. UMES, Princess Anne, MD. 26-29 October. [First prize undergraduate oral presentation in oceans health].

Stone, M. L., K. Ommanney, L. Phalen, K. Chintapenta, V. Kalavacharla, and G. Ozbay. 2014. "Nekton abundance and diversity relative to marsh grasses in Blackbird Cree, Delaware". Oral presentation. Mid-Atlantic Chapter – American Fisheries Society. Cape Henlopen, DE. 06-07 November.

Stone, M. L., K. Ommanney, L. Phalen, K. Chintapenta, V. Kalavacharla, and G. Ozbay. 2014. "Nekton abundance and diversity relative to water quality in Blackbird Creek, Delaware". Oral presentation. National Oceanic and Atmospheric Administration – Educational Partnership Program. Princess Anne, MD. 26-29 October.

How will results be incorporated into NOAA Fisheries operations?

The project is at least one step away from impacting NMFS operations directly. The results of the project will help elucidate the role of disease in the ecology of a very important crustacean fishery in the eastern US. Understanding crustacean disease reservoirs and transmission will have implications for federally managed crustacean fisheries such as white and brown shrimp. The collaboration with a food web expert, Linda Stehlick, at the NMFS JJ Howard Lab, is expected to result in ideas for linking the findings of the study with NOAA/NMFS priorities.

How will results be incorporated into LMRCS research and curriculum?

The preceding virus study, funded by NOAA-LMRCS TABs in 2011 and 2012, was used in a 2015 lecture in a course taught at the University of Maryland (MEES 698T Marine and Environmental Biotechnology). This part of MEES 698T can serve as a template for including disease and disease-related mortality in other LMRCS curricula.

Project Number: 15-10

Project Title: Improving management of deep-sea red crabs, *Chaceon quinque-dens*, Year 2: Reproductive biology, maturity, and age estimation

Project Abstract:

Deep sea red crabs support a small but valuable federally-managed fishery along the US Atlantic coast, but lack of information about their biology, abundance, growth, age, or reproduction prohibits adequate management. Preliminary data collected during LMRCSC cruises aboard NOAA Research Vessels during 2011-2013 indicates that female red crabs have a biennial reproductive cycle, and size of sexual maturity (SM₅₀) of about 61 mm CL but male SM₅₀ could not be determined. In 2013, students began verifying this information by histological analysis of gonad tissues. In 2014-15 we conducted sampling from the commercial fishery to determine seasonality of reproduction, fecundity, and age analysis. Samples from previous cruises were processed to estimate size of oocytes and spermatophores. Oocytes from crabs in different stages of development show distinct size frequencies that can be used to help identify development stages. Examination of male testes shows that spermatophore sizes increase with size of male crab, but do not show a distinct allometric change indicative of maturity. Eystalks and gastric mills were prepared to determine age of crabs, and preliminary results show that age rings are present, but few have been counted yet. Preliminary results of larval cultivation studies indicated that growth was faster at 15 C, but survival was better at 9 C, although no larvae survived to the megalopa stage. This information will be extremely useful for management and conservation of red crab populations.

Thematic Area: Quantitative Fisheries

Lead Scientist: Bradley Stevens (UMES)

NOAA Collaborator: Chris Long (NOAA/AFSC), Matt Poach (NOAA/NEFSC), Rich McBride (NOAA/NEFSC)

Other Collaborators: J. Sook Chung (UMCES/IMET)

Research Students: Stephanie Martinez-Rivera (MS Student, UMES); Justin Wilson (MS Student, UMES); Shadaesha Green (MS Student, UMCES/IMET); Nivette Perez-Perez (MS Student, DESU)

Start Date: September 2014

End Date: August 2015

Results of Project to Date:

Background: During three previous NOAA-sponsored LMRCSC cruises in 2011, 2012, and 2013, red crabs were captured from three depth intervals (250-450 m, 450-650 m, and 650-850 m) at four sites in the Mid-Atlantic Bight from Block Island Canyon to Norfolk Canyon. During those trips we measured >2500 crabs and collected gonads from 245 crabs. In Spring 2014, Stephanie Martinez began doing histological preparations on gonad tissues collected during 2013, and Justin Wilson began to investigate the use of crab eyestalks for aging of red crabs. Shadaesha Green participated in the 2013 cruise, and is now a graduate student working with Dr. Chung. This project has three primary goals: 1) determine seasonality of reproduction, fecundity, and size at 50% sexual maturity (SM₅₀) for male and female red crabs; 2) determine if hard structures can be used to estimate age and growth of crabs, and 3) characterize the physiological regulators of reproduction in red crabs.

