University of Maryland Eastern Shore

NOAA Living Marine Resources Cooperative Science Center

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Final Report

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I. LMRCSC Abstract

The mission of the LMRCSC is "*To prepare a diverse student body for careers in marine and fisheries sciences through exemplary academic and research collaborations"***.** The Center's major Education Goals are: (1) prepare the future workforce for marine and fisheries sciences, and (2) strengthen collaborations across universities and professional networks to enhance academic programs in marine and fisheries sciences, whereas the Research Goal is to: (3) develop an exemplary capacity for scientific collaborations among partner institutions in the fields of marine and fisheries sciences. The Administration Goals include: (4) organizational excellence for effective and efficient management of the programs and activities of the Center, (5) effectively communicate the activities and accomplishments of the Center, and (6) assess and evaluate the Center's goals and objectives.

The Center was guided by two management tracks, A) Administrative and B) Programmatic. The Administrative component included the Center Director, Assistant Director, Executive Committee, Center Core Administration, and the Board of Visitors, whereas the Programmatic component included the Technical Advisory Board that reviewed proposals submitted annually to the Center.

To accomplish Goal 1, the Center supported 113 degree seeking students (50 B.S., 37 M.S., 26 Ph.D.) from September 1, 2016 to August 31, 2022. Of those, 99 individuals or 88% identified as belonging to underrepresented minority (URM) groups. In addition, the center supported 33 non-degree seeking students through programs such as the Geoscience Bridge Program and the Rising Sophomore Experiential Training Program (RSETP). Of these, 32 students or 97% identified as belonging to URM groups. Fifty-seven (57) students (25 B.S., 21 M.S., 11 Ph.D.) of which 51 (89%) identified as URM groups, graduated. Thirty-three (33) of those that graduated have entered the NOAA mission workforce, including 10 working directly for NOAA and one NOAA contractor, whereas 23 have gone to further education. Twelve (12) graduates went to pursue M.S. degrees, 9 are pursuing Ph.D. degrees in NOAA mission fields, and one student is pursuing a J.D. degree with specialization in environmental law. Fifty nine (59) graduate

students, including 49 (83%) students belonging to URM groups, participated in 12-week NERTO internships at NOAA labs/facilities.

To accomplish Goal 2, the Center offered a Data Management course and a two-day Data Carpentry workshop to students to increase their quantitative and analytical skills. Students also increased their computational skills through the analyses of long-term datasets from NOAA or state agencies as part of their thesis or dissertation research or during research internships, including but not limited to NERTO. LMRCSC faculty, staff and students collaborated with at least 64 NOAA scientists to carry out the Center's education and outreach, scientific research, and administrative functions.

In support of Goal 3, 38 research projects were funded of which students as Principal Investigators led 26. These collaborative projects addressed 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. Examples of research projects conducted by LMRCSC-funded scientists, students and NOAA collaborators include: Discard mortality of sub-legal black sea bass in the commercial trap fishery: impact of air exposure and acute temperature changes; Biological baseline data for Jonah Crab management; and Refining stock structure of common bottlenose dolphins through photo-identification and genetic analysis. At least 14 cohort students used data from NOAA or state agencies in their research activities, including monkfish length and hardparts, American Plaice growth and maturity, Hawksbill and Kemp's Ridley sea turtle bone growth, lane snapper lengths and ages, and weakfish diet data.

LMRCSC students and faculty made 282 presentations, including 178 oral and 104 poster presentations. Of those, 198 (128 oral and 80 posters) included the results of directly funded research. Cohort students delivered a total of 174 of these presentations (99 oral and 75 posters). Center students and faculty also published 172 articles in refereed journals and books; 44 were the result of direct funding, and 36 included cohort students as authors. Through its research and 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 $25.54 million was awarded in grants to the LMRCSC institutions, which has had positive impacts on Center activities. These funds enhanced LMRCSC research through support of its faculty and students and development/enhancement of infrastructure.

The foregoing indicate that the LMRCSC educational, research and outreach activities addressed 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 has made significant contributions to the training of a diverse pool of students in NOAA related STEM disciplines that will help increase U.S. competitiveness in the global economy.

II. LMRCSC Award Outcomes Report

Education and Training Outcome 1: Increased number, annually, of CSC post-secondary students trained

Outputs:

- **Increased quantitative and analytical skills**:

The LMRCSC supports student attainment of quantitative and analytical skills by requiring that all graduate students complete Center-sponsored training in Data Management. From 2016-2020, the Center provided a course for credit titled MEES 671: Data Management for Scientists. Of the 63 graduate students supported during this funding period, 41 graduate students or 65% met the requirement by completing the course. After considering feedback from students, mentors, and external evaluators, it was determined that a two day workshop provided by Data Carpentry would be more productive for our students. Data Carpentry is a non-profit organization that provides training workshops that aim “to teach fundamental concepts, skills and tools for working more effectively with data.” We held our first Data Carpentry workshop in Fall 2021. Sixteen (16) graduate students, or 25%, met the requirement by participating in this workshop. Three graduate students joined the Center after the last workshop. These students plan to take the workshop when it is offered again in 2022. In addition, 35 graduate students, or 56% completed additional statistics courses relevant to their individual research goals. These include courses such as Advanced Envirometrics, Database Management, Biostatistics with R, Experimental Design, and Environmental Statistics I and II.

The LMRCSC requires that supported undergraduates begin to build a foundation of quantitative skills by completing at least one course in statistics. Thirty-eight (38) of 50 supported undergraduates (76%) have completed a statistics course. Six students have plans to complete this requirement in the future. The remaining six left the Center before graduation. Finally, in 2020, the LMRCSC developed an asynchronous module to introduce undergraduates to the principles of data management. Thirteen (13) students have completed this training module.

- **Increased competence in applying STEM to decision making, policy, and management**

The LMRCSC students gained literacy in field of policy and how STEM is applied through the cohort workshop. We formed partnerships with NOAA scientists to facilitate training students in the application of STEM related material regarding decision-making, policy and management. Students were also introduced to fisheries management through the courses they took at their respective institutions.

- **Increased skills to use large data sets, geographical information systems (GIS) and statistical analysis, computer modeling, and algorithm development**

The LMRCSC utilized DATA management and geographical information systems (GIS) courses at partner institutions to increase skills in graduate and undergraduate students. LMRCSC students take, at least, a statistics course related to their research as part of their degree and fellowship requirements. Computer modeling and algorithm development are pursued as needed for student research. Students also increased their skills in the described areas through analysis of long-term datasets from NOAA or state agencies as part of their thesis or dissertation research or during research internships including but not limited to NERTO. Examples include (1) the Analysis of American Plaice growth and maturity parameters in Georges Bank and Gulf of Maine Region using NOAA long-term data set, and (2) Analysis of Changes in Fish and Macroinvertebrate Assemblage Structure in the Maryland Coastal Bays using long-term dataset from the Maryland Department of Natural Resources.

Education and Training Outcome 2: Increased number of CSC post-secondary students educated and graduated annually

Outputs:

- **The number of degrees earned annually in NOAA mission-related disciplines**: The LMRCSC has graduated a total of 57 students in NOAA mission-related disciplines during this award period. They consist of 25 B.S., 21 M.S., and 11 Ph.D. graduates. An additional 40 students (11 B.S., 15 M.S., and 14 Ph.D.) remain in the pipeline and are expected to graduate in the future. Of those, 23 have been submitted for approval to transfer to the FY21 award for continued funding including 5 B.S., 10 M.S., and 8 Ph.D. students. The remaining eighteen (18) students in the pipeline are continuing their programs with other support. A summary of these graduates can be found in Table 1, while details related to graduates can be found in Appendix 1 and details related to those still in the pipeline can be found in Appendix 2. Students supported, their majors and research thematic areas are presented in Appendix 3.

Table 1. Summary of students graduated annually during the period September 1, 2016 - August 31, 2022 and students remaining in the pipeline.

NOAA Funding year	B.S.	M.S.	Ph.D.	Total
1	0	0	0	**0**
2	0	1	0	**1**
3	4	3	3	**10**
4	9	6	3	**18**
5	5	5	3	**13**
6	7	6	2	**15**
Total	**25**	**21**	**11**	**57**
Remaining in the Pipeline	**11**	**15**	**14**	**40**

- **The number of students (total and URM) who participated in professional development opportunities, to include at least one on-site experiential research and training opportunity at a NOAA lab, office, or facility with tangible training and research**: (a) for a minimum duration of 4 consecutive weeks, and (b) resulted in a publication or an oral or poster presentation to experts, peers, and/or other stakeholders.

Fifty-nine (59) LMRCSC graduate students, including 49 (83%) students who identify as belonging to URM groups, participated in 12-week NERTO internships. Their details can be seen in Table 2. Of these, at least 26 or 44% had presented or made concrete plans (e.g. submitted an abstract to a conference) to present the results of their internship at the time that they submitted the final report.

Table 2. NERTO internships conducted by LMRCSC graduate students.

Last Name	First Name	Partner	NOAA Mentor	NERTO Title	Line Office	Line office location address
Almodovar-Acevedo*	Laura	UMES	Howard Townsend	Habitat sustainability model for black sea bass	NMFS	NMFS
Andrade*	Emily	DSU	Joseph Dietrich	Antimicrobial assessment of microalgae species for use as aquaculture feed additives for sablefish	NMFS	AFSC Newport, Oregon
Bender*	Arona	HU	Douglas Krause	Initial analysis of the foraging tactics and social behavior of Antarctic fur seals (*Arctocephalus gazella*) from animal-borne HD video footage.	NMFS	NOAA NMS/SWFSC/AERD/ 8901 La Jolla Shores Drive La Jolla, CA, 92037-1508
Best-Otubu*	Chryston	RSMAS	Isaac Kaplan	Spatial modeling of diets, predation, and the pelagic food web of the California Current	NMFS	Northwest Fisheries Science Center, Seattle
Cervera*	Juan Carlo	RSMAS	Jennifer Leo	Essential Fishery Habitat Mapper	NMFS	SEFSC. Galveston, TX
Cohn	Leanne	OSU	Blake Feist	Mapping the footprint of rockfish conservation area (RCA) closures on the US West Coast, 2021	NMFS	Remote NERTO, NWFSC
Coleman*	Nicholas	UMCES	Steven Lindley	Sonar censusing and habitat use by spawning run Green Sturgeon, *Acipenser medirostris*	NMFS	Southwest Fisheries Science Center, Santa Cruz, California

Cruz-Marreo*	Wilmelie	RSMAS	Ron Hill	Evaluation of fisheries parameters for a commercially important marine mollusk: growth rates and habitat distribution	NMFS	Galveston Laboratory
Denson*	Latreese	RSMAS	James Thorson	Environmental influences on indices of abundance for King Mackerel in the Gulf of Mexico examined through spatiotemporal geostatistical models	NMFS	ASFSC, Seattle
Drayton*	Davielle	SSU	Ashok Deshpande	Polymer characterization of plastics collected from Alaska beaches using Pyrolysis GC-MS	NMFS	NEFSC
Frey*	Benjamin	UMCES	Anne Richards	Validation of age and growth estimates of New England and mid-Atlantic demersal fishes using microstructural analysis of hardparts.	NMFS	NEFSC Woods Hole, MA
Galvez*	Brian	DSU	Howard Townsend	Analysis of Delaware Bay Weakfish Data Using a Generalized Linear Model	NMFS	Oxford, Maryland
Garcia Prieto*	David	UMCES	Matthew Galaska & James Shambaugh	A temporal analysis of microbes in the Salish Sea using 16S rRNA	PMEL	Seattle, Washington
Geiger	Savannah	SSU	Kimberly Robeson	An analysis of fish abundance correlation to live-bottom habitat within Gray's Reef National Marine Sanctuary	NOS	ONMS Grays Reef National Marine Sanctuary
Goffe*	Shakira	UMES	Larry Alade	Analyses and comparison of American Plaice maturity Parameters in the Georges Bank and Gulf of Maine Regions	NMFS	NEFSC, Population Dynamics Branch, Woods Hole Laboratory
Green*	Shadaesha	UMCES	Bruce Vogt	Striped Bass habitat indicator for Chesapeake Bay for CSC Student	NMFS	Chesapeake Bay Office, Annapolis, MD

Griffin	Emily	SSU	Patricia Rosel	Evaluation of the southern border of the northern Georgia/southern South Carolina estuarine system stock of common bottlenose Dolphins (*Tursiops truncatus*) through genetic analyses	NMFS	NOAA SEFSC, LA
Hanif*	Ammar	UMCES	Ed Johnson	Microplastics in dreissenid mussels	NOS	NCCOS
Haughton*	Shanelle	UMES	Pamela Jensen	Understanding *Hematodinium* sp. in Alaskan crabs: new hosts, improved detection and health effects in a changing ocean	NMFS	Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA
Hildebrandt	Sierra	HU	Jason Spires	Investigating the impacts of Oyster Conditioned Water on *Crassostrea virginica* Utilizing Direct Setting Techniques in the Hampton River, Hampton, VA	NMFS	NOAA Cooperative Oxford Laboratory, Marine Spatial Ecology Division National Centers for Coastal Ocean Science NOAA National Ocean Service
Howard*	Kristafer	SSU	Roldan Munoz	Abiotic and biotic factors influence the community composition of US Southeast Atlantic fishes from 2015-2019.	NMFS	Beaufort Laboratory
King*	Brittany	OSU	Robert Fonner	Ecological, institutional and social influences on habitat restoration efforts in the Pacific Northwest	NMFS	Remote NERTO, Seattle, WA
Kleponis	Nicole	DSU	Jeanette Zamon	Assessing the relative abundance of the wintering Red-Throated Loon	NMFS	Astoria, Oregon
Kyarii*	Ramarui	UMCES	Gary Wikfors	Flow cytometric investigation of the high-light stress response of heterotrophically grown mutant *Haematococcus pluvialis* strains.	NMFS	Northeast Fisheries Science Center (NEFSC) Milford Laboratory

Lawrence*	Amanda	UMCES	Paul McElhany	Developing methods to detect the effect of CO_2 on the physiology of Dungeness crab	NMFS	21st St, Mukilteo, WA 98275
Layton*	Janelle	OSU	Chris Harvey	Species distribution modeling of climate-vulnerable West Coast groundfishes	NMFS	Seattle, WA
Lemaire	Cloe	SSU	Jennifer Doerr	Galveston Bay Microhabitat Monitoring Pilot Study	NMFS	Southeast Fisheries Science Center
Leslie*	Jaelyn	HU	Douglas Krause	Assessing the mass and body condition of leopard and fur seals using aerial images	NMFS	NOAA NMS/SWFSC/AERD/ 8901 La Jolla Shores Drive La Jolla, CA
Mackey*	Shaneese	SSU	Ron Hill	UAS habitat assessment project	NMFS	NOAA NMFS Southeast Fisheries Science Center, Fishery Ecology Branch, 4700 Avenue U Galveston, TX
Martinez-Rivera*	Stephanie	UMES	Chris Long	Eastern Bering Sea crab survey training for CSC graduate student	NMFS	Kodiak, AK
Mayes*	Cristin	HU	Michael Fogarty	Ecosystem-based approaches to modeling fish species distributions in the Chesapeake Bay	NMFS	NEFSC, Woods Hole, MA
Mayes*	Cristin	RSMAS	Joe Serafy	Advanced predictive modeling, assessment, and web development for coastal restoration opportunity for EPP CSC graduate student	NMFS	Southeast Fishery Science Center
McLean*	Joesette	HU	Laura Weitkemp	Genetic-based methods for assessing prey composition and feeding ecology of Pacific lampreys.	NMFS	NWFSC
Munguia*	Angie	OSU	Laurie A. Weitkamp	Juvenile salmon long term-habitat monitoring and field collections for action effective monitoring research (AEMR) in the Lower Columbia River and Estuary	NMFS	Point Adams Research Station, 520 Heceta Place. Hammond, OR

Munoz Ruiz*	Enid	UMES	Ashok Deshpande	Assessment of microplastics and polybrominated diphenyl ethers in scallops	NMFS	J.J. Howard Sandy Hook Lab
O'Farrell*	Halie	RSMAS	Enric Cortes	Fisheries independent data collection and harvest control rules for sharks.	NMFS	SEFSC, Panama City, FL
Pappas*	Amanda	DSU	Gary Wikfors	The effects of temperature and light on the growth and prey ingestion rate of a Delaware Inland Bay isolate dinoflagellate *Dinophysis acuminata*	NMFS	Milford, Connecticut
Pares*	Olivia	UMCES	Helena Antoun	Systematic review of the disease ecology and conservation & management strategies of stony coral tissue loss disease	Corp Svcs	Southeast Regional Office: Protected Resources Division, NOAA Fisheries
Pelekai*	Keala	OSU	David Huff	Opportunity for EPP Cooperative Science Center Graduate Student: NOAA Acoustic Data Management and Sharing	NMFS	Remote NERTO, NWFSC
Price*	Andre	UMES	Richard McBride	Prey identification and quantification of black sea bass (*Centropristis striata*)	NMFS	Woods Hole, MA
Ramarui*	Kyarii	UMCES	Gary Wikfors	Flow cytometric investigation of the high light stress response of heterotrophically grown mutant *Haematococcus pluvialis* strains.	NMFS	NEFSC Milford Laboratory Director
Ramirez*	Matthew	OSU	Jeffrey Moore	Integration of habitat-specific growth variation into assessment models: a case study in the Kemp's ridley sea turtle	NMFS	NOAA SWFSC, 8901 La Jolla Shores, La Jolla, CA

Reyes Delgado*	Angel	UMES	Brian E. Smith	Diet variation and trophic impact of weakfish (*Cynoscion regalis*) within multiple marine habitats of the Eastern U.S.	NMFS	Population & Ecosystems Monitoring & Analysis Division, Northeast Fisheries Science Center 166 Water St. Woods Hole, MA
Rodriquez*	Jorge	UMES	Gary Wikfors	*Mytilus edulis* hemocytes: study on hemocyte surface glycoconjugates and their possible role in host-pathogen interactions	NMFS	Milford, CT
Rosales*	Detba	UMES	John Jacobs	The influence of okadaic acid on gene expression and bacterial susceptibility	NOS	NOAA NOS Cooperative Oxford Laboratory
Rubalcava*	Kasondra	UMES	Howard Townsend	Development of a Maryland Coastal Bays ecosystem model to assess the influence of climatic factors on biomass distributions of fish and macroinvertebrates, food web linkages and community structure	NMFS	NOAA/NMFS/ST/Ecosystems, Cooperative Oxford Lab, Oxford, MD
Schweitzer *	Cara	UMES	Michael Burton	Evaluation of Southeast Reef Fish Survey (SERFS) videos for Atlantic Sharks	NMFS	Beaufort, NC
Tay*	Sena	SSU	Irvin Schultz	Common bottlenose dolphin contaminant analysis	NMFS	NWFSC Environmental Chemistry Program 2725 Montlake Blvd. East Seattle, WA
Silver*	Ashley	UMES	Larry Alade	Evaluating growth parameters for American Plaice in the Gulf of Maine and George's Bank.	NMFS	NEFSC Woods Hole Lab
Smalls*	Jasmine	UMES	John Jacobs	Prevalence of *Vibrio parahaemolyticus* and *Vibrio vulnificus* in Blue Crabs (*Callinectes sapidus*) and seawater harvested from the	NOS	Cooperative Oxford Lab, 904 S Morris St, Oxford, MD

				Maryland Coastal Bays.		
Johnson*	Tahirah	UMES	John Jacobs	Prevalence and environmental determinants of *Shewanella* spp. in Chesapeake Bay and Maryland Costal Bays	NOS	NCCOS Cooperative Oxford Laboratory
Tait	Noah	HU	Howard Townsend	Chesapeake Bay EwE model focused on invasive blue catfish	NMFS	Oxford Cooperative Lab, Oxford, MD
Thalmann	Hillary	OSU	Ben Laurel	Assessing Pacific Cod metabolic rate under variable temperature scenarios using otolith stable isotopes and microchemistry	NMFS	Newport, Oregon
Wade	Kaitlynn	UMES	Kevin Craig	Low recruitment in US South Atlantic Reef fish	NMFS	SFSC Beaufort SC
Wenker	Rebecca	UMES	Vincent Guida	Development of alternative search strategy for assessing densities of clumped distribution species within a comprehensive image database	NMFS	NEFSC J.J. Howard Lab
Wilburn*	Imani	UMES	Ashok Deshpande	Opportunity for EPP CSC graduate student: quantifying microplastics in Maryland Coastal Bay fish and sediments	NMFS	James J. Howard Marine Sciences Laboratory
Williams*	Victoria	OSU	Shallin Busch	Collaboratively combating ocean acidification: assessing the economic vulnerability of US communities to Ocean Acidification	NMFS	Remote NERTO, NWFSC
Wilson*	Adrianne	RSMAS	Robert Allman	Age and growth of Lane Snapper from the Gulf of Mexico	NMFS	SEFSC, Panama City, FL
Wong-Ala*	Jennifer	OSU	Johanna Wren	opportunity for EPP CSC graduate students to study the transport of *Toxoplasma gondii* oocysts in coastal areas inhabited by the Hawaiian monk seal	NMFS	Honolulu, HI

Education and Training Outcome 3: Increased CSC capacity to train and graduate students

Outputs:

- **Number of seminars, new courses, new programs, and new degrees offered to develop working skills and functional competencies to support the NOAA mission and workforce.**

During this award period, the LMRCSC has contributed to the creation of four new courses, and one new degree program that contribute to the working skills and functional competencies that support the NOAA mission and workforce. The courses are listed in Table 3. The new degree program is the Ph.D. in Integrative Agricultural, Food, and Environmental Sciences first offered at Delaware State University in Fall 2021.

Table 3. New courses developed and offered during the FY16 LMRCSC award period at partner institutions.

Course number	Course Title/Description	Date first offered (month/year)
MEES 671	Data Management for Scientists (UMES)	Fall 2018
MEES 608E	Disease Ecology & Evolution in Aquatic Systems (UMCES)	Fall 2018
MEES718D	Diseases and Population Dynamics of Marine Organisms (UMCES)	Fall 2019
MSCI 7854	Envirometrics (SSU)	Spring 2018

- **Total numbers of students supported by the CSCs and degrees awarded that reflect the changing demographics of the nation (Census Bureau 2014 National Projections, http://go.usa.gov/c2VfP).**

From September 1, 2016 to August 31, 2022, the LMRCSC supported 113 degree seeking students. Of those, 99 individuals or 88% identified as belonging to underrepresented minority groups. A summary of these students by cohort, degree, and URM identity can be found in

Table 4. In the same time period, the LMRCSC graduated a total of 57 students, 51 or 89% of whom identified as belonging to underrepresented minority groups. A summary of these students by cohort, degree, and URM identity can be found in Table 5. The demographic details of all of these students can be found in Appendix 4.

Additionally, the center supported 33 non-degree seeking students through programs such as the Geoscience Bridge Program and the Rising Sophomore Experiential Training Program (RSETP). Of these, 32 students or 97% identified as belonging to underrepresented minority groups.

Table 4. Cohort student supported by cohort, degree, and Underrepresented Minority (URM) identity.

Cohort #	B.S.			M.S.			Ph.D.			Total		
	Students	URM Students	% URM	Students	URM Students	% URM	Students	URM Students	% URM	Students	URM Students	% URM
1	13	13	100	6	3	50	6	5	83	25	21	84
2	9	9	100	8	6	75	8	8	100	25	23	92
3	11	10	91	7	6	86	4	4	100	22	20	91
4	6	6	100	8	7	88	3	3	100	17	16	94
5	11	10	91	8	4	50	5	5	100	24	19	79
Total	50	48	96%	37	26	70	26	25	96	113	99	88

Table 5. Supported students who graduated by cohort, degree, and URM identity.