Sampling: In 2014, red crabs were collected during two 5 d trips aboard a commercial vessel (the Hannah Boden), from The Atlantic Red Crab Company, by S. Martinez and S. Green (July), and B. Stevens and J. Wilson (September). Approximately 200 crabs were dissected and another 300 measured. Tissue samples collected were ovary, testes, vas deferens, hepatopancreas, midgut, eyestalks, stomach, muscle, and blood. Crabs were measured and sexed, and gross morphology was recorded including the presence, size and color of ovaries and external eggs. A third trip planned for November 2014 was cancelled due to weather. We are currently planning a trip in late April, 2015.

Size and maturity: During the past year we worked with the samples (*n*) of 2011 (*n*=168), 2012 (*n*=78), 2013 (*n*=77) and 2014 (*n*=199). Histological and image analysis are used to determine gonad development stages. Image analysis of 2011-2012 samples is nearly complete, and we are working with the histological preparations of 2014 samples. After the histological examinations for all samples are finished we will estimate the SM₅₀ for male and female red crabs using non-linear logistic regression, and variance using bootstrapping. For 2013 samples, we observed different gonad development stages in crabs from the same season, which were collected in July. The gross morphology of the samples and the gonad conditions of 2013 samples suggest that red crabs have a biennial reproductive cycle.

Age Estimation: During the past year we began focusing on age determination of red deep-sea crab using a technique developed by Kilada et al. (2012), who found growth rings or bands in the gastric mill and eyestalks that can be used for age determination. Samples of both structures were obtained on both research trips. Preliminary samples were sent to Raouf Kilada who verified the technique for this species, and estimated the age of one crab at 9 yr. Samples of eyestalks and

gastric mills were obtained from approximately 180 crabs during two 5 d research trips in a partnership with commercial fishermen. In late summer, 2014, Justin Wilson began sectioning and mounting these samples to determine the presence of growth rings, and in February, visited the lab of Dr. Dave Secor at the Chesapeake Biological Laboratory to learn the art of polishing his sections. Growth rings are visible when viewed by compound microscope within the samples tested, but none have been counted yet. [Kilada, R., B. Sainte-Marie, R. Rochette, N. Davis, C. Vanier, and S. Campana. 2012. Direct determination of age in shrimps, crabs, and lobsters. Canadian journal of fisheries and aquatic sciences 69:1728-1733]

Endocrinology: The objective of this goal is to characterize the physiology and biochemistry of red crabs in order to determine their seasonal reproductive patterns, and endocrine regulation of reproduction. Partial cDNA sequence of vitellogenin(VTG) has been obtained for establishing qPCR assay and evaluating the levels of VtG transcripts. In addition, we obtained the full length cDNA sequence of red deep sea crab CHH and established the presence of molt-inhibiting hormone and crustacean female sex hormone in the sinus gland using PAGE-Westernblot analysis and immunohistochemistry.

Larval Biology: Live red crabs were taken to the NOAA J.J. Howard Laboratory at Sandy Hook, where Delaware State graduate student Nivette Perez-Perez began hatching the larvae and raising them to determine feeding and temperature conditions required for larval survival. This work is preliminary to a study on effects of ocean acidification that will be conducted in 2015. Larvae were raised in individual flow-through containers (60 per treatment) in two temperatures (9 and 15 C), with 5 diet treatments (no feeding, diatoms only, rotifers only, and diatoms or rotifers plus Artemia after reaching zoea stage III). Preliminary results indicated that growth was faster at 15 C, but survival was better at 9 C, although no larvae survived to the megalopa stage.

Other Projects: We also collected midgut samples for Dr. Indu Sharma of Hampton University, who is examining them to determine the microbiomes present within the red crab digestive system. Leg muscle samples were collected for Dr. Chuck Jagoe of FAMU who will analyze them for the presence of heavy metals and other contaminants.

Presentations at regional, national, or international meetings:

S. Green, J-S. Chung, and B. G. Stevens. Understanding the molecular mechanisms of reproductive biology of the snow crab, *Chionocetes opilio*, and the red deep-sea crab *Chaceon quinque-dens*. ASLO Meeting, Granada, Spain, February 2015.