Cohort #	B.S.			M.S.			Ph.D.			Total		
	Students	URM Students	% URM	Students	URM Students	% URM	Students	URM Students	% URM	Students	URM Students	% URM
1	9	9	100	6	3	50	5	5	100	20	17	85
2	6	6	100	7	5	71	5	5	100	18	16	89
3	6	6	100	4	4	100	1	1	100	11	11	100
4	1	1	100	3	2	67	0	0	0	4	3	75
5	3	3	100	1	1	100	0	0	0	4	4	100
Total	25	25	100	21	15	71	11	11	100	57	51	89

Education and Training Outcome 4: Reduce the attainment gap for URMs in NOAA mission-related fields

Outputs:

- **Increased number of URM students in student development activities that will lead them to the attainment of degrees and/or employment in NOAA mission fields**.

As described above, 88% of LMRCSC cohort students identify as belonging to URM groups. Center students are provided with instruction in NOAA Fisheries research priorities, data management, science and professional communication, and soft skills.

- **Increased number of URM students who select to pursue higher education in NOAA mission fields**.

From September 1, 2016 to August 31, 2022, the LMRCSC supported 113 degree seeking students. Of those, 99 individuals or 88% identified as belonging to underrepresented minority groups.

Scientific Research Outcome 1: Increased NOAA mission-relevant research capacity at MSIs

Outputs:

- **Number of research collaborations with NOAA and CSC faculty, staff and students**.

LMRCSC faculty, staff and students have collaborated with at least 64 NOAA scientists. A list of these can be found in Table 6. Many of these collaborators have served in multiple roles.

Table 6. NOAA Collaborators with LMRCSC faculty, staff, and students.

First	Last	Line office	TAB/Research Collaborator	NERTO Mentor	NOAA Mentor
Lisa	Ailloud	NMFS			X
Larry	Alade	NMFS		X	X
Robert	Allman	NMFS	X	X	X
Helena	Antoun	Southeast Regional Office		X	
Lisa	Avens	NMFS	X		X
Richard	Brill	NMFS	X		X
Michael	Burton	NMFS		X	
Shallin	Busch	NMFS	X	X	X
Enric	Cortes	NMFS		X	X
Kevin	Craig	NMFS		X	
April	Croxton	OAR			X
Ashok	Deshpande	NMFS	X	X	X
Joseph	Dietrich	NMFS		X	X
Jennifer	Doerr	NMFS		X	X
Peter	Dudley	NMFS	X		
Blake	Feist	NMFS		X	
Michael	Fogarty	NMFS	X	X	X
Robert	Fonner	NMFS		X	
Kevin	Friedland	NMFS			X
Matthew	Galaska	PMEL		X	
Vince	Guida	NMFS	X	X	X
Chris	Harvey	NMFS		X	X
Ron	Hill	NMFS		X	X

David	Huff	NMFS		X	
John	Jacobs	NOS	X	X	X
Pamela	Jensen	NMFS	X	X	X
Ed	Johnson	NOS		X	
Isaac	Kaplan	NMFS		X	
Mandy	Karnauskas	NMFS			X
Todd	Kellison	NMFS			X
Douglas	Krause	NMFS		X	X
Benjamin	Laurel	NMFS	X	X	X
Jennifer	Leo	NMFS		X	X
Steven	Lindley	NMFS		X	X
Chris	Long	NMFS	X	X	X
Richard	McBride	NMFS	X	X	X
Paul	McElhany	NMFS	X		X
Jeffrey	Moore	NMFS	X	X	X
Roldan	Munoz	NMFS		X	
Linda	Park	NMFS	X		
Pedro	Restrepo	NMFS			X
Anne	Richards	NMFS	X	X	X
Kimberly	Robeson	NOS		X	
Patricia	Rosel	NMFS	X	X	X
Irvin	Schultz	NMFS		X	X
Joe	Serafy	NMFS		X	
James	Shambaugh	OAR			X
Burton	Shank	NMFS	X		
Beth	Sharack	NMFS	X		
Brian	Smith	NMFS		X	
Jason	Spires	NMFS		X	X
Andi	Stephens	NMFS			X
James	Thorson	NMFS	X	X	
Howard	Townsend	NMFS	X	X	X
Bruce	Vogt	NMFS		X	
John	Walter	NMFS	X		X
James	Weinberg	NMFS	X		X
Laurie	Weitkamp	NMFS	X	X	X
Kevin	Werner	NMFS	X		X
Gary	Wikfors	NMFS	X	X	X
Johanna	Wren	NMFS		X	X
Mark	Wuenschel	NMFS	X		
Gina	Ylitalo	NMFS	X		
Jeanette	Zamon	NMFS		X	X

- **Number of NOAA scientists serving as mentors and advisors for student research**.

As evidenced in Table 6, 43 NOAA Scientists have advised students by serving as members of graduate student committees. Forty-three (43) have also served as NERTO mentors who supervised students during their NOAA internship.

- **Number of intra-institutional collaborative partnerships established and maintained in support of NOAA's mission**.

TAB funded research projects serve as an important source of collaboration among center scientists. The 38 funded TAB projects presented in Table 20 represent collaborations within the LMRCSC. Center scientists reported an additional four intra-institutional collaborations that resulted from the center (Table 7) and eight collaborations across the center (Table 8).

Table 7. Intra-institutional collaborations created as a result of the LMRCSC

PI		Intra-institutional Collaborator		
Last Name	First Name	Last Name	First Name	Description of involvement
Hoskins-Brown	Dionne	Hintz	Chris	LEK in the GCE LTER
Hoskins-Brown	Dionne	Kenworthy	Matthew	Oyster Reef Restoration in the Skidaway River
Hoskins-Brown	Dionne	Kenworthy	Matthew	Use of Stable Isotopes to Identify Putative Shrimp Habitat
Lewallen	Carolina	Horodysky	Andrij	Student training, supplies

Table 8. Collaborations across LMRCSC institutions that have resulted from the existence of the Center.

PI			LMRCSC Collaborator			
Last Name	First Name	Institution	Last Name	First Name	Institution	Description of involvement
Ozbay	Gulnihal	DSU	Parveen	Salina	UMES	USDA/NIFA
McIntosh	Dennis	DSU	Jacobs	John	NOAA	USDA-CBG (funded 2022-2025), Collaborator
McIntosh	Dennis	DSU	Parveen	Salina	UMES	USDA/NIFA (not funded). Co-PI
McIntosh	Dennis	DSU	Parveen	Salina	UMES	NSF-SBIR (not funded), Co-PI
McIntosh	Dennis	DSU	Parveen	Salina	UMES	NOAA-SBIR (not funded), Co-PI
McIntosh	Dennis	DSU	Parveen	Salina	UMES	NOAA-SK (not funded), Co-PI
McIntosh	Dennis	DSU	Schott	Eric	IMET	USDA-NRAC (funded 2015-2017), Co-PI

McIntosh	Dennis	DSU	Schreier	Harold	IMET & UMBC	USDA-NRAC (funded 2015-2017), Co-PI

- Number of uses of NOAA data in research and tool development.

At least 16 cohort students have used NOAA data or data from state agencies in their research activities. A description of their use can be seen in Table 9.

Table 9. Use of NOAA data sets by LMRCSC cohort students.

Primary User's last name	Primary User's first name	Name of data set	Description of use
Bender	Arona	AMLR	Tagging data -SWFSC
Best-Otubu	Chryston	IBEAM, Mangrove Fish data in Biscayne Bay	Using Biscayne Bay fish monitoring data for ecosystem model inputs
Cohn	Leanne	NWFSC bottom trawl survey data	Used in NERTO to model potential effects of wind energy on long term monitoring
Denson	LaTreese	SEAMAP larval fish	Modeled king mackerel larval distribution/abundance with environmental predictors
Frey	Benjamin	Monkfish length and hard parts	Age determination and validation of monkfish
Goffe	Shakira	NOAA long term data on American Plaice size and maturity in the Georges Bank and Gulf of Maine Regions	Used data to analyze and compare American Plaice maturity Parameters in the Georges Bank and Gulf of Maine Regions
Silver	Ashley	NOAA long term data on American Plaice size and age in the Georges Bank and Gulf of Maine Regions	Used data to estimate growth parameters of American Plaice in the Georges Bank and Gulf of Maine Regions
Mayes	Cristin	IBEAM, Mangrove Fish data in Biscayne Bay	Modeling fish abundance with environmental predictors
McLean	Josette	NWFSC	Cruise location data for Lamprey specimens
O'Farrell	Halie	Pelagic Observer Program and Gulf of Mexico Reef fish longline observer program	Modeled predictors of shark bycatch
Ramirez	Matthew	Hawksbill and Kemp's Ridley sea turtle bone growth chronologies	Analyses and publication of factors that influence sea turtle growth
Reyes Delgado	Angel	Diet data from the Chesapeake Bay Multispecies	Determined diet variation and trophic impact of weakfish (*Cynoscion regalis*) within

		Monitoring and Assessment Program (CHESMMAP), the Northeast Area Monitoring and Assessment Program (NEAMAP) and the NMFS bottom trawl surveys	multiple marine habitats of the Eastern U.S.
Tait	Noah	Oxford lab	Invasive blue catfish data for use in EwE model of the Chesapeake Bay
Thalmann	Hillary	Kodiak Island Beach Seine Survey Data	Both samples of fish and the catch per unit data are being included in Hillary's dissertation and future publications focused on quantifying the impacts of marine heatwaves on early life stages of Pacific Cod
Wilson	Adrianne	NOAA Panama City age and growth data	Used NOAA lane snapper lengths and ages for a growth study
Howard	Kristafer	Southeast Reef Fish Survey (SERFS) video and data	Analysis of Abiotic and Biotic Factors Influencing the Community Composition

- **Number of inter-institutional collaborative partnerships established and maintained in support of NOAA's mission.**

Over the course of this award period, LMRCSC scientists and students have collaborated with 25 organizations (Table 10) and 51 individuals (Table 11).

Table 10. Organizations that have partnered with LMRCSC scientists and students

Type of partner organization	Name	Location	Partner's contribution to the project
City government	Baltimore City Dept. Public Works	Baltimore, MD	Water quality data and collections
Private industry	BF Consultants	McDonough, GA	Evaluation services and participation
NGO	Blue Water Baltimore	Baltimore, MD	Water quality data and collections
Non-profit	Chesapeake Bay Foundation	Richmond, VA	Helped students with oyster restoration project
Tribal government	Columbia River Inter- tribal Fish Commission	Portland, OR	Intellectual investment, samples, collaborative research

State government	DE NREC	Dover, DE	Helped students collect samples
State government	Florida Fish & Wildlife Commission	Jacksonville, FL	Research collaboration
State government	Florida FWC	St. Petersburg, FL	Collaboration on horseshoe crab assessment
State government	GaDNR	Brunswick, GA	Provided access to field sites, provided nets, served on committee
Federal Commission	Gullah Geechee Cultural Heritage Corridor Commission	Beaufort, SC	Included LMRCSC faculty as subawardee on NOAA grant
Regional Fishery Management Organization	International Commission for the Conservation of Atlantic Tunas		Ph.D. student participated in ICCAT stock assessment of mako sharks
State government	MD DNR	Annapolis, MD	Helped students collect samples; provided datasets
Federal	MD Sea Grant	Univ. of MD	Program Development Funding
NGO	National Aquarium	Baltimore, MD	Estuary health outreach, biodiversity
Federal	National Park Service	Assateague Nat'l. Seashore	Grant funding
Federal government	NEFSC	Milford, CT	JSAN Training for students
Federal government	NEFSC	Sandy Hook, NJ	NERTO
State government	NJ DEP	Galloway Township, NJ	Helped students collect samples
State government	SCDNR	Charleston, SC	Grant development
NOAA	SEFSC	Lafayette, LA	Taught student to perform genetic analyses; hosted student
Academia	UCLA	Los Angeles, CA	Accepted LMRCSC students to Diversity program
State government	Virginia Aquarium & Marine Science Center	Virginia Beach, VA	Provided samples for Jaelyn Leslie
NGO	Waterfront Partnership of Baltimore	Baltimore, MD	Water quality data and collections
Environmental NGO	Wildlife Conservation Society	Belize	Helped Adrianne Wilson collect lane snapper samples in Belize
Tribal government	Yakama Nation Fisheries	Prosser, OR	Informal student advisor and collaborator, providing samples

Table 11. Individuals who have collaborated with LMRCSC scientists and students

First Name	Last Name	Title/Affiliation	Description
Debra	Abercrombie	Florida International University	Shared bull shark acoustic telemetry data with Ph.D. Student Halie O'Farrell
Merryl	Alber	Professor, UGA	Grant collaborator
George	Albert	Director of Conservation/SC Aquarium	Hosted debut of the film Savannah Climate Change: A Global Reality with SCETV
Phil	Anderson	Assist. Professor, Salisbury Univ.	Committee member for N. Olsen
Paul	Barber	Biology Professor, UCLA	Trained students in coral reef ecology research
Kelly	Biedenweg	Human Dimensions professor, OSU	Helped with student recruiting for Cohort 2 and was faculty advisor for Cohort 2 student Brittany King
Christina	Bradley	Assist. Professor, Salisbury Univ.	Committee member for W. Cruz
Jay	Brandes	Professor, UGA	Use of Raman Spectroscopy instrumentation
Wei-Jun	Cai	Professor, Univ. Delaware	Research mentor
Michael	Casson	Economics Professor, Delaware State University	Helped with resource economics
Demian	Chapman	Marine Science Professor, FIU	Provided shark data
Sook	Chung	Professor, IMET	Co-PI on Grant
Kathy	Coyne	DE Sea Grant head/Prof UD	Helping student with DNA analysis/lab space
Charmaine	Dahlenberg	Director of Field Conservation	Events, data collection, outreach, fund-raising
Chapman	Demian	Florida International University	Shared bull shark acoustic telemetry data with Ph.D. Student Halie O'Farrell
Gary	Dickinson	The College of New Jersey	Co-PI on Grant
Hilda	Dunkwu	Stevenson University	Collaborator on an Environmental Justice Proposal
Peggy	Fong	Biology Professor, UCLA	Trained students in coral reef ecology research
Sarah	Fortner	Science Education Resource Center (SERC) at Carleton College	Grant collaborator
Marc	Frischer	Professor, UGA	Grant collaborator

Scott	Gallanger	Woods Hole Oceanographic Institution	Consulted on microplastic polymer identification.
Daniel	Gleason	Professor, Georgia Southern University	Grant collaborator
John	Grabowski	Professor, Northeastern Univ.	Grant collaborator
Mike	Grecco	Marine Fisheries, DNREC	Weakfish sampling
Kim	Grove	Chief, Office of Compliance & Research, DPW	Data sharing, water quality
Brian	Helmuth	Professor, Northeastern Univ.	Grant collaborator
Berlynna	Heres	Florida FWC	Collaboration on horseshoe crab assessment
Jon	Hess	Columbia River Intertribal Fish Commission	Working with Pelekai on thesis research
Ronald	Johnson	President, Sapelo Island Cultural and Revitalization Society	Grant collaborator
Tarendra	Lakhankar	City College of the City Univ. of New York	Collaborated on the Geoscience Bridge program
Ralph	Lampman	Yakama Nation	Working with Pelekai on thesis research
Nicole	Lewis	Wildlife Vet/Research Scientist	NERTO river otter collector/co-mentor
Adam	Lindquist	VP of Programs & Environmental Initiatives, Waterfront Partnership	Collaborates on urban estuary health
Rom	Lipcius	Professor, VIMS	Co-author on publication
Ming	Liu	Scientist at Morgan State Univ.	Collaborated in a proposal on USDA Capacity Building grant on oyster aquaculture
Wade	McGillis	Professor, Lamont-Doherty earth Observatory, Colombia University	Collaborated with students using their particle counter coupled with a Raman Spectrometer
Andrew	McGowan	Environmental Scientist, DIB	Assisted with student research
Brian	Neilan	Marine Fisheries, NJDEP	Weakfish sampling

Heather	North	Oyster tech, CBF	Helped students with oyster restoration project
Kimberly	Reese	Professor/VIMS	Assisted with HABs identification
Reddy	Remata	Professor, Jackson State University	Collaborated on the Geoscience Bridge Program
Luisiel	Ricks-Santi	Asst. VP for Research	MS committee member for Josette McLean
Sarah	Ross	Director, Wormsloe CREW	Book editor
Suresh	Seethapathy	Scientist, Thermo Fisher	Advised on Thermo Scientific Trace 1310 Gas Chromatograph - TWQ 8000 Evo Triple Quadrupole Mass Spectrometer
Richard	Stoffle	Professor, Arizona State University	Research Collaborator
Peter	Straub	Professor, Stockton University	Collaborated with students using a scientific freeze-dryer
Mark	Trice	Program Chief, Water Quality Informatics, MD DNR	Installation of a WQ con-mon in the Middle Branch
Aradhna	Tripati	Professor, UCLA	Grant collaborator
Alice	Volpitta	Baltimore Waterkeeper	Data sharing, water quality
Josiah	Watts	100Miles	Grant collaborator
Patricia	Yager	Professor, UGA	Grant collaborator

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

Outputs:

- **Number of peer reviewed publications, presentations, and tools developed by faculty, staff, and students.**

Center Scientists produced 172 total publications over the course of the award. Forty-four (44) were the result of direct funding, and 29 acknowledged the award. Thirty-six (36) included cohort students as authors. A detailed list of these publications is provided in Section VII of this report.

Over the course of the award period, center scientists and students delivered 282 presentations including 178 oral and 104 poster presentations. Of those, 198 (128 oral and 80 poster) included the results of directly funded research. Cohort students delivered a total of 174 of these presentations (99 oral and 75 poster). An additional 109 presentations included cohort student authors who were not the presenter. A detailed list of these presentations is provided in Section VII of this report.

Finally, the LMRCSC has produced three tools. These are listed in Table 12.

Table 12. Tools produced by LMRCSC faculty, staff, and students.

Primary Developer				
Last name	**First name**	**Tool name**	**Status (in development, complete, etc.)**	**Tool description**
Cervera	Juan	EFH Mapper	Complete	Web-based essential fish habitat mapper
Rubalcava	Kasondra	EWE Model	In development	Ecosystem model for the Maryland Coastal Bays
Mayes	Cristin	IBEAM Website	In development	Web-based summaries of Biscayne Bay nearshore fish datasets

- **Use of CSC research results and tools by NOAA and other stakeholders.**

LMRCSC fellows, researchers and faculty collaborated with NOAA and other stakeholders to increase the body of knowledge related to fisheries and fisheries management. The outputs were quantified through graduate NERTO project outputs as seen in Figure 1. Over 53.4% of NERTO participants generated new data for models or products for host office. In addition to NERTO experiences, graduate fellows incorporated skills gained from training in thesis and dissertations. The result is demonstrated new/expanded competencies to conduct research and engage in NOAA mission-aligned activities by 67.2% of graduate fellows according to outcomes in Figure 2.

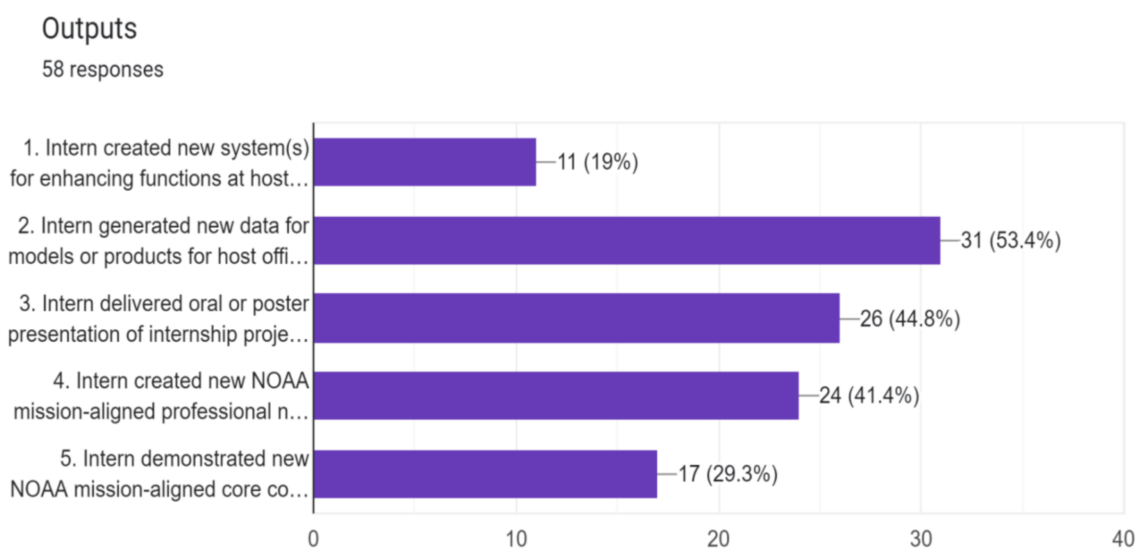

Figure 1. NERTO outputs according LMRCSC Graduate Fellows in Final Reports submitted to NOAA EPP/MSI at the completion of internship.

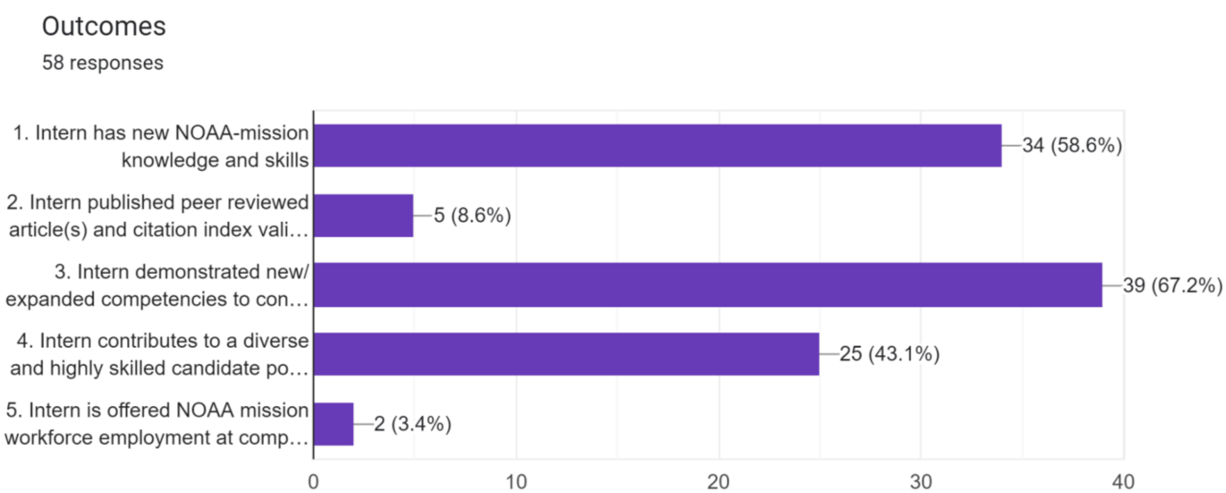

Figure 2. NERTO outcomes according LMRCSC Graduate Fellows in Final Reports submitted to NOAA EPP/MSI at the complete of internship.

- **Number of instances CSC publications were cited.**

The publications listed below in Table 35 and Table 46 have been cited by other scientists a total of 1,313 times. Of those, publications that were directly funded by LMRCSC have been cited 188 times while the results of leveraged programs have been cited 1,125 times.

- **Number of CSC students, staff or faculty recognized nationally for CSC research.**

Twenty-four (24) students and four faculty have been recognized for their CSC research. Details of their awards are in Tables 13 and 14.

Table 13. LMRCSC students recognized for research

Student Awards/Recognition			
Last Name	**First Name**	**Name/Description of Award**	**How is it related to LMRCSC research?**
Andrade	Emily	Poster Award: Water Quality Section of the American Fisheries Society	Poster reports LMRCSC research results
Barry	Teemer	NOAA EPP/MSI Undergraduate Scholarship	Recognition of excellence and potential in the study of NOAA relevant field, including undergraduate research activities
Coleman	Nicholas	Oral Presentation Award: 3rd Place, Healthy Oceans; NOAA EPP/MSI 10th Biennial Science and Education Forum	Presentation reports LMRCSC research results
Coleman	Nicholas	Poster Award: 2rd Place, Healthy Oceans; NOAA EPP/MSI 10th Biennial Science and Education Forum	Presentation reports LMRCSC research results
Fielding	Semaj	NOAA EPP/MSI Undergraduate Scholarship	Recognition of excellence and potential in the study of NOAA relevant field, including undergraduate research activities
Frey	Benjamin	American Fisheries Society Graf Award for the Promotion of Fisheries Research	A longtime AFS Member and CBL supporter donated $2,500 to "support a student involved in fisheries research". Don and Tami Graf have supported CBL students before
Galvez	Brian	ARD Research Symposium 1st Place Oral Presentation	Presentation reports LMRCSC research results
Johnson	Tahirah	Oral Presentation Award: 2nd Place, Resilient Coastal Communities and Economies; NOAA EPP/MSI 10th Biennial Science and Education Forum	Presentation reports LMRCSC research results
Oliver	India	NOAA EPP/MSI Undergraduate Scholarship	Recognition of excellence and potential in the study of NOAA relevant field, including undergraduate research activities

Teat	Marcus	Oral Presentation Award: 3rd Place, Resilient Coastal Communities and Economies; NOAA EPP/MSI 10th Biennial Science and Education Forum	Presentation reports LMRCSC research results
Day	Joe	Oral Presentation Award: 2nd Place, Healthy Oceans; NOAA EPP/MSI 10th Biennial Science and Education Forum.	Presentation reports LMRCSC research results
Cohn	Leanne	Poster Award: 1st Place, Climate Adaptation and Mitigation; NOAA EPP/MSI 10th Biennial Science and Education Forum	Presentation reports LMRCSC research results
Tay	Sena	Poster Award: 1st Place, Healthy Oceans; NOAA EPP/MSI 10th Biennial Science and Education Forum	Presentation reports LMRCSC research results
Green	Shadaesha	Knauss Fellowship	Recognition of excellence and potential in the study of NOAA relevant field, including graduate research activities
Frey	Benjamin	Knauss Fellowship	Recognition of excellence and potential in the study of NOAA relevant field, including graduate research activities
Almodovar-Acevedo	Laura	Knauss Fellowship	Recognition of excellence and potential in the study of NOAA relevant field, including graduate research activities
Lawrence	Amanda	Knauss Fellowship	Recognition of excellence and potential in the study of NOAA relevant field, including graduate research activities
Hanif	Ammar	Knauss Fellowship	Recognition of excellence and potential in the study of NOAA relevant field, including graduate research activities
Hammond	Erianna	NOAA EPP/MSI Undergraduate Scholarship	Recognition of excellence and potential in the study of NOAA relevant field, including undergraduate research activities
Tennant	Alexandria	NOAA EPP/MSI Undergraduate Scholarship	Recognition of excellence and potential in the study of NOAA relevant field, including undergraduate research activities
Wilson	Adrianne	Bouchet Graduate Honor Society inductee 2021	Recognition of academic excellence and contribution to DEI efforts

Wilson	Adrianne	UM Institute for Advanced Study of the Americas (UMIA) Field Research Grant	Competitive Grant for allowed AW to gather biological samples of her study species in Belize.
Thalmann	Hillary	Best Mentor/Mentee Poster Award, 2021. Research Advances in Fisheries, Wildlife, and Ecology Virtual Symposium. Virtual Meeting	Presents research from TAB and dissertation
Thalmann	Hillary	Best Student Oral Presentation, 2021 Alaska Marine Science Symposium. Virtual Meeting.	Presents research from TAB and dissertation

Table 14. LMRCSC faculty recognition for CSC research

Faculty or Staff Awards/Recognition			
Last Name	**First Name**	**Name of Award/Recognition**	**How is it related to LMRCSC research?**
Hoskins-Brown	Dionne	Georgia Clean 13 (2021)	Recognition for extraordinary work to protect Georgia's water and increase diversity in related careers
Lewallen	Carolina	NSF Polar Programs grant	Leopard seal work from the TAB used as baseline data
Gibson	Deidre	Marine Technology Society COMPASS Award	Recognized for her work with student development from all of her work especially the LMRCSC
Chigbu	Paulinus	a) Appointment to the Maryland Commission on Climate Change's Science & Tech. Working Group by Maryland's Secretary of the Environment, Ben Grumbles. b) Award of the Univ. System of Maryland Wilson H. Elkins Professor of Marine Science c) Invited to serve as a contributing Author, 5th National Climate Assessment (Northeast Chapter), U.S. Global Change Research Program	For his expertise and research on the impacts of climate variability and change on coastal marine systems.

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

Outputs:

- **Amount of funds leveraged with CSC award to support NOAA mission education and research**

Over the course of the award period, the LMRCSC successfully obtained a total of $25,537,981 in leveraged funds. Of that, $1,069,755 came from NOAA sources and $24,468,226 came from other sources. A summary of leveraged funding by fiscal year is available in Table 15. A complete listing of leveraged funds can be found in Appendix 5.

Table 15. Summary of leveraged funding obtained by the LMRCSC.

FY	Funding from NOAA	Funding from other sources	Total
2017	$269,332	$3,595,131	$3,864,463
2018	$244,384	$4,015,218	$4,259,602
2019	$156,818	$4,205,980	$4,362,798
2020	$14,075	$3,717,054	$3,731,129
2021	$0	$4,689,252	$4,689,252
2022	$385,147	$4,245,590	$4,630,737
Total	**$1,069,755**	**$24,468,226**	**$25,537,981**

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

Outputs:

- **Number of structured activities to recruit and retain students, particularly from URM communities, in NOAA mission-relevant higher education programs.**

The LMRCSC has participated in at least 29 structured recruitment activities including booths at professional meetings, visits to high schools and community colleges, open houses at our partner institutions, and online recruitment events. A list showing examples of recruitment activities can be found in Table 16.

In addition to the seminars, courses and professional development hosted by LMRCSC universities, the LMRCSC offered regular additional training in the core competencies listed in Table 17. LMRCSC Education and Center-wide activities for the FY16 Grant. Table 17. LMRCSC Education and Center-wide activities for the FY16 Grant. The Cohort Experience was a five day; in person meeting where graduate students, NOAA scientists and LMRCSC faculty engaged in professional development related to NOAA Fisheries and Fisheries Management. The LMRCSC conducted training in DATA Management five times to train students in high level DATA Management skills. Student evaluations after the fourth class informed the center, students were taking similar courses at their home institution and would benefit from an introductory workshop rather than a course. DATA Carpentry was deployed and supported by experts in R coding language. The workshop was considered valuable by faculty and students and was elected to be the Center-delivered training from this point forward. Students in need of a DATA management course not offered at their university take courses offered by partner institutions through the virtual campus.

Table 16. Recruitment events

Date	Event
Nov-2016	American Indian Science and Engineering Society
Nov-2016	College/Career Pathways to Success Night at Wor-Wic Community College, MD
Dec-2016	UMES Open House
Feb-2017	RSMAS recruitment event
Mar-2017	UMES Open House
Sep-2017	UMES SANS Research Roundtable
Sep-2017	National Technical Association, Morgan State University
Sep-2017	Jr. MANRRS Leadership Institute, UMES
Oct-2017	UMES Open House
Oct-2017	Wor-Wic Community College, MD Transfer Fair
Oct-2017	UMES DNS Research Roundtable
Nov-2017	UMES Upward Bound
Dec-2017	UMES Honors Day
Dec-2017	Prince George's Community College
Dec-2017	Eastern Shore Community College Visit
Dec-2017	Northern Virginia Community College
Dec-2017	Chesapeake Community College
Dec-2017	Science In Society Conference, River Hill High School, Clarksville, MD
Dec-2017	Somerset County, Maryland Board of Education
Jan-2018	Eastern Shore Community College Visit
Jan-2018	Northern Virginia Community College
Feb-2018	Northern Virginia Community College HBCU Fair
Feb-2018	Worcester County, Maryland Board of Education
Feb-2018	RSMAS recruitment event
Aug-2018	AFS meeting
Oct-2018	SACNAS meeting
Feb-2020	RSMAS recruitment event
Feb-2020	Wor-Wic Community College
Nov-2020	Center Recruitment Webinar

Table 17. LMRCSC Education and Center-wide activities for the FY16 Grant.

August	September	October	November	December	January	February	March	April	May	June	July
2017/18											
LMRCSC Center-Wide Student Meeting	DATA Management - Dr. Ralf Reidel				LMRCSC Center-Wide Student Meeting		NOAA EPP/MSI Biennial Forum - Howard Univ.				
Research Ethics Training - CITI			LMRCSC Center-Wide Student Meeting				LMRCSC Cohort Experience				
LMRCSC Graduate Seminar	LMRCSC Graduate Seminar	LMRCSC Graduate Seminar	LMRCSC Graduate Seminar	LMRCSC Graduate Seminar							
2018/19											
	DATA Management - Dr. Ralf Reidel										
Research Ethics Training - CITI	LMRCSC Orientation						LMRCSC – CV & Resume Prepartion training	LMRCSC Cohort Experience			
2019/20											
	DATA Management - Dr. Ralf Reidel					LMRCSC – CV & Resume Prepartion training	External Evaluation	LMRCSC Center-Wide Student Meeting		Cross-CSC Education Webinar Series-NOAA NERTO Success Stories	
Research Ethics Training - CITI	LMRCSC Orientation	LMRCSC Center-Wide Student Meeting									
			LMRCSC Graduate Seminar	LMRCSC Graduate Seminar	LMRCSC Graduate Seminar	LMRCSC Graduate Seminar	LMRCSC Graduate Seminar	LMRCSC Graduate Seminar			
2020/21											
	DATA Management - Dr. Ralf Reidel					Cross-CSC Education Lead Webinar Series: NOAA Career Pathways Panel	Virtual Cohort Experience	NEFSC-LMRCSC Virtual Conference			NOAA EPP/MSI Graduate Fellowship Informational Session

Research Ethics Training - CITI	LMRCSC Orientation	Cross CSC Education Lead Webinar Series: Advancement of Social Sci. in Federal Agencies- New Initiatives, and Synergies	LMRCSC Center-Wide Student Meeting		LMRCSC Center-Wide Student Meeting	LMRCSC – CV & Resume Prepartion training	Cross-CSC Education Seminar Series: Faculty and Peer Mentorship				
		LMRCSC Graduate Seminar		LMRCSC Graduate Seminar		LMRCSC Graduate Seminar	NOAA EPP/MSI Biennial Forum - Virtual		LMRCSC Graduate Seminar		
2021/22											
			DATA Carpentry				Time Management Workshop	NERTO Training			
Research Ethics Training - CITI	LMRCSC Center-Wide Student Meeting				LMRCSC Center-Wide Student Meeting		LMRCSC Center-Wide Student Meeting		LMRCSC Center-Wide Student Meeting		
	LMRCSC Orientation	LMRCSC Graduate Seminar	LMRCSC Graduate Seminar	LMRCSC Graduate Seminar	LMRCSC Graduate Seminar						

- **Number of MSI inter-institutional collaborative partnerships established and maintained in support of NOAA's mission.**

Over the course of this award period, LMRCSC scientists and students have collaborated with 25 organizations (Table 10) and 51 individuals (Table 11).

Administration Outcome 3: To increase communication of CSC accomplishments and capacity

Outputs:

- **Number of CSC products used by stakeholders.**

One of the primary stakeholders in LMRCSC research is NOAA. The use of NERTO results by NOAA demonstrates the utility of LMRCSC activities to NOAA. Over 53.4% of NERTO participants generated new data for models or products for host office, while an additional 11% created new systems for enhancing functions at host office.

Additionally, LMRCSC scientists reported forming nine collaborations with end-users (Table 18), and LMRCSC publications have been cited a total of 1,313 times (188 from directly funded publications; 1,125 times from leveraged publications).

Table 18. Collaborations with end-users

LMRCSC Scientist(s)	End-user collaborator, including affiliation	Description of collaboration
Dionne Hoskins-Brown	Matthew MacPherson, Heather Blough	Identification of SE fisheries stakeholders
Tara Cox	Michel Gielazyn	Assessment of bottlenose dolphin health
Dionne Hoskins-Brown	Howard Schnabolt, Lisa Vandiver	Multiple orientations to Gullah Geechee use of fisheries and habitat
Tara Cox	Patty Rosel	Using Photo-Identification and Genetic Data to Examine Fine-Scale Population Structure of Common Bottlenose Dolphins (*Tursiops truncatus*) in the Estuarine Waters Surrounding Savannah, Georgia
Dionne Hoskins-Brown	Jennifer Leo, Jennifer Doerr, Matthew Johnson	Developing a culture system to test Ocean Acidification effects on shrimp, crabs, and oyster
Dionne Hoskins-Brown	Jonathon Molineaux	Student training and recruitment panels (2)
Dionne Hoskins-Brown	Jonathon Molineaux	GIS development
Gulnihal Ozbay	Mark Casey, oyster aquaculturist	Boat driver/student research
Dennis McIntosh	Ed Hale, DE Sea Grant	Aqucaculture grant co-author

- Number of featured articles in print or digital media referencing the NOAA CSC.

The Center has been featured in at least 28 articles in print or digital media. Examples are:

a) 47 wmdt television documentary, October 2021 – UMES receives $30 million from NOAA to continue research opportunities, expand diversity in STEM.
b) HBCUBUZZ documentary, October 7, 2021 – UMES receives $30 million grant for efforts to train marine biologists entering workforce.
c) UMES SANS monthly Digest in October 2021, May 2022, July 2022, and August 2022.
d) LMRCSC quarterly newsletter: The Living Sea issues

Administration Outcome 4: Increased use of post-secondary education evaluation methodologies

Outputs:

- **Number of best practices that are measurable, scalable, and transferrable.**

The LMRCSC provided training for grant proposals. This training was provided each academic year. The training was conducted as 1-hour sessions over a 5-day period during the cohort experience. This training was offered four times over the course of the project. Student proposals were evaluated by the Technical Advisory Board. The Board used a rubric developed to critique proposals. Upon request, students received feedback regarding elements of the proposal. Additionally, the external review team developed a rubric to measure student literacy in the research thematic areas based on program evaluations and the objectives of the research themes.

- **Consistent use of established evaluation practices including higher education practices, to measure effectiveness of each component of the award.**

The LMRCSC employed a continuous improvement practice informed by student evaluations. The College of Exploration provided surveys post training and seminar activities. The College of Exploration provided reports regarding student perceptions and recommendations for improvement to provide the best possible learning experiences. The in-person Cohort Experience was offered every other year based on student feedback, which reported loss of academic progress with back to back travel. The center also employed strategies to identify best times of the academic year to provide training to improve engagement in center training and seminars.

III. LMRCSC Award Executive Summary

The mission of the LMRCSC is "*To prepare a diverse student body for careers in marine and fisheries sciences through exemplary academic and research collaborations"***.** The Center's major Education Goals are: (1) prepare the future workforce for marine and fisheries sciences, and (2) strengthen collaborations across universities and professional networks to enhance academic programs in marine and fisheries sciences, whereas the Research Goal is to: (3) develop an exemplary capacity for scientific collaborations among partner institutions in the fields of marine and fisheries sciences. The Administration Goals include: (4) organizational excellence for effective and efficient management of the programs and activities of the Center, (5) effectively communicate the activities and accomplishments of the Center, and (6) assess and evaluate the Center's goals and objectives.

The Center was guided by two management tracks, A) Administrative and B) Programmatic. The Administrative component included the Center Director, Assistant Director, Executive Committee, Center Core Administration, and the Board of Visitors, whereas the Programmatic component included the Technical Advisory Board that reviewed proposals submitted annually to the Center.

Center students completed the Student Development Plan form each semester in order to provide Center staff with an up-to-date view of student progress toward Center requirements. The plan was reviewed each semester by the Program Director at the student's institution as well as Center-level staff to ensure that all team members are informed of student progress. It allowed staff to intervene in the event that a student was falling behind both in terms of their degree program and their Center training.

The Center organized five-day intensive Cohort Experience workshops that provided graduate fellows with opportunities to participate in full emergent learning with professionals representing academia and NOAA. Material delivered was aligned with the core competencies to prepare fellows for NOAA mission and career preparedness. In addition to the core competencies, fellows were trained in soft skills related to working in both academia and federal government settings. The cohort experience was evaluated by the fellows for continuous improvement, which also included follow up with fellows employed by NOAA. The incorporation of feedback and NOAA mission alignment produced content and practice with the preparedness of fellows for the NOAA workforce in mind.

To accomplish Goal 1, the Center supported 113 degree seeking students (50 B.S., 37 M.S., 26 Ph.D.) from September 1, 2016 to August 31, 2022. Of those, 99 individuals or 88% identified as belonging to underrepresented minority (URM) groups. In addition, the center supported 33 non-degree seeking students through programs such as the Geoscience Bridge Program and the Rising Sophomore Experiential Training Program (RSETP). Of these, 32 students or 97% identified as belonging to URM groups. Fifty-seven (57) students (25 B.S., 21 M.S., 11 Ph.D.) of which 51 (89%) identified as URM groups, graduated. Thirty-three (33) of those that graduated have entered the NOAA mission workforce, including 10 working directly for NOAA and one NOAA contractor, whereas 23 have gone to further education. Twelve (12) graduates went to pursue M.S. degrees, 9 are pursuing Ph.D. degrees in NOAA mission fields, and one student is pursuing a J.D. degree with specialization in environmental law. Sixty-one (61) graduate students, including 51 (84%) students belonging to URM groups, participated in 12-week NERTO internships at NOAA labs/facilities. 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 Forum and the American Fisheries Society conference.

To accomplish Goal 2, the Center offered a Data Management course and a two-day Data Carpentry workshop to students to increase their quantitative and analytical skills. Students also increased their computational skills through the analyses of long-term datasets from NOAA or state agencies as part of their thesis or dissertation research or during research internships, including but not limited to NERTO. Students gained literacy in the field of policy and how STEM is applied through the cohort workshop. We also formed partnerships with NOAA scientists to facilitate student training in the application of STEM related materials regarding decision-making, policy and management. LMRCSC faculty, staff and students collaborated with at least 64 NOAA scientists to carry out the Center's education and outreach, scientific research, and administrative functions.

In support of Goal 3, 38 research projects were funded of which 26 were led by students as Principal Investigators. These collaborative projects addressed 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 addressed some of the goals, objectives and priorities listed in the NMFS 2007 Strategic Plan for Fisheries Research. Examples of research projects conducted by LMRCSC-funded scientists, students and NOAA collaborators include: Discard mortality of sub-legal black sea bass in the commercial trap fishery: impact of air exposure and acute temperature changes; Biological baseline data for Jonah Crab management, and Refining stock structure of common bottlenose dolphins through photo-identification and genetic analysis. At least 14 cohort students used data from NOAA or state agencies in their research activities, including monkfish length and hardparts, American Plaice growth and maturity, Hawksbill and Kemp's Ridley sea turtle bone growth, lane snapper lengths and ages, and weakfish diet data.

LMRCSC students and faculty made 282 presentations, including 178 oral and 104 poster presentations. Of those, 198 (128 oral and 80 posters) included the results of directly funded research. Cohort students delivered a total of 174 of these presentations (99 oral and 75 posters). Center students and faculty also published 172 articles in refereed journals and books; 44 were the result of direct funding, and 36 included cohort students as authors. Through its research and 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 $25.54 million was awarded in grants to the LMRCSC institutions, which has had positive impacts on Center activities. These funds enhanced LMRCSC research through support of its faculty and students and development/enhancement of infrastructure.

The foregoing indicate that the LMRCSC educational, research and outreach activities addressed 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 has made significant contributions to the training of a diverse pool of students in NOAA related STEM disciplines that will help increase U.S. competitiveness in the global economy.

IV. Goals and Objectives

Education, Training, and Graduation Outcomes

Stem diversity in NOAA mission fields as Center Contributions

LMRCSC supported students come from 12 different majors, with Environmental Science (41%) and Marine Science (34%) being most common. A summary of these majors can be seen in Figure 13.

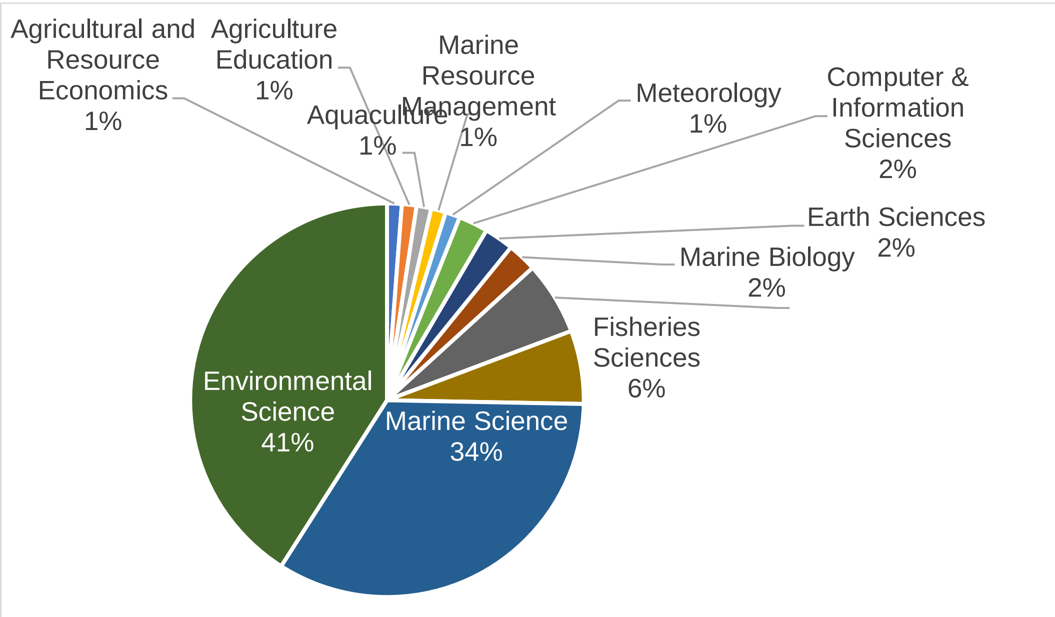

Figure 3. LMRCSC student majors

NOAA Workforce Impact

Of the 57 cohort students who have graduated, 33 have entered the NOAA mission workforce including ten working directly for NOAA and one NOAA contractor. A summary of their employment types can be found in Figure 14. Further details can be found in Appendix 1.

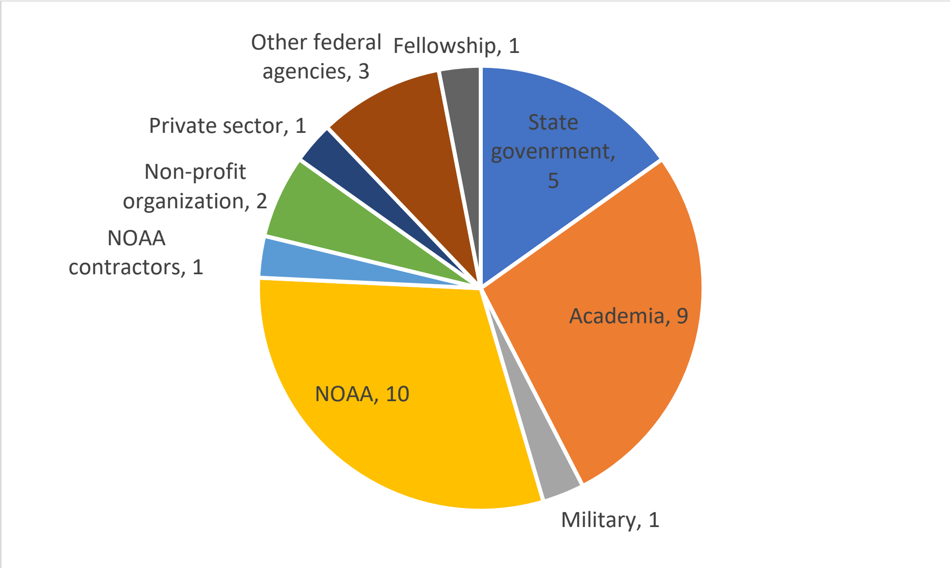

Figure 4. Employment types of LMRCSC cohort graduates.