S. Green, J-S. Chung, and B. G. Stevens. Understanding the molecular mechanisms of reproductive biology of the snow crab, *Chionocetes opilio*, and the red deep-sea crab *Chaceon quinque-dens*. NOAA-EPP 7th Biennial Education and Science Forum, Oct. 27-29, 2014.

J. Wilson and B. G. Stevens. Age determination of red deep-sea crab (*Chaceon quinque-dens*) by growth ring analysis. ASLO Meeting, Granada, Spain, February 2015.

J. Wilson and B. G. Stevens. Age determination of red deep-sea crab (*Chaceon quinque-dens*) by growth ring analysis. (Poster) NOAA-EPP 7th Biennial Education and Science Forum, Oct. 27-29, 2014.

S. Martinez and B. G. Stevens. Sexual maturity of the red deep-sea crabs (*Chaceon quinque-dens*) in the Mid-Atlantic Bight. NOAA-EPP 7th Biennial Education and Science Forum, Oct. 27-29, 2014.

N. Perez-Perez, M. Poach, B. G. Stevens, S. Smith, and G. Ozbay. Effects of diet and temperature on the development of larval stages of the red deepsea crab *Chaceon quinque-dens* in laboratory conditions. NOAA-EPP 7th Biennial Education and Science Forum, Oct. 27-29, 2014.

How will results be incorporated into NOAA Fisheries operations?

The federally-managed fishery for red crabs is conducted using industry-agreed size and catch limits, but little is known about their biology, abundance, growth, age, or reproduction. We are providing basic information on life history, reproduction, age, growth, and maturity that will lead to improved management of the red crab population and fishery based on biological benchmarks. This information will be invaluable for setting goals for sustainable management of this marine resource.

How will results be incorporated into LMRCSC research and curriculum?

Three graduate students and one undergraduate student have been trained in anatomy and dissection protocols for deep-sea red crabs and histological preparation. Results of this research have been incorporated into classes including MEES 688 'Biostatistics with R' (Dr. Stevens, Fall 2014), and MEES 698M 'Comparative and Molecular Endocrinology' (Dr. Chung, Spring 2015).

Project Number: 15-11

Project Title: Augmenting the Black Sea Bass, *Centropristis striata*, Stock Assessment, Year 3: Assessing the importance of fixed and fluid habitats.

Project Abstract:

Black sea bass (BSB, *Centropristis striata*) support important commercial and recreational fisheries in the Mid Atlantic Bight. Adults live offshore, but juveniles depend on reef and hard bottom habitats in estuaries in the summer and early fall. We hypothesize that BSB recruitment is associated with the availability of oyster reefs in the Chesapeake, and annual variability in temperature, precipitation and salinity. In Year 1, we began developing a habitat suitability model (HSM) to determine preferred habitats of BSB in the Chesapeake, and test the model by sampling a variety of known and unknown habitats. In Year 2 we continued development of the HSM and expanded the range of sampling for BSB. In this third year, we linked the HSM to a GIS database of suitable hard-bottom habitat sites to define the actual potential habitats for BSB. We also plan to place sonic tags on BSB in order to determine when sonic tagged fish leave Chesapeake Bay. We have conducted experimental surgery and obtained an IACUC permit for this process, but are waiting for the return of small fish to Chesapeake Bay in 1015 to complete the tagging process.

Thematic Area: Essential Fish Habitat

Lead Scientist: Bradley Stevens (UMES)

NOAA Collaborator: Howard Townsend (NOAA/NOS/CBO)

Other Collaborators:

Research Students: Laura Almodovar-Acevedo (MS Student, UMES)

Start Date: September 2014 **End Date:** August 2015

Results of Project to Date:

Model development: After an extensive literature research on the minimum, maximum and optimum temperature and salinity for black sea bass growth, we started to develop a Growth Rate Potential (GRP) model based on Kitchell et al. (1977, J. Fish. Res. Board Can. 34: 1922-1935), using temperature and salinity data. This model was linked to the Chesapeake Regional Ocean Modeling System (ROMS) with a code written in R by Mejs Hasan to create a Habitat Suitability Model based on temperature and salinity. We compared a high flow year with a low flow year to determine which had more suitable habitat for black sea bass and the model showed that years with lower river flow had more suitable habitat for them. In 2014, the Habitat Suitability Model output was overlaid with a benthic habitat map of the Chesapeake Bay. Through GIS analysis we were able to determine which reefs had suitable habitat in terms of temperature, salinity and bottom structure. Inter-annual and seasonal variability of suitable and optimal habitat was determined. These results were part of an oral presentation at the 2015 ASLO Ocean Sciences Meeting in Granada, Spain. Preliminary progress was presented orally at the Bi-annual NOAA Education Partnership Program Forum in Princess Anne in October 2014.