Experiential Training Center Provided to Supported Cohort Students

In addition to the research experience required by their degree programs, the LMRCSC offers two experiential opportunities to students: NERTO and the Rising Sophomore Experiential Training Program (RSETP).

Sixty-one (61) LMRCSC graduate students participated in 12-week NERTO internships. Their details can be seen in Table 12. The Outcomes and Outputs from these experiences are described in Figure 1 and Figure 2.

In addition to providing application support for undergraduate students to apply to outside internships, the LMRCSC supported undergraduate research experience through the RSETP, which funded rising sophomores to participate in summer research programs at partner institutions. During the program, students also learned about the opportunities available through the Center and through NOAA. Nine students participated in the Rising Sophomore Experiential Training Program (RSETP). Their details are listed in Table 19. Seven of these students were recruited into Center cohorts.

Table 19. Participants in RSETP

First	Last	Home Institution	Year	Major	Site of the RSETP
Nakia	Coit	UMES	2017	Biology	UMES
India	Oliver	UMES	2017	Env. Sci.	SSU
Ileana	Fenwick	HU	2017	Mar. Sci.	UMES
Chryston	Otubu	HU	2017	Mar. Sci.	UMES
Isaiah	Milton	HU	2017	Mar. Sci.	UMES
Colby	Bommer	HU	2018	Marine Science	UMES
Khari	Crommarty	HU	2018	Marine Science	UMES
DaQuan	Davis	UMES	2018	Env. Sci.	UMES
Erianna	Hammond	SSU	2019	Marine Science	UMES

LMRCSC Annual Professional Development in Preparation for NOAA-Mission Career Paths

Annual Professional Development activities are summarized in Table 17.

LMRCSC Core Competencies Attained Annually by Cohort Students

LMRCSC Fellows participated in training focused on the core competencies for the LMRCSC. The core competencies encompass the four main research areas identified by NOAA. In addition to in person and virtual training in the research thematic areas, the LMRCSC included proposal training through the Technical Advisory Board (TAB) activity. The TAB allows for students to demonstrate understanding and synthesis through proposal development. Students received feedback from members of the TAB, made up of NOAA scientists and led by the NOAA Technical Monitor. The level of competency attained by LMRCSC graduate students in the research priority areas is provided in Appendix 6.

SASI: Stock Assessment Support and Information

Conservation and management of living marine resources including fish, invertebrates, and protected species, require reliable and current information on the status of their populations and habitats, and the impacts caused by humans from fishing or environmental disturbance. New and improved methods and procedures are continually needed to accurately quantify the abundance and distribution of living marine resources, and to assess anthropogenic impacts on populations and habitats. Reducing scientific uncertainty and improving the accuracy and precision of stock assessments require improved quality of information. This can be achieved by enhancing traditional methods of assessment by incorporating habitat information, using new technologies (such as optical, acoustic, molecular/genomic, etc.), developing improved climate and stock forecasting models, and incorporating socio-economic impacts. Advanced assessments will improve our ability to develop optimal harvest strategies that promote long-term sustainability, and to determine the tradeoffs between alternative policy choices.

The LMRCSC encourages proposals to support research on:

- Stock assessment of fish, invertebrates, and marine mammals, including population abundance, migration and distribution patterns;
- Biological processes such as trophic relationships, habitat use, age structure, growth, mortality, reproductive biology and behavior, and responses to environmental variability;
- Development of alternative or efficient harvesting strategies, methods, and gear;
- Innovative technology to support surveys, observations, and data collection, and improvements in fishing gear to reduce bycatch and habitat impacts.

CLIME: Climate Impacts on Marine Ecosystems (CLIME)

Climate change is producing major impacts on marine ecosystems, which can affect the productivity and distribution of living marine resources. Warming ocean temperatures are causing species distributions to shift toward the poles, and increased CO_2 production is increasing ocean acidification. These changes may disrupt ocean ecosystems and trophic webs in ways that we do not understand. Understanding and predicting the long-term impacts of climate change will require increased research on changes in the marine ecosystem such as temperature, salinity, pH, sea level rise, sea ice extent, freshwater inputs, and ocean currents. Accomplishing this requires advances in technology, observations, and modeling of both the ocean and atmosphere.

The LMRCSC encourages proposals to support research on:

- Effects of changes in ocean temperature, salinity, acidification, current patterns, or other physical parameters on the marine ecosystem;
- Effects of climate on the distribution and production of living marine resources, including reproduction, growth, mortality, diseases and contaminants, and sustainability;
- New technologies to measure and record changes in the environment, and models to understand and predict the outcomes of future scenarios;
- Socio-economic consequences of environmental change on coastal communities;
- Methods to support or achieve EBFM (Ecosystem Based Fisheries Management)

HaBS: Habitats and Biological Systems

Ocean, coastal, and riverine habitats play a critical role in the health and sustainability of fish, invertebrate, and marine mammal populations. Healthy habitats and ecosystems are critical for long-term sustainability of aquatic resources, as well as the fisheries, economies, and communities that depend on them. Climate change and anthropogenic impacts such as chemical contaminants affect the distribution of species, and the ability of habitats to sustain them, and both may play roles in the long-term decline of coral reefs and the expansion of harmful algal blooms. Assessment of the condition of marine ecosystems and habitats is essential for improving stock assessments, understanding the impacts of resource exploitation on marine populations and species, planning for compatible uses of the marine ecosystem, and evaluating potential benefits of habitat restoration. Understanding how coastal development activities affect fish, invertebrate, turtle, and marine mammal populations and species is necessary to mitigate those effects and to support coastal zone planning.

The LMRCSC encourages proposals to support research on:

- Defining the essential characteristics and value of habitats required for the health and sustainability of fish, invertebrate and marine mammal populations;
- Impacts of human activities on marine habitats, ecosystems, populations and species, including fishing, bycatch and discard mortality, coastal development, nutrient and sediment overload, anoxia, pollution, anthropogenic noise, harmful algal blooms, and exposure to contaminants;
- Strategies to conserve and restore marine habitats and ecosystems, and to mitigate impacts of habitat degradation on exploited and protected species and populations, particularly for fragile habitats such as coral reefs and estuaries;
- Impacts of climate change on social-ecological systems, including development of improved coastal and marine spatial planning efforts.

SNAP: Seafood, Nutrition, Aquaculture, and Pathology

Seafood is one of the best sources of healthy human food, providing large quantities of protein and essential fatty acids. A long-term supply of sustainable, safe, and secure seafood is necessary to support healthy human populations and communities. Aquaculture production now exceeds the production of world capture fisheries. However, pathogens, harmful algal blooms (HABs), chemical contaminants, and other stressors of marine ecosystems pose significant risks to the health of seafood resources and human consumers. It is critical to ensure a safe and healthy supply of seafood, and increase consumer confidence in the quality of seafood. Innovative science and technology is required to support aquaculture development while protecting and maintaining ecosystem health, and mitigating the risks posed by marine stressors.

The LMRCSC encourages proposals to support research on:

- Economically and environmentally sustainable marine aquaculture, including biological and physical conditions for rearing fish and shellfish, husbandry, physiology, genetics, immunology, metabolism, pathology and disease-resistance, chemical ecology, reproduction, and nutrition of aquaculture species;
- Development of improved diets for aquaculture species, and methods to optimize growth and production in culture systems;
- Impacts of harmful algal blooms (HABs);
- Assessment of environmental, social and economic impacts of aquaculture in order to improve the efficiency and sustainability of shellfish and finfish cultivation.

FESS: Fisheries Economics and Social Science

Fisheries science research occurs within a socio-cultural context. While social science does not constitute a separate thematic area for research, knowledge of the social, economic, and behavioral sciences is critical to understand and predict the outcomes of fisheries management and policy decisions. For this reason, the social, economic, and cultural impacts of research must be addressed within every thematic area of research outlined above. Consistent with NOAA Fisheries' priorities, socio-economic aspects must be integrated into all research proposals, either as targeted research programs, or as components of other research plans. Specifically, we will focus on the impacts of changes in fishery management, regulations, or economics on coastal communities, in an effort to understand wider social impacts, and the characteristics of resilient communities

Scientific Research Outputs and Outcomes

Thematic Areas – Students in Research

The LMRCSC has defined five research priority areas listed above based on the priorities of NOAA Fisheries. Figure 5 shows the involvement of graduate students in these areas. This involvement occurs through their research, TAB proposals, and NERTO.

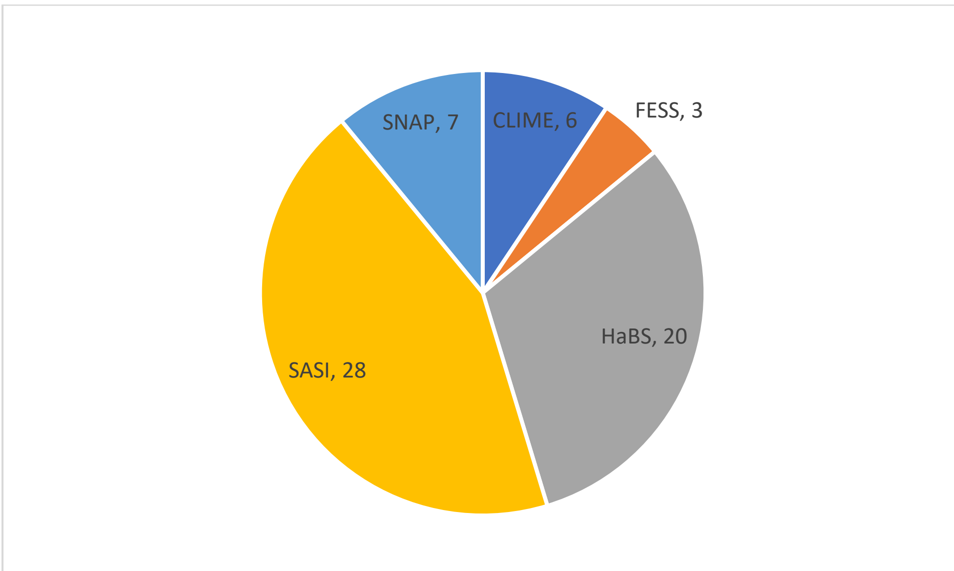

Figure 5. Graduate student involvement in the 5 LMRCSC research priority areas.

Thematic Areas – Award Postdoctoral Fellows

a) Dr. Daniel Cullen was a Post-doctoral Research Associate at UMES. His areas of research were Population Dynamics/Stock Assessement, and Fisheries Habitat.

b) Dr. Matthew Kenworthy was a Post-doctoral Research Associate at SSU. His areas of research include Fisheries Habitat, and Population Dynamics.

Collaborative Research with NOAA

The LMRCSC partners with NOAA scientists in three specific ways. First, each TAB proposal is required to include a NOAA scientist as a collaborator. As listed in Table 6, 27 individual NOAA scientists have participated in funded TAB projects. The details of those projects are located in Table 20.

Second, cohort graduate students are required to participate in a 12-week internship under the supervision of a NOAA scientist. This effort is a research collaboration between the NOAA scientist, the student, and the student's research mentor within LMRCSC. Sixty-one (61) LMRCSC graduate students have completed this activity (Table 2) with the guidance of 44 individual NOAA mentors (Table 6).

Finally, LMRCSC scientists seek additional funding to conduct NOAA relevant research through other grant programs at NOAA. Appendix 4 shows that Center scientists have secured nine research grants totaling over $1 million from NOAA sources over the course of this award period.

NOAA Mission Research Capacity Built through the LMRCSC Award

The LMRCSC award has been used to built capacity at Center institutions, including, (a) enhancement of the Fish and Zooplankton Ecology Lab at UMES, purchasing of field sampling equipment such as YSI 6600, and laboratory supplies (e.g., Plankton nets, Van Veen Grab), b) retrofitting of the *RV Aquaria III,* enhancement of the Zooplankton/Oyster/Microscopy Lab, Marine Mammal Genetics Lab, Wet lab, and Fisheries Lab at HU. Additionally, (c) new faculty members were hired at HU and UMES.

Administrative Outcomes

Communication, Engagement, and Sustainability

There was enhanced communication and engagement within the center, and with external stakeholders, including NOAA. More than 64 NOAA scientists collaborated with LMRCSC students and faculty during the funding period. Two new faculty positions funded at UMES in marine and fisheries science using the HBCU coalition settlement funds, inaddition to increased leveraging of funds from various agencies by LMRCSC scientists will help in sustaining the Center.

Faculty Productivity at MSI Partners

Faculty at Center MSIs were PIs on 34 of 108 leveraged grants secured by the Center. Center scientists at MSIs authored or co-authored 55 publications and made 122 presentations at scientific meetings. Faculty at the MSIs also trained and graduated 20 individuals enrolled in M.S. and Ph.D. degrees in their institutions.

LMRCSC Collaboration with End-Users of Center Research Products

Additionally, LMRCSC scientists reported forming nine collaborations with end-users (Table 18), and LMRCSC publications have been cited a total of 1313 times (188 from directly funded publications; 1125 times from leveraged publications).

V. LMRCSC Purpose

Objectives and LMRCSC Focus

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

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

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

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

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

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

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

Objective 2.2: Use Virtual Campus technology to provide students with the opportunity to learn from some of the nation's leading scholars in marine and fisheries sciences **Objective 2.3**: Ensure that curricula of degree programs at partner institutions address current challenges and emergent needs within the profession

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

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

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

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

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

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

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

Objective 4.2: Monitor and ensure compliance with Center Award Conditions

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

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

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

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

Objective 6.1: Assess and evaluate center educational programs

Objective 6.2: Assess and evaluate center research

Objective 6.3: Assess and evaluate administration

Education, Training, Scientific Research, Future Workforce Development

Center-wide Student Recruitment

The LMRCSC recruits students through a variety of means, both formal and informal. Formal recruitment activities were described in Table 16. Additionally, Program Directors recruit informally by posting fliers and through word of mouth on their campus. In response to feedback from the Independent External Review conducted in 2020, the LMRCSC has created a single center-wide application as well as an information request form that allows students to request information about the Center. That request is automatically delivered to the Program Director at each institution that the student identifies an interest in.

Center-wide Core Competencies Framework and Validation of Proficiencies by CSC

The LMRCSC developed the Cohort Experience Workshop to provide all graduate students with the minimum level of competency required in each of the competency areas. Beyond that level, each student's course of study is tailored to their research and career goals and assessed by the Program Director at their institution. Details of these competencies can be found in Appendix 6.

Center-wide Social Science Integration

Center-wide social science integration comes from three activities: the Cohort Experience Workshop, the social science integration into TAB proposals, and enrollment in a social science course for credit.

The social science section of the Cohort Experience Workshop is designed to introduce the broad range of social science applications in NOAA relevant research presented by an expert in the field. As an example, Kelly Biedenweg, Ph.D., Assistant Professor of Human Dimensions, Oregon State University, Department of Fisheries and Wildlife provided this training during the 2019 Cohort Experience Workshop. The abstract is reproduced here:

Abstract

Fully understanding marine systems requires attention to the social processes that affect their status, often called the human dimension. The ubiquity of use of this term, however, usually hides what we really mean. The first portion of this workshop will help you identify and develop the "human dimensions" of your research. You will learn about three categories of human dimensions: Social Research, Arts and Humanities, and Application (communication, education and management). In an actively engaged process, we will rotate through a variety ofrelevant social sciences, with each student developing prototypes for integrating social scientific questions into an existing project of their choice. The second half of the workshop will facilitate the communication of social components to marine conservation. While all scientists need to practice effectively communicating their message, the marine social sciences and human component are particularly problematic for many professionals to frame in meaningful ways.

Using tools and frameworks from COMPASS (Communication Partnership for Science and the Sea), you will learn how to identify your audience, frame, and deliver your human dimensions' message. Through a hands-on activity and small group feedback, you will leave with a better understanding of how to identify, incorporate, and communicate human dimensions in your research. To prepare for this session, you should read three articles provided: Spalding and Biedenweg 2017; Spalding et al. 2017; Bennett et al. 2016.

Key concepts: The human dimensions of marine science include scientific and outreach efforts that inform management. Social science is the empirical assessment of human thoughts and actions. Communication and outreach build on social science knowledge to more effectively share ideas.

In TAB proposals, students are asked to integrate social science along a continuum from a description of the broader impacts of the proposed research to actually testing a social science hypothesis through the research. Student applicants to the TAB receive feedback on the appropriateness of the social science integration of their proposals.

Finally, all students are required to complete a course in Social Science for credit. At the undergraduate level, we accept courses including GIS, economics, sociology, and anthropology whose course description will clearly introduce them to decision making processes. At the graduate level, students are required to take a course that more specifically relates to natural resource policy such as Resource Economics, Coastal Zone Management, or Environment and Society.

Professional Development: Rising Sophomore Summer Internship

The LMRCSC supports undergraduate research experience through the Rising Sophomore Experiential Training Program (RSETP), which funds rising sophomores to participate in summer research programs at partner institution. During the program, students also learn about the opportunities available through the Center and through NOAA. Nine students participated in RSETP. Their details are listed in Table 19. Seven of these students were recruited into Center cohorts.

Professional Development Supported through LMRCSC Award

Annual Professional Development activities are summarized in Table 17.

CSC Cohort Fellows Completed NERTO Internships

Sixty-one (61) LMRCSC graduate students, including 51 (84%) students who identify as belonging to URM groups, participated in 12-week NERTO internships. Their details can be seen in Table 2. Of these, at least 26 or 44% had presented or made concrete plans (e.g., submitted an abstract to a conference) to present the results of their internship at the time that they submitted the final report.

CSC Graduates and Future Education

Of the 57 cohort students who have graduated, 23 have gone on to further education. Twelve (12) have gone on to pursue M.S. degrees and nine are pursuing Ph.D. degrees in NOAA mission fields. One student is pursuing a J.D. degree with the hope to specialize in environmental law, and one student is pursuing a Doctor of Veterinary Medicine degree with special interest in marine organisms. Complete information about the degrees they are pursuing can be found in Appendix 1.

CSC Cohort Graduates and Entry in NOAA-Mission Enterprise Workforce

Of the 57 cohort students who have graduated, 33 have entered the NOAA mission workforce including ten working directly for NOAA and one NOAA contractor. A summary of their employment types can be found in Figure 1. Further details can be found in Appendix 1.

LMRCSC Scientific Research

Research supported by LMRCSC is aligned with NOAA Research Priorities and goals as defined by the NOAA Science and Technology Focus Areas, and the NOAA Fisheries Strategic Plan for 2019-2022. The LMRCSC contributes to the achievement of these goals by supporting research in four major thematic areas: SASI: Stock Assessment Support and Information, CLIME: Climate Impacts on Marine Ecosystems (CLIME), HaBS: Habitats and Biological Systems, and SNAP: Seafood, Nutrition, Aquaculture, and Pathology. These four themes overlap with the strategic goals of NOAA Fisheries to some degree.

The LMRCSC Research Strategy

The research goals of the Center were accomplished via five primary mechanisms:

- An annual science meeting;
- Collaborative research funded through the Technical Advisory Board (TAB) process;
- NOAA Experiential Research and Training Opportunities (NERTO);
- Participation in NOAA research cruises;
- Leveraged external grant funding.

1. Annual Science Meeting: The LMRCSC conducted annual Science meetings involving LMRCSC scientists, as well as NOAA scientists, and the TAB. The objectives of these meetings are to: Identify NOAA Fisheries research priorities, establish partnerships, and discuss collaborative projects between and among LMRCSC scientists, and NOAA Fisheries scientists, and develop strategies to secure external funding. To increase the participation of NOAA scientists, and improve communication and collaboration between LMRCSC partners and NOAA, the LMRCSC held its Science Meetings at the NOAA Fishery Science Centers, starting with the NEFSC in 2016, and rotated the meeting among each of the centers in subsequent years.

2. Technical Advisory Board (TAB) Grant Program: Each year, the LMRCSC conducted a science development process involving issuance of a Request for Proposal (RFP), acceptance of research proposals, and a rigorous scientific review process. The amount of funding dedicated to this process varied annually, and has ranged from $350,000 to $450,000. The major goals of the TAB-funding process were to provide start-up funds for collaborative research projects, and to support training of graduate and undergraduate students in NOAA-mission specific STEM disciplines.

a. <u>The LMRCSC RFP</u> was reviewed and revised annually by the Distinguished Research Scientist (DRS), and reviewed by the LMRCSC Research Committee and the NOAA Technical Monitor. The RFP was issued in the fall of each year, and proposal submissions occurred in late January. The TAB reviewed the proposals during January-February, and awards were made during the Spring semester. This allowed incoming students to develop proposals during their first semester (fall) and submit them in time to receive funding for research starting during their first summer.

b. <u>Review of the Proposals Submitted to the LMRCSC</u>: Proposals submitted to the LMRCSC following issuance of the annual RFP were reviewed by the TAB to ensure that LMRCSC research is of high quality and aligned with NOAA-NMFS research priorities.

c. <u>Evaluation Criteria of the Proposals Submitted to the TAB and Research Priorities</u>: Proposals were evaluated by the TAB based on the following criteria:

i. <u>Alignment with NOAA Fisheries</u> was evaluated based on how well the proposed project fits the research themes described above, the NOAA Fisheries priorities, and the NOAA Fisheries Strategic Plan.

ii. <u>Level of Student Involvement</u> included the amount of work to be performed by students, and the number and type of students (Undergraduate, Graduate) involved in the project.

iii. <u>Strength of Collaboration</u> was evaluated based on the number of LMRCSC and other scientists, the number of NOAA scientists, and the number of different institutions, laboratories, or EPP Cooperative Science Centers were involved in the research.

iv. <u>Scientific Merit</u> reflects the quality and value of the proposed scientific research. Scientific merit criteria included: The potential for the proposed activity to advance knowledge and understanding within the marine sciences and to advance desired societal outcomes; Application of creative, original, or innovative methods, or potentially transformative concepts; Evidence that the proposed activities are well-reasoned, well organized, and based on a sound scientific rationale; Clarity, including a clear set of objectives and hypotheses; and integration of social and economic aspects.

v. Feasibility of the Proposal, reflects the qualifications of the individual, team, or institution to conduct the proposed activities; the availability of facilities and infrastructure; and realistic financial expectations.

3. **NERTO, Internships and NOAA Lab visits:** All graduate students supported by the LMRCSC were required to have a NOAA scientist serve on their advisory committees, and we supported internships for students at NOAA laboratories for up to several months for NOAA Experiential and Research Training Opportunities (NERTO). The length of such interactions depended on the research activities involved, relevance to the student's research and education requirements, and available funding.

4. **Research Cruise Participation:** We strongly encouraged all LMRCSC supported students to participate in at least one regular NOAA research cruise during their residency at one of our academic partner institutions. Each year, we obtained lists and schedules of NOAA research cruises in which students could participate, and disseminated them to students and scientists at our partner institutions. Examples of cruises available to students included the NEFSC Bottom Trawl Surveys, scallop surveys, acoustic surveys, clam surveys, AFSC Bering Sea or Gulf of Alaska stock assessment surveys, SEFSC longline survey, NWFSC Newport Hydrographic Line Monitoring, and Okeanos Explorer Internships.

Leveraged Research: In addition to TAB grants, LMRCSC Faculty submitted proposals for competitive external grant programs, Fellowships, and Travel awards.

VI. LMRCSC Approach for Administrative, Education and Training, and Scientific/Research Functions

Key Personnel and Center Staffing

Director

Paulinus Chigbu, has held the position since 2006. He provided executive leadership, strategic communications and visibility, and managed, planned, coordinated, organized, implemented, reported, and monitored LMRCSC finances. Further responsibilities included administration, education, scientific research, engagement and recruitment, retention and graduation of students at the center. He developed comprehensive reporting for all LMRCSC sponsored activities, and secured leveraged funding to make the LMRCSC sustainable. He was also Project Director of an REU site in Marine and Estuarine Sciences, Geoscience Bridge Program, and the CREST Center for an Integrated Study of Coastal Ecosystem Processes and Dynamics in the Mid-Atlantic region, all of which are funded by NSF and leveraged with NOAA LMRCSC funds. Chigbu devotes 50% of his time to lead the LMRCSC.

Assistant Director
Margaret Sexton, assisted in the administration of the LMRCSC, and allocated 100% of her time to the LMRCSC activities. Among her responsibilities were oversight, coordination and execution of all Center plans and timelines, meetings, and engagement with internal and external groups to promote the Center. She also assisted in student assessment, longitudinal tracking of students, writing semi-annual reports, and in coordinating LMRCSC leveraged programs.

Distinguished Research Scientist
Bradley Stevens, allocated 100% of his time during a 9 month period to the Center-wide level coordination, leadership and management of Center research. He was responsible for developing and managing significant research projects for the LMRCSC; leading the development and assessment of the LMRCSC Science Plan, coordinating the annual science meeting; and facilitating and coordinating scientific research between NOAA and LMRCSC scientists, including scientists at other NOAA EPP Cooperative Science Centers. Dr. Stevens retired June 30, 2021. At the close of the FY16 award period, a search was underway to fill this position.

Education Expert
Victoria Young, devoted 50% of her time to coordinating the Center's Education Plan. She provided center-wide level leadership and coordination to ensure that all Center-supported students were successfully following the Center's Education Plan including, education, training, experiential and professional development to attain the working skills and competencies for the agency mission future workforce.

Coordinator for Budget and Data Management
Alexander Kessie, devoted 100% of his time working for the LMRCSC. He coordinated subcontracting of funds to LMRCSC partners, kept track of LMRCSC budgets and invoicing from partner institutions, managed the LMRCSC education, research, student tracking data and information systems, and facilitated the process that produced the Center performance report and the annual LMRCSC student tracker deliverables. He also assisted with maintenance of LMRCSC website.

Communications and Outreach Specialist
Anne Dudley led the LMRCSC communications efforts from 2016-2016. **Tanesha Hankerson** led the communication of center achievements for high visibility with internal and external stakeholders, managed the center web site, and was responsible for increased public access to results from LMRCSC research. She devoted 50% of her time to the LMRCSC activities. She joined the program in 2018 after Anne Dudley, who led the LMRCSC communications from 2016-2017, left.

Advisory Boards and Committees

Board of Visitors (BOV): The BOV developed the MOUs, reviewed Center policies and procedures, and work plans for each year. They also addressed and resolved higher level administrative issues associated with cooperative arrangements between academic institutions. Finally, the group facilitated inter-institutional course offerings by helping to execute the Articulation Agreement of LMRCSC. As a result of the Articulation Agreement, a student enrolled at one center institution could register for courses offered at another center institution. The BOV is composed of the Presidents of Center institutions or their designees, NOAA representative from NMFS, Center Director (ex-officio member), NOAA EPP Representative. The President of UMES or the designee serves as chair of the BOV. The BOV met once a year in October or November.

Technical Advisory Board (TAB): The TAB reviewed and provided recommendations to the Center Director on the Center's science plan and research proposals, and by so doing, ensured that the research conducted at the Center is of high quality and in line with NOAA Fisheries research priorities. The TAB committee is comprised of scientists with various areas of expertise in NOAA related sciences working at various NOAA Laboratories. The TAB is chaired by the LMRCSC Technical Monitor. Selection of TAB members is made by the LMRCSC Technical Monitor based on research record and expertise in NOAA-related fields. Membership is for a period of 5 years. Replacement of members is made after discussions between the LMRCSC Technical Monitor and the Center Director.

Center Directorate: The Center Directorate is composed of Key Management Positions; Center Director, Assistant Director, Distinguished Research Scientist, Education Expert, Coordinator for Budget and Data Management, Communication and Outreach Specialist, and Administrative Assistant. The Center Directorate is the hub through which all communications and decisions regarding the NOAA LMRCSC pass. It is the point of contact for all matters pertaining to the NOAA LMRCSC and its programs at the collaborating institutions, and the administrative center for the research, education and training programs of the Center.

Executive Committee (EC): The EC is chaired by the Center Director and is comprised of the Center Directorate, and the Project Directors from each Partner Institution. The EC represents the programmatic interests of each of the collaborating institutions and the Center Directorate addressing the progress towards meeting programmatic objectives at each institution. The EC provided direct oversight and advice to the Center Director. EC meetings were used to discuss and develop center-wide strategies for recruiting students and placing them at NOAA Labs for internships. Internal quantitative and qualitative assessments of the Center institutions were made individually by the Project Directors at each institution and collectively by the EC.

Center Core Administration (CCA): The Provost and Vice President for Academic Affairs at UMES serves as Chair of the CCA. The CCA discussed, identified and resolved administrative affairs that pertained to the Center. The CCA functions to integrate NOAA

LMRCSC administratively and physically into UMES operations and ensures that the Center has the necessary resources to achieve its mission and meet its programmatic objectives. The CCA is composed of the following at UMES: Provost and Vice President for Academic Affairs, Representative from the Office of the President, Vice-President for Administrative Affairs, Dean of the School of Agricultural and Natural Sciences, Chair of the Department of Natural Sciences, and the Center Director.

Education Committee: The Education Expert chairs this committee, which includes representatives from each of the Center partner institutions and works to coordinate schedules for course offerings, and LMRCSC seminar series, as well as develop and modify LMRCSC program curricula, and seek funding from various agencies to establish new center-wide education programs.

Center Decision-Making Process

Project Management and Key Participants Critical to the Success of the Award

The LMRCSC has an administrative structure that facilitates decision-making and the accomplishments of the Center's goals and objectives. As stated previously above, the Administrative component of the Center includes the LMRCSC Management Key Positions: Center Director, Deputy Center Director, Distinguished Research Scientist (DRS), Education Expert, Data and Information Manager, Communication and Outreach Specialist, and Executive Committee (EC), Center Core Administration (CCA) and the Board of Visitors (BOV).

The programmatic component of the center includes the ***Technical Advisory Board (TAB)*****:** The TAB reviews and provides recommendations on the Center's science plan and research proposals, and was established to ensure that the research conducted at the Center is of high quality and in line with NOAA Fisheries research priorities. As described in Section VI, decisions about the Center's education, research and outreach are made through the executive committee and the TAB.

Research Activities

CSC Postdoctoral Fellows Program

Dr. Daniel Cullen was a postdoctoral fellow at UMES. He worked on habitat associations of fishes in the northwest Atlantic and authored/co-authored several publications such as:

Cullen DW, Guida V. 2021. Use of geographically weighted regression to investigate spatial non-stationary environmental effects on the distributions of black sea bass (*Centropristis striata*) and scup (*Stenotomus chrysops*) in the Mid-Atlantic Bight, USA. Fisheries Research. 234.

Cullen, D. W., and Stevens, B. G. 2020. A brief examination of underwater video and hook-and-line gears for sampling black sea bass (*Centropristis striata*) simultaneously at 2 Mid-Atlantic sites off the Maryland coast. Journal of Northwest Atlantic Fishery Science, 51:1–13. doi:10.2960/J.v51.m725.

Cruz-Marrero, W., **Cullen, D. W.**, Gay, N. R., and Stevens, B. G. 2019. Characterizing the benthic community in Maryland's offshore wind energy areas using a towed camera sled: Developing a method to reduce the effort of image analysis and community description. PLoS One, 14(5):e0215966.

Dr. Matthew Kenworthy was a postdoctoral fellow at SSU. He conducted research funded by the Center after reviews by the TAB. The title of his project was *Evaluating the effects of landscape scale habitat variability on white shrimp (Litopenaeus setiferus) population dynamics in Georgia estuaries*.

TAB Projects

The LMRCSC has funded 38 research projects (Table 20), with 8 funded in FY17, 11 funded in FY18, 7 funded in FY19, 10 funded in FY20, and 2 funded in FY21. Twenty-six (26) of these projects were led by a student PI.

Table 20. TAB projects funded by LMRCSC from September 1, 2016 - August 31, 2022. The first two digits of each project number represent the fiscal year in which the project was funded. Cohort students are identified in bold.

Project #	Lead PI	Project Title	Research Thematic Area	NOAA Scientists & Other Participants
17-01	**Cara Schweitzer** (Ph.D. student, UMES)	Discard mortality of sub-legal black sea bass in the commercial trap fishery: Impacts of air exposure and acute temperature changes	SASI	Brad Stevens, UMES; Andrij Horodysky, HU; Richard Brill, NOAA
17-02	Bradley Stevens (UMES)	Biological baseline data for Jonah Crab Management	SASI	Noelle Olson, UMES; Melati Tarrant, UMES REU, Burton Shank, NOAA
17-03	**Stephanie Martinez-Rivera** (UMES) and **Shadaesha Green** (UMCES)	Reproductive Biology of red deepsea crabs, *Chaceon quinquedens*.	SASI	Brad Stevens, UMES; Sook Chung, UMCES; Burton Shank, NOAA; Chris Long, NOAA; James Weinburg, NOAA
17-04	Tara Cox (SSU)	Refining stock structure of common bottlenose dolphins (*Tursiops truncatus*) through photo-identification and genetic analysis	SASI	Joe Pitula, UMES; **Emily Griffin**, M.S. Student , SSU; **Debra Baskerville**, B.S. student UMES; Patricia Rosel, NOAA

17-05	Shari Wiley (HU)	The Impact of Increasing Sea Surface Temperatures on Piscivore and Planktivore Species Dynamics: An Ecosystem-Based Modeling Approach	CLIME	**Cristin Mayes**, M.S. student; Andrij Horodysky, HU; Howard Townsend, NOAA
17-06	Joseph Pitula (UMES)	Ecosystem impact of a harmful algal bloom species (*Dinophysis acuminata*) on aquaculture shellfish	HaBS	**Detbra Rosales**, Ph.D. student UMES; Gulni Ozbay, DESU; John Jacobs, NOAA
17-07	Jessica Miller (OSU)	Migration and foraging ecology of at-risk species: Columbia River Chinook salmon and Atlantic weakfish	SASI	**Angie Munguia** M.S. student, OSU; Stacy Smith, DSU; Louise Copeman, OSU; Lyndsey King, OSU; Laurie Weitkamp, NOAA
17-08	**Ammar Hanif,** Ph.D. student (UMCES-IMET)	Comparing the diet and microbiome of Atlantic menhaden and Eastern oyster using DNA barcoding	SASI	Rose Jagus, UMCES; Allen Place, UMCES; Joe Pitula, UMES; John Jacobs, NOAA
18-01	**Brittany King,** Ph.D. student, OSU	Underrepresentation in marine and fisheries science professions: how significant life experiences shape a diverse workforce	FESS	K. Biedenweg, OSU; K. Werner, NOAA; S. Russell, NOAA
18-02	S. Chung, IMET	Baseline Data of Male Reproductive Status for Jonah Crab Management	SASI	B. Stevens, UMES; **Amanda Lawrence**, M.S. student at IMET; B. Shank, NOAA
18-03	**LaTreese Denson**, Ph.D. student, RSMAS	Indices of abundance for King Mackerel in the Gulf of Mexico and South Atlantic improved by incorporating spatiotemporal and environmental variability	SASI	E. Babcock, RSMAS; D. Hoskins-Brown, SSU; J. Walter, NOAA; J. Thorson, NOAA
18-04	Tara Cox (SSU)	Examining ecosystem health through contaminant analysis of common bottlenose dolphins (*Tursiops truncatus*)	SASI	C. Bonin Lewallen, HU; G. Ylitalo, NOAA

18-05	**Matthew Ramirez**, Ph.D. student, OSU	Integration of habitat-specific growth variation into assessment models: a case study in the Kemp's Ridley sea turtle	SASI	S. Heppell, OSU; E. Babcock, RSMAS; J. Moore, NOAA; L. Avens, NOAA
18-06	**Detbra Rosales,** Ph.D. student, UMES	Assessing the Impacts of Harmful Dinoflagellates and *Vibrio* spp. on Oyster Aquaculture in the Delaware Inland Bays	HaBS	J. Pitula, UMES; J. Jacobs, NOAA
18-07	**Rebecca Wenker**, M.S. student, UMES	Cold-water corals in the Mid-Atlantic Bight: Age, colony complexity, and growth	SASI	B. Stevens, UMES; V. Guida, NOAA
18-08	Eric Lewallen, HU	Genetic-based methods for assessing prey composition and feeding ecology of Pacific lampreys	SASI	C. Bonin Lewallen, HU; L. Weitkamp, NOAA; L. Park, NOAA
18-09	**Brian Galvez,** M.S. student, DSU	Diet analysis of juvenile weakfish in the Delaware Bay using stomach content and stable isotope analysis	SASI	S. Smith, DSU; M. Crawford, UMES; H. Townsend, NOAA
18-10	**Andre Price,** M.S. student, UMES	Feeding Ecology of Black Sea Bass at Selected Reef Sites using Gut Content and Stable Isotope Analyses	SASI	B. Stevens, UMES; R. McBride, NOAA
18-11	**Enid Munoz,** M.S. student, UMES	Assessment of Microplastics and Polybrominated Diphenyl Ethers (PBDEs) in Scallops as Possible Indicators of Plastic Pollution from the Georges Bank, Mid-Atlantic, Southern New England, and Gulf of Maine Stock Fisheries	HaBS	A. Ishaque, UMES; A. Deshpande, NOAA; B. Sharack, NOAA
19-01	**Anya Byrd**, Ph.D. student at IMET	Baseline data on environmental impacts on physiological and molecular parameters determining growth for commercially valuable decapod crustacean management	SASI	J. Sook Chung, IMET; Elizabeth Babcock, RSMAS; Paul McElhany, NOAA

19-02	**Shanelle Haughton**, Ph.D. student, UMES	Evaluating physiological and immune responses of snow crabs (*Chionoecetes* sp.) to *Hematodinium* infection	SASI	Reuel Danquah, M.S. student at UMES; Joseph Pitula, UMES; Pamela Jenson, NOAA
19-03	**Amanda Pappas**, M.S. student at DSU	Ecological investigation of a toxic harmful algal bloom species (*Dinophysis acuminata*) and its potential impact to the aquaculture industry of Delaware Inland Bays	HaBS	Detbra Rosales, Ph.D. student at UMES; Gulnihal Ozbay, DSU; Gary Wikfors, NOAA
19-04	**Benjamin Frey**, MS student at IMET	Validation of Monkfish Age and Growth Using Microconstituent Analysis of Hardparts	SASI	Rosemary Jagus, IMET; Anne Richards, NOAA
19-05	**Keala Pelekai**, MS student at OSU	Evaluation of age, natal origin, and trophic history of Pacific Lamprey *(Entosphenus tridentatus)*	SASI	Jessica Miller, OSU; Laurie Weitkamp, NOAA
19-06	**Hillary Thalmann**, MS student at OSU	Thermal impacts on juvenile Pacific Cod *(Gadus macrocephalus)* foraging and growth in Gulf of Alaska nursery habitats	CLIME	Jessica Miller, OSU; Ben Laurel; NOAA
19-07	**Adrianne Wilson**, Ph.D. student at RSMAS	Population structure and growth of lane snapper, a data limited species	SASI	Elizabeth Babcock, RSMAS; Robert Allman (NOAA)
20-01	**Savannah M. Geiger**, M.S. student, SSU	An analysis of distribution and abundance of microplastics in selected commercially important species in Northern Georgia coastal waters	HaBS	Ali Ishaque, UMES; Ashok Deshpande, NOAA; Kimberly Roberson, NOAA
20-02	**Sierra Hildebrandt**, M.S. student HU	Investigating the Impacts of Adult-Oyster-Conditioned-Water on Crassostrea virginica Larval Setting Efficiency Utilizing Direct Setting in the Hampton River, Virginia	HaBS	Deidre Gibson, HU; Stephanie Westby, NOAA; Jason Spires, NOAA
20-03	**Kyarii Ramarui**, Ph.D. student UMCES	Proteomic analysis of two *Haematococcus pluvialis* strains as aquaculture feedstock	SNAP	Yantao Li, UMCES; Allen Place, UMCES; Joseph Pitula,

				UMES; Gary Wikfors, NOAA
20-04	Eric Schott, UMCES	Life history and disease ecology of the blue crab, a key benthic-pelagic link in tropical and temperate American estuaries	SASI	Bradley Stevens, UMES; Bruce Vogt NOAA; **Olivia Pares**, Ph.D. student, UMCES; Harold Manrique Hernandez, San Juan Bay Estuary Program
20-05	Matt Kenworthy, SSU	Evaluating the effects of landscape scale habitat variability on white shrimp (*Litopenaeus setiferus*) population dynamics in Georgia estuaries	HaBS	Dionne Hoskins-Brown, SSU; Jennifer Doerr, NOAA; Maurice Crawford, UMES
20-06	**Janelle Layton**, M.S. Student, OSU	Investigating the effects of climate change on heat shock proteins and development in the early life history stages of Nassau grouper	CLIME	Scott Heppell, OSU; Carolina Bonin, HU; Steve Gittings, NOAA
20-07	Dennis McIntosh, DSU	Assessment of New Technologies for Post-Harvest Oyster Purification	SNAP	Daniel Grosse; Dorothy Leonard; Salina Parveen, UMES
20-08	**Shanelle Haughton**, Ph.D. student, UMES	Evaluating physiological and immune responses of snow crabs (*Chionoecetes* sp.) to *Hematodinium* infection	SASI	Joseph Pitula; UMES, Pamela Jensen, NOAA
20-09	**Victoria (Williams) Moreno**; Ph.D. student, OSU	Understanding Adaptive Capacity: An Analysis of Community Perceptions and Policy Responses to Ocean Acidification and other marine stressors on the West Coast	CLIME	Ana Spalding, Co-PI; Shallin Busch, NOAA
20-10	**Imani Wilburn**, M.S. student, UMES	The Occurrence of Microplastics in Maryland Coastal Bay Fishes	HaBS	Maurice Crawford, UMES; Kausik Das, UMES; Ashok Deshpande, NOAA
21-01	Tunde Adebola, HU	Developing a Coupled Human Ecological System for Chesapeake Bay Shellfish Fisheries	SASI	**Noah Tait**, M.S. student, HU; Eric Lewallen, HU; Howard Townsend, NOAA

21-02	**Nicholas Coleman**, M.S. Student, UMCES	Sonar Censusing and Habitat Use by Spawning Run Atlantic and Green Sturgeon, *Acipenser oxyrinchus* and *A. medirostris*	SASI	Dave Secor, UMCES; Rose Jagus, UMCES; Steve Lindley, NOAA; Peter Dudley, NOAA

Center Evaluation

Annual Center Evaluation Results and Recommendations of Center External Evaluator

The Center contracted the College of Exploration as the external evaluator for this award. Throughout the award, they have evaluated the activities of the LMRCSC through surveys of students, faculty, and NOAA collaborators. Their recommendations were used to inform decision making in order to improve Center performance. The complete reports provided by the external evaluator are presented in Appendix 7.

VII. Major LMRCSC Accomplishments and Findings

Significant Outputs and Outcomes in Alignment with CSC Desired Program Level Outcomes and Outputs

Education and Training Outcome 1: Increased number, annually, of CSC post-secondary students trained. (FFO p. 8)

- **Output 1.1:** Increased quantitative and analytical skills
    - Center students gained quantitative analytical skills through Course work such as Biostatistics with R, Population Dynamics, Ecosystem Modeling, Bayesian Statistics, etc., and participation in research activities (e.g., thesis and dissertation work, and NERTO projects)
- **Output 1.2:** Increased competencies in applying STEM to decision making, policy, and management
    - All cohort students participated in Cohort Experience workshop
    - Center students took at least a social science course
    - Center students developed and submitted proposals that were reviewed by the TAB, and received feedback that included the extent to which social science would be integrated in the proposed project.
- **Output 1.3:** Increased skills to use large data sets, geographical information systems (GIS), and statistical analysis, computer modeling, and algorithm development
    - All Center graduate students took Biostatistics with R or its equivalent or are planning to take it.

- 57 Center students took a Data Management course or participated in a Data Carpentry workshop
- Additionally, some students analyzed large data sets obtained from NOAA for the NERTO or as part of their thesis or dissertation research.

Education and Training Outcome 2: Increased number of CSC post-secondary students educated and graduated annually (FFO p. 8).

- **Output 2.1:** The number of degrees earned annually in NOAA mission-related disciplines: B.S., total =11 (0 – 9), M.S., total = 15 (0 - 6), Ph.D., total =14 (0 - 3). Please see Table 47 for details.

- **Output 2.2:** The number of students (total and URM) who participated in professional development opportunities

  a) For a minimum duration of 4 consecutive weeks: NERTO participants = 59 of which 49 (85%) belonged to URM groups.

  b) Resulted in a publication or presentation: 31 students

Education and Training Outcome 3: Increased CSC capacity to train and graduate students. (FFO p. 8)

- **Output 3.1:** Number of seminars, new courses, new programs, and new degrees offered to develop working and functional competencies in support of the NOAA mission and workforce

  During this award period, the LMRCSC contributed to the creation of four new courses, and one new degree program that contribute to the working skills and functional competencies that support the NOAA mission and workforce. The courses are listed in Table 3. The new degree program is the Ph.D. in Integrative Agricultural, Food, and Environmental Sciences first offered at Delaware State University in Fall 2021.

- **Output 3.2:** Total number of students supported by the CSCs and degrees awarded that reflect the changing demographics of the nation

  - **Supported** (B.S. 48, M.S. 26, Ph.D. 25)
  - **Awarded** (B.S. 25, M.S. 15, Ph.D. 11)

Education and Training Outcome 4: Reduce the attainment gap for URMs in NOAA mission-relevant fields (FFO p. 8).

- **Output 4.1:** Increased number of URM students in student development activities that will lead them to the attainment of degrees and/or employment in NOAA mission fields: B.S. 48, M.S. 26, Ph.D. 25.

- **Output 4.2:** Increased number of URM students who select to pursue higher education in NOAA mission fields: Total students = 23; URMs = 21.

Description of Accomplishment for Center Communications With NOAA

Through communications and engagements with NOAA, at least 64 NOAA scientists have collaborated with the Center, and the LMRCSC funded 38 research projects that address NOAA Fisheries priorities with NOAA scientists as collaborators. Members of the Technical Advisory Board, who are NOAA scientists, reviewed the projects.

Description of Center Best Practices Developed for Award Performance

TAB Proposal Review Process

The Technical Advisory Board (TAB) proposal process provides an opportunity for students to produce a research proposal for evaluation by the NOAA scientists who make up the Board. Through this evaluation process, students receive feedback regarding the quality of their proposal as well as an opportunity to make improvements based on that feedback, thus providing critical training for the NOAA mission workforce.

Cohort Experience Workshop

The Cohort Experience provided graduate fellows with a five-day intensive, learning week. Fellows participated in full emergent learning with professionals representing academia and NOAA. Material delivered was aligned with the core competencies to prepare fellows for NOAA mission and career preparedness. In addition to the core competencies, fellows were trained in soft skills related to working in both academia and federal government settings. The cohort experience was evaluated by the fellows for continuous improvement, which also included follow up with fellows employed by NOAA. The incorporation of feedback and NOAA mission alignment produced content and practice with the preparedness of fellows for the NOAA workforce in mind.

Student Development Plan

The Student Development Plan form is completed by students each semester in order to provide Center staff with an up-to-date view of student progress toward Center requirements. The plan is reviewed each semester by the Program Director at the student's institution as well as Center-level staff to ensure that all team members are informed of student progress. It allows staff to intervene in the event that a student is falling behind both in terms of their degree program and their Center training.

Graduate Seminar Series

All Graduate Fellows are required to make a presentation to the Center in the Graduate Seminar Series. This presentation provides integral practice presenting research to peer stakeholders. Students are given the opportunity to field questions from their peers and mentors. They receive feedback on their presentations before presenting to a wider audience.

NERTO – NOAA Experiential Research Training Opportunity
NERTO internship provides students hands-on experience at NOAA facilities under the supervision of NOAA scientists.