Telemetry: We captured eight black sea bass from the Chesapeake Bay and have been keeping them for general observations of behavior and to practice inserting the tags. One practice tag, VEMCO V7-1L 180Hz, was acquired. This tag was used as a model for building other practice tags of the same shape, size and weight. We practiced the tagging insertion surgery and established the protocol in order to obtain our IACUC permit in October 2014. Almost all the materials for the project have been bought, including several VEMCO V7-1L 180Hz tags.

Fish sampling: We sampled for black sea bass with traps during two trapping sessions: The first was in the Choptank River near Oxford and Cambridge MD, from May to October, but no black sea bass were found there at that time. A second session occurred near Deal Island in October and November where traps were deployed for 24 hours in areas for different habitat types. Black sea bass were found there during October. Next year we'll deploy the traps where the Habitat Suitability Model suggest the fish might be.

Presentations at regional, national, or international meetings:

L. Almodóvar-Acevedo, M. Hasan, H. M. Townsend, and B. G. Stevens. Developing a habitat suitability model for black sea bass in the Chesapeake Bay. ASLO Meeting, Granada, Spain, February 2015.

L. Almodóvar-Acevedo, M. Hasan, H. M. Townsend, and B. G. Stevens. Developing a habitat suitability model for black sea bass in the Chesapeake Bay. NOAA-EPP 7th Biennial Education and Science Forum, Oct. 27-29, 2014.

How will results be incorporated into NOAA Fisheries operations?

The results of this work are already being integrated into a large-scale ecosystem model developed by the Chesapeake Bay Office of NOAA, and will be used to predict habitat associations for black sea bass, and impacts of habitat change on habitat availability. Although few juvenile fish were found, sampling will occur in 2015 in other areas where the model predicts that fish will occur.

How will results be incorporated into LMRCSC research and curriculum?

This project will expand upon earlier work using acoustic tags to track croaker (Dr. Andrea Johnson), and will help UMES develop experience and expertise with fish tagging and tracking.

Project Number: 15-12

Project Title: Integrating habitat, prey and predators over space and time to assess distributional responses to environmental variability and climate change: California sea lions and their pelagic prey off Oregon and

Project Abstract:

Although distributional responses of marine predator populations to temporal and environmental variability have been demonstrated, these studies did not account for predator-prey relationships and therefore lacked an element of realism. This project will generate species distribution models of California sea lions and their prey items off the Oregon and Washington coasts to (1) describe and compare habitat use patterns, (2) predict distribution patterns under various temporal and climate change scenarios, and (3) evaluate the ecological and management implications of overlap or mismatch between predator and prey. This collaboration involves four agencies and two universities, aims to train under-represented students in spatial analysis, oceanographic, and science communication skills, and will deliver novel results to assist ecosystem based management.

Thematic Area: Quantitative Fisheries

Lead Scientist: Leigh Torres (OSU)

NOAA Collaborator: Rich Brodeur (NOAA/NWFSC)

Other Collaborators: Tara Cox (SSU); Bryan Wright (OR DFW)

Research Students: Caren Barcelo (PhD Student, OSU)

Start Date: September 2014 **End Date:** August 2015

Results of Project to Date:

Presentations at regional, national, or international meetings:

How will results be incorporated into NOAA Fisheries operations?

How will results be incorporated into LMRCSC research and curriculum?

Appendix VI: Acronyms

Table of Acronyms

AFSC	Alaska Fisheries Science Center
DSU	Delaware State University
Hampton U.	Hampton University
NEFSC	Northeast Fisheries Science Center
NWFSC	Northwest Fisheries Science Center
MS	Master of Science Student

OSU	Oregon State University
PhD	PhD Student
PIFSC	Pacific Islands Fisheries Science Center
SEFSC	Southeast Fisheries Science Center
SSU	Savannah State University
UMES	University of Maryland Eastern Shore
UMCES	University of Maryland Center for Environmental Science
UMCES-IMET	UMCES Institute for Marine and Environmental Technology
UM-RSMAS	University of Miami, Rosenstiel School of Marine and Atmospheric Science
SWFSC	Southwest Fisheries Science Center
UG	Undergraduate Student

LMRCSC Link: www.umes.edu/lmrcsc