Development of the New NOAA-Mission Courses, Programs, Majors, Degrees

During this award period, the LMRCSC contributed to the creation of four new courses, and one new degree program that enable the acquisition of working skills and functional competencies that support the NOAA mission and workforce. The courses are listed in Table 3. The new degree program is the Ph.D. in Integrative Agricultural, Food, and Environmental Sciences first offered at Delaware State University in Fall 2021.

UMES-LMRCSC successfully renewed its Research Experiences for Undergraduates (REU) in Marine and Estuarine Sciences during this period, and continued to run its Summer Geoscience Bridge program. It was also successful in obtaining funding for the Phase II of the Center of Research Excellence in Science and Technology (CREST) Center for the Integrated Study of Coastal Ecosystem Processes and Dynamics in the mid-Atlantic region. These programs have enabled UMES to recruit, train and graduate more students in its Marine and Fisheries sciences programs. UMES is a partner in the Cooperative Institute for the North Atlantic Region (CINAR) with NOAA, Woods Hole Oceanographic Institution (WHOI), Gulf of Maine Research Institute (GMRI), University of Maine, University of Massachusetts Dartmouth - School for Marine Science and Technology, University of Rhode Island and Rutgers University. One of the scientists at UMES recrived a two-year CINAR Fellowship. The LMRCSC leadership at UMES has continued to provide assistance with the execution of other programs at non-LMRCSC institutions aimed at training URMs in geosciences, such as the Woods Hole Partnership Education Program (PEP) and the newly developed NOAA IN FISH program that began in June 2021. Interns in the program enrolled in *ENVS 488J: Ecosystem Dynamics* course offered through UMES.

Integrated Social Science that is NOAA-Mission Aligned
Center-wide social science integration comes from three activities: the Cohort Experience Workshop, the social science integration into TAB proposals, and enrollment in a social science course for credit. Mission alignment is ensured by the involvement of NOAA scientists in the Cohort Experience Workshop and review of TAB proposals.

Significant Challenges and Resolution Actions

Research and educational activities were impacted negatively by the covid-19 pandemic. Closure of universities for some months prevented students from working in the lab and conducting field research. There were also challenges with identifying NERTO opportunities and processing NERTO applications for some of the Center students. Time to graduation for some students increased. Students had to attend lectures, conduct thesis/dissertation committee meetings, and participate in NERTO internships virtually.

Description of Need for Additional Work at Center

There is a great need for the Center to continue to recruit and train students, especially those belonging to URM groups, in marine and fisheries science. The Center has made significant positive impacts on the number of URMs who earned doctoral degrees in marine science, however, minorities are still unrepresented in the field.

List of Conference presentations and other presentations (Arranged by Year and Performance Period)

Over the course of the award period, center scientists and students delivered 282 presentations including 178 oral and 104 poster presentations. Of those, 198 (128 oral and 80 poster) included the results of directly funded research. Cohort students delivered a total of 174 of these presentations (99 oral and 75 poster). An additional 109 presentations included cohort student authors who were not the presenter. A summary of these presentations separated by reporting period, presentation type, and funding type are found in Table 21.

Table 21. A summary of presentations by LMRCSC scientists and students from September 1, 2016 to August 31, 2022.

Reporting Period	Total Presentations				Oral Presentations				Poster Presentations			
	All	Directly Funded	Leveraged	Cohort Student Presenter	All	Directly Funded	Leveraged	Cohort Student Presenter	All	Directly Funded	Leveraged	Cohort Student Presenter
Sept. 1, 2016-Feb. 28, 2017	3	0	3	0	2	0	2	0	1	0	1	0
Mar. 1, 2017 to Aug. 31, 2017	19	9	10	7	12	5	7	3	7	4	3	4
Sept. 1, 2017-Feb. 28, 2018	22	16	6	15	10	8	2	7	12	8	4	8
Mar. 1, 2018-Aug. 31, 2018	39	30	9	25	19	15	4	12	20	15	5	13
Sept. 1, 2018-Feb. 28, 2019	35	34	1	25	17	17	0	13	18	17	1	12
Mar. 1, 2019-Aug. 31, 2019	33	19	14	19	16	8	8	7	17	11	6	12

Sept. 1, 2019-Feb. 29, 2020	37	20	17	19	28	14	14	11	9	6	3	8
Mar. 1, 2020-Aug. 31, 2020	19	9	10	8	19	19	10	8	0	0	0	0
Sept. 1, 2020-Feb. 28, 2021	9	2	7	2	9	2	7	2	0	0	0	0
Mar. 1, 2021-Aug. 31, 2021	17	12	5	11	14	9	5	8	3	3	0	3
*Sept. 1, 2021-Feb. 28, 2022	8	8	0	8	6	6	0	6	2	2	0	2
*Mar. 1, 2022 – Aug. 31, 2022	41	39	2	35	26	25	1	22	15	14	1	13
TOTAL	**282**	**198**	**84**	**174**	**178**	**128**	**60**	**99**	**104**	**80**	**24**	**75**

**No Cost Extension Year*

September 1, 2016-February 28, 2017

In the first funding period of the grant, no directly funded results of the grant were presented at scientific meetings as they had not yet been generated; however, three presentations (2 oral, 1 poster) were delivered by Center scientists from leveraged efforts. The detailed list can be found in Table 22. Citations for presentations made during the period Sept. 1, 2016-Feb. 28, 2017. Center scientists are listed in bold. Cohort students are identified by an asterisk (*).

Table 22. Citations for presentations made during the period Sept. 1, 2016-Feb. 28, 2017. Center scientists are listed in bold. Cohort students are identified by an asterisk (*).

Presentation	Funding	Type
Jagus, R. 2017.Trans-splicing of mRNA in dinoflagellates - a link to translational control? Feb 2017.	Leveraged	Oral
Zhao Zhao, Michael Gonsior, Yuanchao Zhan, Rui Zhang, Nianzhi Jiao, **Chen, F**. 2017. The microbial degradation of dissolved organic matter released from *Synechococcus* by viral lysis in coastal seawater. 3rd Xiamen Symposium on Marine Environmental Science (XMAS III), Xiamen, China, January 2017.	Leveraged	Oral
E. Legrand, T. Schock, and **J. Sook Chung**. 2017. Melt-related metabolomic and transcriptomic analyses of the blue crab, *Callinectes sapidus*. 24th Annual NIST Sigma Xi Postdoctoral Poster presentation. Gaithersburg, MD.	Leveraged	Poster

March 1, 2017-August 31, 2017

During this reporting period, Center Scientists made 19 total presentations at conferences. These included 12 oral and 7 poster presentations. Nine were directly funded (5 oral, 4 poster), while 10 were the result of leveraged funding (7 oral, 3 poster). Seven presentations were made by cohort students (3 oral, 4 poster). The detailed list can be found in Table 23.

Table 23. Citations for presentations made during the period of March 1-August 31, 2017. Center scientists are listed in bold. Cohort students are identified by an asterisk (*).

Presentation	Funding	Type
Chen, F. 2017. Ecological Roles of Picocyanobacteria and Cyanophages. Aoshan Forum: Deep Ocean Ecosystem: Extreme environments and life process, Qingdao, China, August 29-30.	Leveraged	Oral
Chen, F. 2017. Transportation of Picocyanobacterial cDOM to the Deep Ocean. Aoshan Forum: Deep Ocean Ecosystem: Extreme environments and life process, Qingdao, China, August 29-30.	Leveraged	Oral
Chigbu, P. 2017. A comprehensive, integrated educational framework for recruiting and training of underrepresented minorities in marine and fisheries sciences. Presented at the American Fisheries Society annual meeting, Tampa, FL, August 20-24, 2017.	Direct: reporting record of LMRCSC	Oral
Chung, JS. 2017. Becoming a sook: It is all in her eyes. Duke Marine Laboratory	Leveraged	Oral
Griffin*, E.K., Z. Wong, R.M. Perrtree, and **T.M. Cox**. 2017. Evaluation of the southern boundary of the Northern Georgia Southern South Carolina Estuarine System stock of common bottlenose dolphins (*Tursiops truncatus*) in the waters around Savannah, GA. Presented at the Southeast and Mid-Atlantic Marine Mammal Symposium, Beaufort, NC April 7-9, 2017.	Direct: Cohort 1 Student	Oral
Major, S. R., D. Stephens, E. Pagliaroli, L. Xiao, R. Powell and **R. T. Hill**. 2017. Succession of the microbial communities in microalgal polycultures for biofuel production. ASM Microbe 2017. New Orleans, LA.	Leveraged	Oral
Miller, J. A., Morgan, C. A., Beckman, B. R., Burke, B. J., Van Doornik, D. M., Weitkamp, L. A. 2017. Migratory patterns of Snake River spring Chinook salmon: comparison of hatchery and presumably wild yearlings. Salmon Ocean Ecology. Seattle, WA.	Leveraged	Oral
Olsen, N.A. and **Stevens, B.G.** 2017. From pest to plate: Using morphometry to help improve management of Jonah crabs, *Cancer borealis*, in the mid- Atlantic Bight. Presented at the American Fisheries Society 147th annual meeting, Tampa, FL, August 20-24, 2017.	Direct: FY 16 TAB project	Oral
Olsen, N.A. and **Stevens, B.G.** 2017. Reproductive biology of Jonah crabs**,** *Cancer borealis*, in the Mid-Atlantic Bight. Presented at the American Fisheries Society Tidewater Chapter 31st Annual Meeting, Virginia Beach, VA, March 9- 11, 2017	Direct: FY 16 TAB project	Oral
Peters, R. and **Chigbu, P. 2017.** Site fidelity and growth rate of juvenile black sea bass, *Centropristis striata*, in the Maryland Coastal Bays using mark- recapture. Presented at the American Fisheries Society annual meeting, Tampa, FL, August 20-24, 2017.	Leveraged	Oral
Rosales*, D. and **Pitula, J.** 2017. The Impacts of Harmful Dinoflagellates and *Vibrio* sp. On Aquaculture in The Delaware Inland Bays. Presented at Living Marine Resources Cooperative Science Center (LMRCSC) Annual Science Meeting, NOAA Southeast Fisheries science Center, Miami, FD, April 2017.	Direct: FY16 TAB project	Oral

Wilson*, A. 2017. Larval Fish Assemblages in the Gulf of Mexico during the Deepwater Horizon Oil Spill. Presented at the American Fisheries Society Annual Meeting, Tampa, FL August, 2017	Leveraged	Oral
Ferranti, D., Peters, R.* and **Chigbu, P.** 2017. A Comparison of the Abundance and Size of Black Sea Bass in the Delaware and Maryland Coastal Bays. Presented at the American Fisheries Society annual meeting, Tampa, FL, August 20-24, 2017.	Leveraged	Poster
Flowers, E.M., Johnson, A., Aguilar, R., **Schott, E.J.** 2017. Disease prevalence in proximity to flow through crustacean aquaculture in a North American Atlantic estuary Association for the Science of Limnology and Oceanography. March, Honolulu, HI.	leveraged	Poster
Green*, S., **Chung, J.S. 2017.** Elucidating the presence and expression of the crustacean hyperglycemic hormone of the red deep-sea crab, *Chaceon quinquedens*. DelMarVa's Aquatic Resources & Ecosystems Research Symposium, University of Maryland Eastern Shore, Berlin, MD, April, 2017.	Direct: Cohort 1 student	Poster
Griffin*, E.K., Z. Wong, R.M Perrtree, and **T. Cox. 2017.** Evaluation of the southern boundary of the Northern Georgia/Southern South Carolina Estuarine System stock of common bottlenose dolphins (*Tursiops truncatus*) in the waters around Savannah, GA. Presented at Savannah State University 7th Annual Research Conference, Savannah, GA April 10, 2017. Poster.	Direct: LMRCSC student stipend	Poster
Hanif,* A, James White, **Rosemary Jagus, Allen Place.** 2017. Menhaden: Nature's ultimate environmental sampler. Delmarva's Aquatic Resources & Ecosystems Symposium, University of Maryland Eastern Shore, Berlin, MD, April 2017	Direct: LMRCSC student stipend	Poster
Lawrence*, A, Green*, S, **Chung, JS.** 2017. The isolation of an insulin-like androgenic gland hormone in the male deep-sea red crab, *Chaceon quinquedens*. DelMarVa's Aquatic Resources & Ecosystems Research Symposium, University of Maryland Eastern Shore, Berlin, MD, April, 2017.	Direct: LMRCSC student stipend	Poster
Spitznagel, M., Small, H., Shields, J., Lively, J., Johnson, A., **Schott, E.J.** 2017. Association of a virus pathogenic to Atlantic blue crabs (*Callinectes sapidus*) with fishing and aquaculture practices National Shellfisheries Association. Nashville, TN. March 26-30, 2017.	leveraged	Poster

September 1, 2017- February 28, 2018

During this reporting period, Center Scientists made 22 total presentations at conferences. These included 10 oral and 12 poster presentations. Sixteen (16) were directly funded (8 oral, 8 poster), while 6 were the result of leveraged funding (2 oral, 4 poster). Fifteen (15) presentations were made by cohort students (7 oral, 8 poster). The detailed list can be found in Table 24.

*Table 24. Citations for presentations made during the period September 1, 2017-February 28, 2018. Center scientists are listed in bold. Cohort students are identified by *.*

Presentation	**Funding**	**Type**
Almodóvar*, L. 2017. Juvenile black sea bass in the Chesapeake Bay. Presented at the MEES Colloquium 3 Minute Thesis. Cambridge, MD. September 2018. Oral Presentation.	Direct: Cohort 2 Student	Oral
Dorsey*, K., et.al. 2018. Effect of Ocean Acidification on Auditory Neurobiology in a tropical Marine Fish. Presented at Ocean Sciences Meeting, Portland, OR. February 2018.	Direct: Cohort 2 student	Oral
Fenwick*, I., Price, A.*, and **Stevens, B.** 2018. Assessing the Condition Index of Black Sea Bass Using Fat/Oil Content and BMI. Presented at Ocean Sciences Meeting, Portland, OR. February 2018.	Direct: Cohort 1 and 2 Students	Oral
Jagus, R. 2017. Dinoflagellates: Eukaryotes that are not plants, fungi or metazoa. EMBL Conference on Translational Control, Heidelberg, Germany.	Leveraged	Oral
Miller, J. A., Morgan, C. A., Beckman, B. R., Burke, B. J., Van Doornik, D. M., and Weitkamp, L.A. 2017. Reconstructing patterns of migration and estuarine residence in Columbia River Chinook salmon: the potential role of otolith barium in large river systems. CERF 2017, Providence, RI	Direct: TAB	Oral
Place, AR, Ernest Williams, Saddef Haq and Tsvetan R. Bachvaroff. 2017. Some Assembly Required - Beyond the type I, II and III polyketide synthase paradigms in dinoflagellates. 9th U.S. Conference on Harmful Algae, Baltimore, MD, Sept 6-9, 2017.	Leveraged	Oral
Rosales*, D.**, S. Parveen,** G. Ozbay, J. Pitula: Detection of *Vibrio parahaemolyticus* and harmful algal species in *Crassostrea virginica* in the Delaware Inland Bays. 2017. 9th Symposium on Harmful Algae in the US. Baltimore, MD November 2017.	Direct: Cohort 1 student	Oral
Schweitzer*, C.C., **Stevens, B.G.** 2017. The Use of Sea Whips (*Leptogorgia* spp.) as an Indicator Species (IS) for Habitat Quality Assessment within the Mid-Atlantic Bight (MAB). Presented at national AFS. August 2017	Direct: Cohort 2 student	Oral
Schweitzer,* C.C., Horodysky, A.Z., Price, A.L., Stevens, B.G. 2018. Evaluating the effectiveness of reflex action mortality predictor (RAMP) in black sea bass, *Centropristis striata,* bycatch within the commercial trap fishery. Presented at AFS Tidewater, North Carolina. Jan 2018.	Direct: Cohort 2 student	Oral
Wenker*, R.P. 2017. Cold-water corals in the Mid-Atlantic Bight: Age, growth, and recovery. Presented at Marine Estuarine and Environmental Science (MEES) Colloquium, Horn Point Laboratory, Cambridge, MD, September, 2017. Oral Presentation.	Direct: Cohort 1 Student	Oral
Galvez, B.*, Neilan, B., Greco, M., Oliver, D.*, Ozbay, G., **Smith, S.** 2017 Stable Isotope Analysis of Juvenile Weakfish (*Cynoscion regalis*) from the Delaware Bay. Presented at the Mid-Atlantic Fisheries meeting, Dover, DE, October 2017.	Direct: Cohort 1 student	Poster
Galvez, B.*, Oliver, D.*, Neilan, B., Greco, M., Ozbay, G., **Smith, S.** 2018. Estimating Diet of Juvenile Weakfish (*Cynoscion regalis*) from the Delaware Bay Using Stable Isotope Analysis Presented at the Ocean Sciences meeting, Portland, OR, February 2018.	Direct: Cohort 1 student	Poster

Griffin*, E., Wong, Z., Perrtree, R., Rosel, P., **Cox, T.** 2017. Using photo-identification and genetic data to identify fine-scale stock structure. Savannah State University GIS Day, November 15, 2017. Award: 2nd Place Graduate Level	Direct: Cohort 1 student	Poster
Griffin*, E., Wong Z., Perrtree R., Rosel P., **Cox, T.** 2017. Using photo-identification and genetic data to identify fine-scale stock structure. The Society for Marine Mammalogy (SMMS) 22nd Biennial Conference, Halifax, Nova Scotia, Canada, October 24, 2017.	Direct: Cohort 1 student	Poster
Haq, S, **Place, A.R.**, Bachvaroff, T.R., Oyler, BL, & Place, A.R. 2017. Phylogenetic analysis of acetyl CoA carboxylases in dinoflagellates. 17th ICHA Proceedings, Florianópolis, Brazil.	Leveraged	Poster
Mayes*, C., et al. 2018. Ecosystem Based Approaches to Modeling Fish Species Distribution in Chesapeake Bay Area. Presented at VA Sea Grant Symposium, WA, DC., February 2018.	Direct: Cohort 1 student	Poster
Milton*, I. 2018. Frequency of *Vibrio parahaemolitycus* and *Vibrio vulnificus* in Blue Crabs and Seawater of the Maryland Coastal Bays. Presented at Ocean Sciences Meeting, Portland, OR. February 2018.	Direct: Cohort 1 student	Poster
Munguia*, A.**, Miller, J. A.,** Weitkamp,L. A. and Van Doornik, D. 2017. Potential indicators of habitat use: diet and stable isotope composition during juvenile salmonid emigration. CERF 2017, Providence, RI.	Direct: Cohort 1 student and TAB	Poster
Noland, K, Liu, CL, & **Jagus, R.** 2017. Dramatic changes in eIF4E-1a phosphorylation accompany the striking diel changes in protein synthetic rate of axenic A*mphidinium carterae*. EMBL Conference on Translational Control, Heidelberg, Germany.	Leveraged	Poster
Oyler, BL, Donald F. Smith, Saddef Haq, David R. Goodlett, and **Allen R. Place,** 2017. Primary structure elucidation of hemolytic toxins from dinoflagellates responsible for fish kills by accurate tandem mass spectrometry. 9th U.S. Conference on Harmful Algae, Baltimore, MD, Sept 6-9, 2017	Leveraged	Poster
Smith*,N., et al. 2018. Macroalgal predictability, quantity, and species assemblage affect estimates of herbivory rate and herbivore selectivity on coral reefs. Presented at Ocean Sciences Meeting, Portland, OR. February 2018.	Direct: Cohort 1 student	Poster
Williams, EP, Bachvaroff, T, **Place, AR:** 2017. Phosphopantetheinyl transferases in dinoflagellates: toxin versus fat synthesis 9th U.S. Conference on Harmful Algae. Baltimore, MD. 2017.	Leveraged	Poster

March 1, 2018 - August 31, 2018

During this reporting period, Center Scientists made 39 total presentations at conferences. These included 12 oral and 20 poster presentations. Thirty (30) presentations were directly funded (15 oral, 15 poster), while nine were the result of leveraged funding (4 oral, 5 poster). Twenty-five (25) presentations were made by cohort students (12 oral, 13 poster). The detailed list can be found in Table 25.

*Table 25. Citations for presentations made during the period March 1-August 31, 2018. Center scientists are listed in bold. Cohort students are identified by *.*

Presentation	Funding	Type
Almodovar-Acevedo*, L., and **Stevens, B.G.** 2018. Effect of Temperature on Respiration Rates of Black Sea Bass and Applications in Modeling. American Fisheries Society 148th Annual Meeting, Atlantic City, NJ, August 21, 2018.	Direct: Cohort 2 student and TAB	Oral
Almodóvar-Acevedo, L.*; **Stevens, B.** 2018. Effect of temperature on juvenile black sea bass respiration rates. Oral presentation at the NOAA EPP/MSI Biennial Education and Science Forum. Washington DC.	Direct: Cohort 2 student and TAB	Oral
Bachvaroff, T.R. 2017. Scaling ribosomal RNA differences within dinoflagellates for species identification 9th U.S. Conference on Harmful Algae. Baltimore, MD. 2017.	Leveraged	Oral
Cruz-Marrero*, W., Tuohy, C., Appeldoorn, R. and **Stevens, B.G.** 2018. Comparing Divers and Camera Sled Surveys: An Improvement for Fisheries Independent Data for Queen Conch in Puerto Rico? American Fisheries Society 148th Annual Meeting, Atlantic City, NJ, August 21, 2018.	Direct: Cohort 3 student	Oral
Cullen, D., and Stevens, B.G. 2018. Application of Systematic Adaptive Cluster Sampling for the Assessment of Black Sea Bass *Centropristis striata* Abundance. American Fisheries Society 148th Annual Meeting, Atlantic City, NJ, August 21, 2018.	TAB Project	Oral
Galvez, B.*, Neilan, B., Greco, M., Oliver, D., **Ozbay, G., Smith, S.** 2018. Diet Analysis of Weakfish (*Cynoscion regalis*) from the Delaware Bay using stable isotope and stomach content analyses. Presented at the NOAA EPP meeting, Washington, D.C., April 2018.	Direct: Cohort 1 student and TAB	Oral
Galvez, B.*, Neilan, B., Greco, M., **Ozbay, G.,** Townsend, H., **Smith, S.** 2018. Stable Isotope Analysis of Juvenile Weakfish (*Cynoscion regalis*) from the Delaware Bay. Presented at the American Fisheries Society meeting, Atlantic City, NJ, 2018.	Direct: Cohort 1 student and TAB	Oral
Gonsior, M, Leanne Powers, Philippe Schmitt-Kopplin, Mourad Harir, Feng Chen, Ernest Williams, & **Allen R. Place** 2017. Disinfection by-products arising from *Microcystis aeruginosa* algal DOM. 9th U.S. Conference on Harmful Algae. Baltimore, MD.	Leveraged	Oral
Green, S.* 2018. Elucidating the presence and expression of the crustacean hyperglycemic hormone of the red deep-sea crab, *Chaceon quinquedens*. Presented at the American Fisheries Society meeting, Atlantic City, NJ, 2018.	Direct: Cohort 2 student and TAB	Oral
Hanif, A.* 2018. Insights into the gut microbiome and diet of Atlantic menhaden. Presented at the American Fisheries Society meeting, Atlantic City, NJ, 2018.	Direct: Cohort 2 student and TAB	Oral
King*, B. 2018. Underrepresentation for racial and ethnic groups in fisheries science profession. Presented at the International Symposium on Society and Resource Management, Snow Bird, UT, June 2018.	Direct: Cohort 2 student	Oral

Lawrence*, A. 2018. Isolating insulin-like androgenic gland (IAG) hormone cDNA sequence of the red deep-sea male crab, *Chaceon quinquedens*. Presented at the American Fisheries Society meeting, Atlantic City, NJ, 2018.	Direct: Cohort 1 student and TAB	Oral
O'Farrell*, H. and **Babcock, E.A.** 2018. Evaluation of Environmental Conditions as Predictors for Mako Shark CPUE using Generalized Linear Mixed Modeling and Quantile Regression. Presented at NOAA EPP Forum. Washington, DC. March 2018	Direct: Cohort 1 student	Oral
Oliver*, I. 2018. Seasonal changes affect the accumulation of starch in *Spartina alterniflora* rhizomes. Presented at NOAA EPP Forum, March 2018.	Direct: Cohort 1 student	Oral
Olsen, N.A., and **Stevens, B.G.** 2018. Reproductive Biology and Size at Sexual Maturity of Jonah Crabs (*Cancer borealis*) in the Mid-Atlantic Bight**.** American Fisheries Society 148th Annual Meeting, Atlantic City, NJ, August 21, 2018.	Direct: TAB	Oral
Schweitzer, C.C*. and **Stevens, B.G.** 2018. The effectiveness of increasing connectivity between two patch reefs for increasing site fish abundance in the Mid-Atlantic. Presented at Ecological Society of America, New Orleans, LA August 2018.	Direct: Cohort 2 student	Oral
Stevens, B.G. 2018. Supporting NOAA with Research Education at the Living Marine Resources Cooperative Science Center. American Fisheries Society 148th Annual Meeting, Atlantic City, NJ, August 20, 2018.	Direct: reporting record of LMRCSC	Oral
Stevens, B.G. and Miller, T.J. 2018. Status and Trends of World Crab Fisheries. American Fisheries Society 148th Annual Meeting, Atlantic City, NJ, August 22, 2018.	Leveraged	Oral
Stevens, B. G., Wilson, J., Olsen, N.A. and Martinez*, S. 2018. Direct Aging of Red Deep-Sea and Jonah Crabs, and Implications for Lifetime Reproduction. American Fisheries Society 148th Annual Meeting, Atlantic City, NJ, August 21, 2018.	Direct: Cohort 2 Student	Oral
Dorsey*, K., Brill, R., Stojilovic, O., Schwarz, M.H., Hurst, T.P. and **Horodysky, A.** 2018. Effect of Ocean Acidification on Auditory Neurobiology in a tropical Marine Fish. 9th Biennial NOAA EPP Science and Education Forum. Howard University, Washington, DC, March 18-21, 2018.	Direct: cohort 2 Student	Poster
Broemsen, L., Kepple, D.D., **Place, A.R.** and Parrow, M.W. 2017. Image Cytometry (ICM) as a method for cell cycle analysis of mixotrophic cultures and field bloom samples of *Karlodinium veneficum*. 9th U.S. Conference on Harmful Algae. Baltimore, MD. 2017	Leveraged	Poster
Campbell, N., Vinson, C., and **Pride**, C. 2018. Outrunning sea-level rise: A study of seasonal sediment accretion rates in salt marshes of Savannah, GA. HBCU Climate Change Conference, Oct. 19-23, New Orleans, LA. Sept. 2018	Leveraged	Poster
Coit, N.*, Pitula, J. 2018. *Perkinsus*: An Aquatic Parasite as an Alternative Model for Lipid Metabolism. 9th Biennial NOAA EPP Science and Education Forum. Howard University, Washington, DC, March 18-21, 2018.	Direct: Cohort 1 Student	Poster

Cruz K, Rittman J, Carter N, Carter K, Pressley N, Milton* I, Layton* J, Smith* N, **Bonin C, Lewallen EA.** 2018. Genetic Techniques for Monitoring Black Sea Bass Abundance in the Chesapeake Bay Region. 23rd Annual School of Science Research Symposium, Hampton University, Hampton, VA. April 11-12, 2018.	Direct: cohort 1 and 2 students	Poster
Fenwick* I, Salcedo A, Rogers J, Leslie J, **Gibson, D.** 2018. Save the Bay: *Crassostrea virginica* Oyster Spat Recruitment Study in Hampton River of Virginia. 9th Biennial NOAA EPP Science and Education Forum. Howard University, Washington, DC, March 18-21, 2018.	Direct: cohort 1 Student	Poster
Fenwick* I, Salcedo A, Rogers J, Leslie J, **Gibson, D.** 2018. Save the Bay: *Crassostrea virginica* Oyster Spat Recruitment Study in Hampton River of Virginia. Annual School of Science Research Symposium, Hampton University, Hampton, VA April 11-12, 2018.	Direct: cohort 1 Student	Poster
Haq, S., & Bachvaroff, T.R, Oyler, B.L, & **Place, A.R.** 2017. Acetyl-coa carboxylases in dinoflagellates: fueling the polyketide synthase pathways. 9th U.S. Conference on Harmful Algae. Baltimore, MD. 2017.	Leveraged	Poster
Jagus, R., Gillespie, K.M. & Bachvaroff, T.R. 2017. Widespread distribution of Class III eIF4E family members in metazoans. EMBL Conference on Translational Control, Heidelberg, Germany.	Leveraged	Poster
King*, B. 2018. Underrepresentation for racial and ethnic groups in fisheries science profession. Presented at Oregon State University for the Research Advances in Fisheries, Wildlife, and Ecology Symposium (RAFWE), April 2018.	Direct: cohort 2 Student	Poster
Kleponis*, N., Mendez*, D., Heckscher, C., **Smith, S.** (2018). Assessing the Relative Abundance of Wintering Red-throated Loon in the Delaware Bay. Presented at the NOAA EPP meeting, Washington, D.C., April 2018.	Direct: cohort 2 Student	Poster
Layton*, J.M., **Bonin, C.A.**, Pressley, N., Park, L.K., Weitkamp, L.A., **Lewallen, E.A**. 2018. Genetic-based methods for assessing prey composition and feeding ecology of Pacific lampreys, 23rd Annual School of Science Research Symposium, Hampton University, Hampton, VA April 11-12, 2018.	Direct: cohort 2 Student	Poster
Layton* JM, **Bonin CA**, Pressley N, Park LK, Weitkamp LA, **Lewallen EA** (2018). Genetic-based methods for assessing prey composition and feeding ecology of Pacific lampreys, 9th Biennial NOAA EPP Science and Education Forum. Howard University, Washington, DC, March 18-21, 2018.	Direct: cohort 2 Student	Poster
Liu, CL, Gillespie, KM, Place, AR & **Jagus, R.** (2017). Use of antibiotics for maintenance of axenic cultures of *Amphidinium carterae* for the analysis of translation. 9th U.S. Conference on Harmful Algae, Baltimore, MD.	Leveraged	Poster
Mayes* C, **Horodysky, A., Bonin, C.A.**, Fogarty, M., **Gibson, D.,** Wiley, S., **Lewallen, E.A**. 2018. Ecosystem Based Approaches to Modeling Fish Species Distributions in Chesapeake Bay. 23rd Annual School of Science Research Symposium, Hampton University, Hampton, VA April 11-12, 2018.	Direct: Cohort 1 Student	Poster

McClain*, N., Richardson, C., **Ali, I.** 2017. Creating A Dynamic Food Web of The Summer Flounder Using Fatty Acid, Stable Isotope, and Gut Content Analysis. Presented at NOAA EPP Forum, August 2017, Howard University	Direct: Cohort 1 Student	Poster
Milton* IA, Smith* NN, Goebel M, Krause D, **Lewallen EA,** Barreto F, Hoffman J, Bonin CA. 2018. Social Structure of Leopard Seal, *Hydrurga leptonyx*, at Livingston Island, Antarctica. 9th Biennial NOAA EPP Science and Education Forum. Howard University, Washington, DC, March 18-21, 2018.	Direct: 2 Cohort 1 students	Poster
Milton* IA, Smith* NN, Goebel M, Krause D, **Lewallen EA**, Barreto F, Hoffman J, Bonin CA. 2018. Social Structure of Leopard Seal, *Hydrurga leptonyx*, at Livingston Island, Antarctica. 23rd Annual School of Science Research Symposium, Hampton University, Hampton, VA April 11-12, 2018.	Direct: 2 Cohort 1 students	Poster
Smith* NN, Milton* IA, **Cox T,** Kellar N, Trego M, Morin P, Lewallen EA, Bonin CA. 2018. Assessing the utility of microRNAs as biomarkers for marine mammal health. 23rd Annual School of Science Research Symposium, Hampton University, Hampton, VA April 11-12, 2018.	Direct: 2 Cohort 1 students	Poster
Smith* NN, Milton* IA, Cox T, Kellar N, Trego M, Morin P, Lewallen EA, Bonin CA. 2018. Assessing the utility of microRNAs as biomarkers for marine mammal health. 9th Biennial NOAA EPP Science and Education Forum. Howard University, Washington, DC, March 18-21, 2018.	Direct: 2 Cohort 1 students	Poster

September 1, 2018 - February 28, 2019

During this reporting period, Center Scientists made 35 total presentations at conferences. These included 17 oral and 18 poster presentations. Thirty-four (34) presentations were directly funded (17 oral, 17 poster), while 1 poster presentation was the result of leveraged funding. Twenty-five (25) presentations were made by cohort students (13 oral, 12 poster). The detailed list can be found in Table 26.

Table 26. Citations for presentations made during the period Sept. 1, 2018 – Feb. 28, 2019. Center scientists are listed in bold. Cohort students are identified by an asterisk (*).

Presentation	Funding	Type
Cruz-Marrero, W.*, Touhy, C. & **Stevens, B.G.,** Appeldoorn, R.A. 2018. Comparing divers and camera sled surveys: an improvement for fisheries independent data for queen conch in Puerto Rico. Gulf and Caribbean Fisheries Institute. San Andres, Colombia, Nov. 2018.	Direct: Cohort 3 student	Oral
Das, N., Mayor, E. & **Chigbu, P.** 2019. Population dynamics of blue crabs in the Maryland Coastal Bays. ASLO, Puerto Rico, Feb. 24 to March 1, 2019.	Direct: LMRCSC PI	Oral
DaSilva, L.V., Ossai, S., **Chigbu, P. & Parveen, S.** 2019. Characterization of *Vibrio vulnificus* isolated from environmental and blue crab samples collected from Maryland Coastal Bays. ASLO, Puerto Rico, Feb. 24 to March 1, 2019.	Direct: LMRCSC PI	Oral

Fenwick*, I., Salcedo, A., Leslie, J., Rogers, J. & **Gibson, D.** 2018. An Innovative Approach to Oyster Reef Restoration and Understanding Our Waterways. *90th Annual National Technical Association (NTA) Conference*. Hampton University, Sept. 26-28, 2018.	Direct: Cohort 1 Student	Oral
Galvez*, B., Townsend, H. & **Smith, S.** 2019. Trophic ecology of Delaware Bay weakfish using stomach content and stable isotope analyses. Presented at the Association for Sciences of Limnology and Oceanography (ASLO) meeting, San Juan, PR, February 2019.	Direct: Cohort 1 Student	Oral
Gibson, D. 2019. Hampton University's Impact on Marine Science Research. Presented at And Still I Rise symposium at Nauticus Museum, Feb. 2019.	Direct: LMRCSC PI at HU	Oral
Gibson, D. 2019. Underrepresented But Not Forgotten: The Making of a Marshall Scholar. Presented at the ASLO meeting, San Juan, PR, Feb. 2019.	Direct: LMRCSC PI at HU	Oral
Kleponis*, N. & Heckscher, C. 2019. The winter habitat of the protected species the red-throated loon. Presented at the Pacific Seabird Group Conference, Kauai, HI (2019).	Direct: Cohort 2 Student	Oral
Layton*, J. 2019. The Feeding Ecology of Pacific Lampreys Assessed by Gut Fullness and Prey Identification. Presented at the ASLO meeting, San Juan, PR, Feb. 2019.	Direct: Cohort 2 Student	Oral
Oliver*, I. 2018. Exploring Ocean optical Properties using Satellite and *in-situ* Data. National Technical Association, Hampton, Virginia September, 26-28, 2018.	Direct: Cohort 1 student	Oral
Ramirez*, M.D., Avens, L. & **Heppell, S.S.** 2018. Intrapopulation variation in resource use by Kemp's ridley sea turtles revealed through combined skeletal and stable isotope analyses. 11th International Conference on the Applications of Stable Isotope Techniques to Ecological Studies (IsoEcol 2018), Viña del Mar, Chile. Oral Presentation	Direct: Cohort 2 Student	Oral
Ramirez, M.D.*, Avens, L., Goshe, L.R., Snover, M.L. & **Heppell, S.S.** 2019. Density-independent decline in Kemp's ridley somatic growth rates following the Deepwater horizon oil spill. International Symposium on Sea Turtle Biology and Conservation, Charleston, SC. Oral Presentation	Direct: Cohort 2 Student	Oral
Rosales*, D., **Ozbay, G., Parveen, S.,** Jacobs, J. **& Pitula, J.S.** 2019. Harmful Algae Succession and Vibrio Association in the Delaware Inland Bays. AFS Tidewater Annual Meeting, Salisbury University, Feb. 2019	Direct: Cohort 1 Student	Oral
Rubalcava, K.* & **Chigbu, P.** 2019. Influence of Environmental Factors on the Abundance and Growth of Spot (*Leiostomus xanthurus*), in the Maryland Coastal Bays. AFS Tidewater Chapter Meeting, Salisbury University, Feb. 2019	Direct: Cohort 2 Student	Oral
Rubalcava, K.* & **Chigbu, P.** 2019. Recruitment and Density-dependent growth of Spot (*Leiostomus xanthurus*) in the Maryland Coastal Bays. ASLO 2019 San Juan, Puerto Rico.	Direct: Cohort 2 Student	Oral
Wenker, R.P.* & **Stevens, B.G.** 2019. Sea Whip coral (*Leptogorgia virgulata*) in the Mid-Atlantic Bight: Age, colony complexity and distribution. AFS Tidewater Annual Meeting, Salisbury University, February 2019.	Direct: Cohort 1 Student	Oral

Wenker, R.P. * & **Stevens, B.G.** 2019. Sea Whip coral (*Leptogorgia virgulata*) in the Mid-Atlantic Bight: Age, colony complexity and distribution. ASLO 2019 Aquatic Sciences Meeting. February 23-March 2. San Juan, Puerto Rico.	Direct: Cohort 1 Student	Oral
Best-Otubu, C.*, Crumrine, P. 2018. The effect of predator personality on intraguild predation in aquatic insects. 90th Annual National Technical Association, NTA) Conference, Hampton University, September 26th - Sept 28th, 2018.	Direct: Cohort 1 Student	Poster
Denson*, L., **Babcock, E.A. &** Thorson, J. 2018. The effect of spatial and temporal variation on larval indices used for King mackerel in the northern Gulf of Mexico. Presented at Hamburg University for the International Council for the Exploration of the Seas Annual Science Conference, Hamburg, Germany, September, 2018. Poster Presentation	Direct: Cohort 2 student and TAB	Poster
Dorsey*, K., et al. 2018. Effect of Ocean Acidification on Auditory Neurobiology in a tropical Marine Fish. 90th Annual National Technical Association (NTA) Conference. Hampton Univ. Sept. 26-28, 2018.	Direct: Cohort 2 student	Poster
Elfadul, R., Jesien, R., Elnabawi, A., **Chigbu, P. & Ishaque, A.** 2019. Analysis of emerging contaminants in Maryland Coastal Bays using *in vitro* bioassays as biological screening tools. ASLO, Puerto Rico, Feb. 24 to March 1, 2019.	Direct: LMRCSC PI	Poster
Fenwick*, I., et al. 2019. Herbivory Increases Energy Allocation Towards Reproduction in Small *Turbinaria ornata*. Presented at the ASLO meeting, San Juan, PR, Feb. 2019	Direct: Cohort 1 Student	Poster
Freeman*, D.; Deshpande, A.; Lynch, J.; Lascelles, N.; Drayton, D.*; Brignac, K.; Jung, M.; **Hoskins-Brown, D.** 2019. Comparing 2 Methods To Characterize The Chemical Components Of Marine Plastic Debris	Direct: Cohort 2 student	Poster
Hart, J.N.M., Ramirez, M.D.*, Chasco, B., Kenney, A., Nemyre, N., Piacenza, S.E., Rincon-Diaz, M.P., VanBemmel, M., **Heppell, S.S.** 2019. Identifying data needs for sea turtle demographic studies: a data gap analysis. International Symposium on Sea Turtle Biology and Conservation, Charleston, SC. Poster Presentation.	Direct: Cohort 2 student	Poster
Layton*, J.M., **Bonin, C.A.,** Pressley, N., Park, L.K., Weitkamp, L.A. & **Lewallen,** E.A. 2018. Genetic-based methods for assessing prey composition and feeding ecology of Pacific lampreys. *90th Annual National Technical Association (NTA) Conference*. Hampton University Sept 26-28, 2018.	Direct: Cohort 2 student	Poster
Mayes*, C., **Horodysky, A., Bonin, C.**, Fogarty, M., **Gibson, D**., Wiley,S. 2018. Ecosystem Based Approaches to Modeling Fish Species Distributions in the Atlantic. 90th Annual National Technical Association Conference, Hampton University, Hampton, VA, September 28-29, 2018.	Direct: Cohort 1 Student	Poster
Milton*, I., et al. 2019. Coral Reef Structural Complexity Impacts Ecosystem Functions. Presented at the ASLO meeting, San Juan, PR, Feb. 2019.	Direct: Cohort 1 Student	Poster

Milton*, I.A., Smith, N.N., Goebel, M., Krause, D., **Lewallen, E.A**., Barreto, F., Hoffman, J. & **Bonin, C.A.** 2018. Social Structure of Leopard Seal, *Hydrurga leptonyx*, at Livingston Island, Antarctica. *90th Annual National Technical Association (NTA) Conference*. Hampton University Sept 26-28, 2018.	Direct: Cohort 1 Student	Poster
Morales, A. & Chigbu, P. 2019. The community structure of soft-bottom macrobenthic fauna in dead-end canals in the Maryland Coastal Bays, USA. ASLO, Puerto Rico, Feb. 24 to March 1, 2019.	Direct: LMRCSC PI	Poster
Pereiera, V. & **Pitula J.S.** 2019. Exploring the parasitic Dinoflagellate *Hematodinium perezi* and Vibrio Bacteria Co-infection in the hemolymph of *Callinectes sapidus* from the Maryland Coastal Bays. AFS Tidewater Annual Meeting February 2019	Leveraged	Poster
Popovska, T., **Babcock, E.,** Ramirez, M.D.*, Avens, L., Goshe, L.R. & Heppell, S.S. 2019. A meta-analysis of somatic growth in sea turtles. International Symposium on Sea Turtle Biology and Conservation, Charleston, SC. Poster Presentation.	Direct: Cohort 2 student	Poster
Smith*, N.N., et al. 2019. Sea Urchin Importance in cropping Algal Turf and Removing Sediment on Coral Reefs. Presented at the ASLO meeting, San Juan, PR, Feb. 2019.	Direct: Cohort 1 Student	Poster
Smith*, N.N., Milton, I.A., Cox, T., Kellar, N., Trego, M., Morin, P., **Lewallen, E.A. & Bonin, C.A.** 2018. Assessing the utility of microRNAs as biomarkers for marine mammal health**.** *90th Annual National Technical Association (NTA) Conference*. Hampton University Sept 26-28, 2018.	Direct: Cohort 1 Student	Poster
Tay*, S. & Kaltenberg, A. 2019. Seasonality of the Gulf Stream current velocity off Cape Hatteras, NC. Presentation at the Emerging Researchers National Conference in Washington D.C. Feb. 2019.	Direct: Cohort 2 student	Poster
VanBemmel, M., Ramirez, M.D.*, Chasco, B., Kenney, Hart, J.N.M., Nemyre, N., Piacenza, S.E., Rincon-Diaz, M.P. & **Heppell, S.S.** 2019. A global synthesis of sea turtle life history data for demographic studies: a case study in the loggerhead sea turtle. International Symposium on Sea Turtle Biology and Conservation, Charleston, SC. Poster Presentation	Direct: Cohort 2 student	Poster

March 1, 2019 - August 31, 2019

During this reporting period, Center Scientists made 33 total presentations at conferences. These included 16 oral and 17 poster presentations. Nineteen (19) were directly funded (8 oral, 11 poster), while 14 were the result of leveraged funding (8 oral, 6 poster). Nineteen (19) presentations were made by cohort students (7 oral, 12 poster). The detailed list can be found in Table 27.

Table 27. Citations for presentations made during the period March 1-August 31, 2019. Center scientists are listed in bold. Cohort students are identified by an asterisk (*).

Presentation	Funding	Type
Chung. J. Sook 2019. Evolutionary and Ecological endocrinology of invertebrate carbohydrate metabolism using the blue crab, *Callinectes sapidus* as a model. 5th biannual NASCE, Gainsville, May 24-28, 2019	Leveraged	Oral
Chung. J. Sook 2019. Morgan State University, Patuxent Environmental and Aquatic Research Laboratory, Is Crustacean molting a growth-stress? April 18, 2019.	Direct: TAB	Oral
Denson*, L.S., **Babcock E.A.** & Walter J.F. 2019. The effect of spatial and temporal variation on larval indices used for King mackerel in the Northern Gulf of Mexico. Presented at the LMRCSC 2019 Science Meeting, NOAA HQ, Silver Spring, MD, June 2019.	Direct: TAB, Cohort 2 student	Oral
Frey*, B.A., **Secor, D**., Richards, A., & **Jagus, R.** 2019. Monkfish age validation using hardpart analysis of known-age cohorts. LMRCSC Science Meeting, NOAA HQ, Silver Spring, MD, June 2019. Lightning Talk	Direct: TAB	Oral
Galvez*, B., Townsend, H., **Ozbay, G. & Smith, S.** 2019. Trophic ecology of Delaware Bay weakfish using stomach content and stable isotope analyses. Presented at the Association for Research Directors (ARD) meeting, Jacksonville, FL, March 2019, winner 1st place oral presentation.	Direct: Cohort 1	Oral
Hanif*, A. & Johnson, E. 2019. Assessing temporal changes of the microbial community in gills of invasive dreissenid mussels collected from Lake Michigan. LMRCSC Science Meeting, NOAA-HQ, Silver Spring, MD, June 2019.	Direct: NERTO	Oral
Lawrence*, A. 2019. Investigating male Jonah crab, *Cancer borealis* sexual maturity. Presented at LMRCSC Science Meeting, NOAA-HQ, Silver Spring, MD, June 2019.	Direct: TAB	Oral
Pelekai*, K.P. 2019. Evaluation of Pacific Lamprey age, natal origins, and trophic history through anatomical structures. Research Advances in Fisheries, Wildlife, and Ecology Symposium. Presentation.	Direct: Cohort 3	Oral
Schott, EJ. 2019. Blue crab virus genetics may help improve fishery management NOAA-LMRCSC Science Meeting. June, 2019. NOAA-HQ, Silver Spring, MD.	Leveraged	Oral
Schott, EJ. 2019. Presentation at the Oyster Symposium hosted by the Anne Arundel Watermen's Association and the West/Rhode Riverkeeper. Smithsonian Environmental Research Center, Edgewater, MD. March 9, 2019.	Leveraged	Oral
Schott, EJ. 2019. Crustacean contagion: a blue crab virus found in aquaculture may help us understand crab population connectivity University of Maryland Eastern Shore, School of Agricultural and Natural Sciences. April 25, 2019.	Leveraged	Oral
Secor, D.H. 2019. Keynote Address. Adaptation to Climate Change: Can we better equip Hudson River fishes to succeed. 2019 Hudson River Symposium, Vassar College, NY.	Leveraged	Oral
Stevens, B.G. & Miller, T.J. 2019. Status and Trends of World Crab Fisheries. Presentation to Norwegian Institute of Fisheries and Aquaculture Research, June, 2019.	Leveraged	Oral

Stevens, B.G. 2019. Experimental Design for Biologists. Presentation for NSF-Research Experience for Undergraduates, UMES, June 10, 2019.	Leveraged	Oral
Stevens, B.G. 2019. Hab in the MAB: Characterizing Black Sea Bass Habitat in the Mid-Atlantic Bight. Project completion report to the Atlantic States Marine Fisheries Commission, August 6, 2019.	Leveraged	Oral
Thalmann*, H.L., **Miller, J.A.** & Laurel, B. 2019. Quantifying impacts of warm years on juvenile Pacific Cod growth and foraging patterns. Presented at Oregon State University's Research Advances in Fisheries, Wildlife, and Ecology Symposium. Corvallis, OR. April 2019.	Direct: Cohort 1	Oral
Arzola, N., Ross, M., **Schott, EJ,** O'Neil, J. 2019. Tracking microbial contaminants in Baltimore Harbor: Are current techniques sufficient for assessing human risk? American Society of Limnology and Oceanography. San Juan, Puerto Rico. February 26- March 1, 2019.	Leveraged	Poster
Dorsey*, K., et al. 2019. Comparison of the Visual Neurobiology of Tropical and Coastal Marine Fishes Under Ocean Acidification. Presented at the 1st Annual Caribbean Health Disparities Conference and 24th Annual School of Science Symposium April 17, 2019, Hampton, VA	Direct: Cohort 2	Poster
Dorsey*, K., et al. 2019. Comparison of the Visual Neurobiology of Tropical and Coastal Marine Fishes Under Ocean Acidification. Presented at the ASLO conference, San Juan, PR., Feb-Mar. 2019	Direct: Cohort 2	Poster
Farmer*, M. A. & **Stevens, B.G.** 2019. Where are the Baby Oysters? University of Maryland Eastern Shore Graduate Studies Regional Research Symposium 2019, Princess Anne, MD, April 16, 2019. (3 minute thesis)	Leveraged	Poster
Farmer*, M.A., **Pitula, J.S.,** North, E.W. & Stevens, B.G. 2019. Spatial and Temporal Distribution of *Crassostrea virginica* Spat Settlement in the Maryland Coastal Bays. University of Maryland Eastern Shore Graduate Studies Regional Research Symposium 2019, Princess Anne, MD, April 16, 2019. (10 minute oral presentation)	Leveraged	Poster
Fenwick*, I., et al. 2019. Assessing Oyster Recruitment and Water Parameters in the Hampton River. Presented at the 1st Annual Caribbean Health Disparities Conference and 24th Annual School of Science Symposium April 17, 2019, Hampton, VA	Direct: Cohort 1	Poster
Harris, L., Dahlenburg, C., **Schott, E.J.** & Woodland, R. 2019. Jump starting scientific co-production in Baltimore: results of the 'Harbor Science' workshop. American Society of Limnology and Oceanography. San Juan, Puerto Rico. February 26- March 1, 2019	Leveraged	Poster
Layton*, J., et al. 2019. The feeding ecology of Pacific lampreys assessed by gut fullness and prey identification. Presented at 1st Annual Caribbean Health Disparities Conference and 24th Annual School of Science Symposium April 17, 2019, Hampton, VA	Direct: Cohort 2	Poster
Medero, L. **Schott, EJ,** Zhao, M. 2019. Genetic Variation of a Blue Crab Virus as a Tool to Understand Crab Movement. American Society of Limnology and Oceanography. San Juan, Puerto Rico. February 26- March 1, 2019	Leveraged	Poster

Milton*, I., et al. 2019. Social Structure of Leopard Seal, *Hydrurga leptonyx*, at Livingston Island, Antarctica. Presented at the 1st Annual Caribbean Health Disparities Conference and 24th Annual School of Science Symposium April 17, 2019, Hampton, VA	Direct: Cohort 1	Poster
Pelekai*, K.P**., Miller, J.,** Hess, J. & Porter, L. 2019. Determination of age, natal origin, and trophic history of Pacific Lamprey **(***Entosphenus tridentatus*). Oregon Chapter of the American Fisheries Society Annual Meeting.	Direct: Cohort 3	Poster
Smith*, N., et al. 2019. Human homolog microRNAs are found in common Bottlenose Dolphin skin tissues. Presented at the 1st Annual Caribbean Health Disparities Conference and 24th Annual School of Science Symposium April 17, 2019, Hampton, VA	Direct: Cohort 1	Poster
Thalmann*, H.L**., Miller, J.A.** & Laurel, B. 2019. Thermal effects on juvenile Pacific Cod phenology, growth, and foraging in Gulf of Alaska nursery habitats. Presented at the Pacific Estuarine Research Society Meeting, Anacortes, WA. April 2019. Poster Presentation.	Direct: Cohort 1	Poster
Thalmann*, H.L., **Miller, J.A.** & Laurel, B. 2019. Thermal effects on pre-recruit Pacific Cod phenology, early growth, and prey quality in the Gulf of Alaska. Presented at the Oregon American Fisheries Society Meeting, Bend, OR. March 2019. Poster Presentation	Direct: Cohort 1	Poster
Thalmann*, H.L**., Miller, J.A.** & Laurel, B. 2019. Thermal impacts on juvenile Pacific Cod foraging in Gulf of Alaska nursery habitats. Presented at the 25th Annual Markham Graduate Student Research Symposium, Newport, OR. June 2019. Poster Presentation.	Direct: Cohort 1	Poster
Young, V., Hoskins-Brown, D., Chigbu, P., Sexton, M. A., Gibson, D., Jagus, R., … Stevens, B.G. 2019. The NOAA LMRCSC and Its Multifaceted Approaches to Facilitate Student Development and Diversity in the Marine Sciences. *28th Symposium on Education*. Presented at the American Meteorological Society 99th Annual Meeting, Phoenix, AZ.	Direct: reporting record of LMRCSC	Poster
Zhao, M, Behringer, D., Plough, L., Bojko, J., Kough, A., Tavares, C., **Schott, E.J.** 2019. Genetic variation of a blue crab reovirus (CsRV1) is linked to host geography and life history. Presented at the Atlantic Estuarine Research Society meeting, Woodbridge, VA. April 4, 2019.	Leveraged	Poster

September 1, 2019 - February 29, 2020

During this reporting period, Center Scientists made 37 total presentations at conferences. These included 28 oral and 9 poster presentations. Twenty (20) presentations were directly funded (14 oral, 6 poster), while 17 were the result of leveraged funding (14 oral, 3 poster). Nineteen (19) presentations were made by cohort students (11 oral, 8 poster). The detailed list can be found in Table 28.

Table 28. Citations for presentations made during the period Sept. 1, 2019 – Feb. 29, 2020. Center scientists are listed in bold. Cohort students are identified by an asterisk (*).

Presentation	Funding	Type
Chung, J.S. 2019. Current status of shellfish aquaculture. Mokpo National University, S. Korea: September 2019	Leveraged	Oral
Chung, J.S. 2019. Current status of shellfish aquaculture. University of Virginia (Dept. Environmental Science), Charlottesville: Nov. 12, 2019	Leveraged	Oral
Chung, J.S., Bachvaroff, TR and Plough, L. 2019. Cracking the genetic code of the blue crab, *Callinectes sapidus*, IMBC, Shizouka, Japan, September 2019.	Leveraged	Oral
Cruz-Marrero*, W. & **Stevens, B.G.** 2018. Comparing diver and camera sled surveys: An improvement for fisheries independent data for queen conch in Puerto Rico? Oral presentation; Gulf and Caribbean Fisheries Institute, Colombia.	Direct: Cohort 3 student	Oral
Curran, M.C. and P. Wilber. 2019. Seasonal and interannual variability in flatfish assemblages in a southeastern USA estuary. Coastal and Estuarine Research Federation Mobile, AL November 2019	Leveraged	Oral
Curran, Robertson, and Richlen. 2019. HAB science made easy: Teaching students about the ecology and toxicology of harmful algal blooms. US Harmful Algal Bloom Ocean Beach, AL (Nov 2019)	Leveraged	Oral
Curran, Robertson, Richlen. 2019. Invited Presentation: Chemical ecology made easy: Teaching students about the link between toxin chemistry & HABs. Southeastern Regional Meeting of the American Chemical Society (October 2019)	Leveraged	Oral
Denson*, L.S., **Babcock E.A.,** Walter J.F. 2019. Incorporating spatial and spatiotemporal variation into indices of abundance for king mackerel in the gulf of mexico. Presented in the NOAA EPP session at the AFS & TWS Joint Conference, Reno, NV, September 2019.	Direct: Cohort 2 student, TAB	Oral
Green*, S, **Chung, J.S.** 2019. Transcriptomic Analysis of the Red Deep-Sea Crab, *Chaceon quinquedens* throughout Ovarian Development. American Fisheries Society & The Wildlife Society Joint Annual Meeting, Reno, NV, Sept 2019. Oral Presentation.	Direct: TAB and Cohort 1 student	Oral
Hildebrandt*, S. Spires, J., et. al. 2020. Testing Direct Setting of *Crassostrea virginica* larvae. Presented at the Ocean Sciences meeting, San Diego, CA.	Direct: Cohort 2 student	Oral
Hoskins-Brown, D.L. 2019. Coastal Resilience and the Gullah Geechee Corridor. U.S. Forest Service Project Team for the International Seminar on Community Resilience. Savannah, GA November 20, 2019	Direct: SSU PK	Oral
Jonas, L. & **Hill,** RT. 2019. Sponge symbionts and phosphorus cycling in coral reefs.International Marine Biotechnology Conference, Shizuoko, Japan, Sept. 2019.	Leveraged	Oral
Kenworthy, M. 2019. Exploring the spatiotemporal factors regulating the success and function of restored oyster reefs in North Carolina Estuaries. Savannah State University Graduate Student Seminar. Savannah, GA, September 2019.	Direct: LMRCSC Post Doc	Oral

Kenworthy, M. 2019. Exploring the spatiotemporal factors regulating the success and function of restored oyster reefs in North Carolina Estuaries. LMRCSC Graduate Student Seminar Series. Savannah, GA, November 2019.	Direct: LMRCSC Post Doc	Oral
Lawrence*, A**.** 2019. Presented at American Fisheries Society 149th Annual Meeting and Joint Conference with the Fish and Wildlife Society for the Diversity and Inclusion Seminar Series, Reno, Nevada, September 29, 2019 - October 03, 2019	Direct: Cohort 2	Oral
Lawrence*, A., **Chung, J.S. and Stevens, B.** 2019. Investigating Male Sexual Maturity of the Jonah Crab, *Cancer borealis*. Presented at American Fisheries Society 149th Annual Meeting and Joint Conference with the Fish and Wildlife Society for the Techno- Fish Seminar Series, Reno, Nevada, September 29, 2019 - October 03, 2019.	Direct: TAB and Cohort 1 student	Oral
Losee, J., Claiborne A., Dapp, D., Freeman, R. Madel, G., Seamons, T., **Miller, J.A**., Quinn, T., Hellström, G. and Palm, D. 2020. New insight into the Management and Ecology of Anadromous Cutthroat Trout. 2020 Salmon Ocean Ecology Meeting, Santa Cruz, CA.	Leveraged	Oral
McLean*, J. et. al. 2020. The Impact of Marsh Impoundment on Methane Production in a Phragmites Wetland. Presented at the Ocean Sciences meeting, San Diego, CA.	Direct: Cohort 2 student	Oral
Miller, J.A, Hess, J., Porter, L., Parker, K., Sutton, T., Pelekai*, K. 2019. Understanding Pacific lamprey migration: the potential of statolith structure and chemistry. Lamprey Information Exchange Meeting. Oral.	Direct: Cohort 3 student	Oral
O'Farrell*, H. and **Babcock, E.** 2019. Using generalized linear modeling and quantile regression to produce habitat suitability maps for shortfin mako sharks in the North Atlantic. Presented at the American Fisheries Society Conference, Reno, NV, Oct. 2019.	Direct: LMRCSC Cohort 1 student	Oral
Ramarui*, K. 2019. Improving *Haematococcus pluvialis* growth and astaxanthin production through chemical mutagenesis. LMRCSC Student Seminar Series, January 15, 2020.	Direct: Cohort 4	Oral
Ramirez*, M.D., **Miller, J.A.,** Shiel, A.E., Avens, L., Goshe, L.R., Snover, M.L. and **Heppell, S.S.** 2020. Discriminating regional Kemp's ridley sea turtle habitat use through complementary trace element, lead isotope, and growth rate analyses. 2020 Southeast East Regional Sea Turtle Network Meeting.	Direct: Cohort 2 student	Oral
Ramsden, S. and **Curran, M.C.** 2019. From graduate to elementary school: Engaging young students can be easy! Coastal and Estuarine Research Federation Mobile, AL November 2019	Leveraged	Oral
Secor, D.H. 2019. Before After Gradient Designs to evaluate coastal wind farm impacts to migratory and sedentary fishes. Coastal and Estuarine Research Federation Conferences, Mobile AL.	Leveraged	Oral
Secor, D.H. 2019. Fish Movement Ecology and Dynamic Seascapes: Making seascapes dynamic and relevant. Ocean Studies Board, The National Academy of Science, Washington DC.	Leveraged	Oral
Secor, D.H. 2019. New York Harbor: High stakes ecological corridor. Surge Barrier Environmental Effects and Empirical Experience. NERRS Workshop, New York, NY.	Leveraged	Oral

Tizabi, D, Sosa, A, **Bachvaroff, TR,** Harinantenaina Rakotondraibe, L. & **Hill, RT.** 2019**.** Bioprospecting marine actinomycetes to combat tuberculosis. IMBC, Shizuoko, Japan, September 2019.	Leveraged	Oral
Wilson*, A. 2019. Age and Growth of Lane Snapper in the Gulf of Mexico. Presented at the NOAA EPP session of the annual American Fisheries Society meeting, Reno, NV.	Direct: Cohort 2 student	Oral
Barry*, T. and **Cox, T.** 2019. Distribution of Non-native Red Lionfish (*Pterois volitans*) and Devil Firefish (*Pterois miles*) Throughout Georgia's Coastal Waters. Ocean Sciences Meeting 16-21Feb 2020, Honolulu, HI	Leveraged	Poster
Bender*, A., et. al. 2020.Using Relative Body Measurements of Nassau Grouper to Predict Total Length. Presented at the Ocean Sciences meeting, San Diego, CA.	Direct: Cohort 3 student	Poster
Layton* J.M., et. al. 2020. Investigating Marine Wildlife Ecotourism In Southern California: A Case Study for La Jolla Cove. Presented at the Ocean Sciences meeting, San Diego, CA.	Direct: Cohort 2 student	Poster
Milton* I.A., et. al. 2020. The Effects of Feeding Activity on the Bioenergetics of a Pelagic Calanoid Copepod, *Pleuromamma xiphias*. Presented at the Ocean Sciences meeting, San Diego, CA.	Direct: Cohort 1 Student	Poster
Milton, I*, **C. Bonin,** N. Smith*, K. Dorsey*, O. Stojilovic, J. Layton*, K. Cruz***, D. Gibson, AZ Horodysky.** 2020. MicroRNA isolation from three neurosensory structures in CO2-exposed marine fishes. 149th Ann. Mtg. Am. Fish. Soc. Reno, NV.	Leveraged	Poster
Muniz, W., Howard, K., and **Hoskins-Brown, D.L.** 2019. Abundance of the Diamondback Terrapins (*Malaclemys terrapin*) in Coastal Georgia. Ocean Sciences Meeting 16-21Feb20, Honolulu, HI	Leveraged	Poster
Pelekai*, K.P., Hess, J., Porter, L., and **J. Miller. 2019.** Evaluation of Pacific Lamprey statoliths and eye lenses as records of age, natal origin, and trophic history. State of the Coast Conference. Poster.	Direct: Cohort 3 student	Poster
Pelekai*, K.P., Hess, J., Porter, L., Lampman, R. and **Miller, J.** 2019. Evaluation of Pacific Lamprey statoliths and eye lenses as records of age, natal origin, and trophic history. Lamprey Information Exchange Meeting. Poster.	Direct: Cohort 3 student	Poster
Thalmann*, H.L., Laurel, B.J., **Miller, J.A.** 2020. Few surviving juvenile Pacific Cod are bigger, fatter, and shifting diets in a warm ocean year. Alaska Marine Science Symposium. Anchorage, AK. January 2020. Poster Presentation.	Direct: Cohort 1 Student	Poster

March 1, 2020- August 31, 2020

During this reporting period, Center Scientists made 19 total presentations at conferences, all of which were oral presentations. Nine were directly funded, while 10 were the result of leveraged funding. Eight presentations were made by cohort students. The detailed list can be found in Table 29. During this period, conference activities were impacted by Covid-19 pandemic safety measures. Many conferences were canceled. Those that did take place were held virtually.

Table 29. Citations for presentations made during the period March 1-August 31, 2020. Center scientists are listed in bold. Cohort students are identified by an asterisk (*).

Presentation	Funding	Type
Babcock, E. A. and O'Farrell*, H. 2020. Developing a standardized methodology for estimating bycatch of rare species in the Gulf of Mexico. Presented at LMRCSC Virtual Science Meeting. April 29, 2020	Direct: Cohort 1 student and TAB	Oral
Bachvaroff, T.R. 2020. DNA databases and high throughput sequencing. IMET Virtual Summer Internship Program, June 2020.	Leveraged	Oral
Coleman*, N. 2020. Use of video to study predator/prey interactions. SERC, Aug 2020	Leveraged	Oral
Frey*, B.A., **Secor, D.,** Richards, A. **and Jagus, R.** 2020. Monkfish age validation using hardpart analysis of known-age cohorts. NOAA LMRCSC 2020 Virtual Science Meeting, MD, April 2020.	Direct: Cohort 3 Student and TAB	Oral
Hill, R.T. 2020. Featured panelist. UMBC College of Natural and Mathematical Sciences Career Day. Spoke to 100 undergraduate students on career opportunities in the marine and environmental sciences. UMBC, March 2020.	Leveraged	Oral
Hill, R.T. 2020. Invited seminar: “Drugs from the Sea”. Lunchtime Lecture at the Maryland Science Center 13 March, 2020.	Leveraged	Oral
Hill, R.T. 2020. Microbially mediated nutrient cycles in marine sponges through FEMS Microbiology Ecology. This was the inaugural FEMS Microbial Ecology webinar and was attended by 260 people across the world. July 9, 2020.	Leveraged	Oral
Hill, R.T. 2020. UMBC Connects: Employers in the Sciences. Virtual information session for Undergraduate Science students, during university closure caused by COVID-19 pandemic. 17th April, 2020.	Leveraged	Oral
Hoskins-Brown, D.L. 2020. Climate Change and Vulnerabilities for Coastal Communities of Color for the South Miami Dade NAACP Environmental and Climate Justice Town Hall, July 20, 2020 (via Zoom)	Leveraged	Oral
Jagus, R. 2020. Molecular Tools for Fisheries and Environmental Biologists, IMET Virtual Summer Internship Program, June 2020.	Leveraged	Oral
Jagus, R. and Hanif*, A. 2020. Differences in the diet of Gulf menhaden at two locations in Apalachicola Bay, FL, by DNA metabarcoding. NOAA LMRCSC 2020 Virtual Science Meeting, MD, April 2020.	Direct: Cohort 1 student and TAB	Oral
King*, B. 2020. Underrepresentation in marine and fisheries science professions: How social identities influence career experiences. Research Advances in Fisheries, Wildlife, and Ecology Symposium (RAFWE), Corvallis, OR, May 2020	Direct: Cohort 2 Student	Oral
King*, B. 2020. Utilizing cloud-based services in a time of uncertainty: perceptions of natural marine resource management. Presented at NOAA Living Marine Resources Cooperative Science Center Annual Science Meeting, April 2020	Direct: Cohort 2 Student	Oral
Pares*. O. and **Schott, E.S.** 2020. Life history and disease ecology of the Blue Crab, *Callinectes sapidus*, a key benthic-pelagic link, in Puerto Rico. NOAA LMRCSC 2020 Virtual Science Meeting, MD, April 2020.	Direct: TAB	Oral

Pelekai*, K.P., Hess, J., Porter, L. and **Miller, J**. 2020. Evaluation of Pacific Lamprey statoliths and eye lenses as records of age, natal origin, and trophic history. NOAA LMRCSC Virtual Science Meeting. April 2020	Direct: Cohort 3 student	Oral
Schott, E.S. 2020. A community of students and citizen scientists are revealing the biodiversity of an urban harbor. NOAA LMRCSC 2020 Virtual Science Meeting, MD, April 2020.	Leveraged	Oral
Schott, ES. 2020. Long term approaches on health and biodiversity in Baltimore Harbor. IMET Virtual Summer Internship Program, June 2020.	Leveraged	Oral
Thalmann*, H.L., Laurel, B.J., **Miller, J.A.** 2020. Few surviving juvenile Pacific Cod are bigger, fatter, and shifting diets in a warm ocean year. NOAA LMRCSC Virtual Science Meeting. April 2020	Direct: Cohort 1 Student	Oral
Wilson*, A. and **Babcock, E. A.** 2020. Age, growth, and genetic diversity of Lane Snapper, a data limited species. Presented at LMRCSC Virtual Science Meeting. April 29,2020	Direct: Cohort 1 Student	Oral

September 1, 2020 - February 28, 2021

During this reporting period, Center Scientists made nine total presentations at conferences all of which were oral presentations. Two were directly funded, while 7 were the result of leveraged funding. Two presentations were made by cohort students. The detailed list can be found in Table 30. During this period, conference activities were impacted by Covid-19 pandemic safety measures. Many conferences were canceled. Those that did take place were held virtually.

Table 30. Citations for presentations made during the period Sept. 1, 2020-Feb. 28, 2021. Center scientists are listed in bold. Cohort students are identified by an asterisk (*).

Presentation	Funding	Type
Arai, K., M. Castonguay, **D.H. Secor.** 2020. Decadal trends in stock mixing of Northwest Atlantic mackerel from otolith oxygen and carbon stable isotopes. American Fisheries Society Tidewater Chapter meeting. Zoom.	Leveraged	Oral
Dahlenburg, C., Alavi, M., Bachvaroff, T., Burkett, T., Frederick, A., Gash, L., Jaffe, M., Johnston, A., Khan, S., Lim,Y-B., Scheifele, L., Teferri, S., Vonderhaar, M,. **Schott, E.** 2020. Community science can help fill knowledge gaps about the ecology of urban estuaries. Maryland Water Monitoring Conference, December 4, 2020.	Leveraged	Oral
Ebanks, S. 2021. From Back Page to Reoccurring Theme: A Scientist's Systematic Approach to Elevating the Science. NRT Program on Climate Resilience, Auburn University. February 26, 2021.	Leveraged	Oral
Ebanks, S. 2021. The Next Generation of Geoscience Leaders: Strategies for Excellence in Diversity and Inclusion. Presented at the Pardee Symposium 27 Oct., 2020, 1:30–5:30 pm	Leveraged	Oral
Eric Schott. 2021. Community Science Census of Biodiversity in an Urban Estuary. Johns Hopkins University Whiting School of	Leveraged	Oral

Engineering. Department of Environmental Health and Engineering. February 2, 2021.		
King, B*, Fonner, R. 2020. Ecological & Social Predictors of Salmon Habitat Restoration Effort in Puget Sound. NOAA Northwest Fisheries Science Center Ecosystem Science Division Meeting. December, 2020 (Virtual Presentation)	Direct: Cohort 2 Student	Oral
King, B*, Fonner, R. 2020. Ecological & Social Predictors of Salmon Habitat Restoration Effort in Puget Sound. Puget Sound Partnership Social Science Advisory Committee Meeting. November, 2020 (Virtual Presentation)	Direct: Cohort 2 Student	Oral
Pride, C. Connecting HBCU Students and Coastal Communities to Georgia's Barrier Island. Geoheritage Distinguished Speaker Series (Invited). U.S. National Committee for Geoscience, Oct. 20, 2020.	Leveraged	Oral
Secor, D.H. 2020. Assessing migration "flyways" of migratory fishes in the MD Wind Energy Area. Electric Power Research Institute Sturgeon Interest Group. Zoom.	Leveraged	Oral

March 1, 2021- August 31, 2021

During this reporting period, Center Scientists made 17 total presentations at conferences. These included 12 oral and 5 poster presentations. Twelve (12) oral presentations were directly funded while 5 were the result of leveraged funding (5 oral, 0 poster). Eleven (11) presentations were made by cohort students (8 oral, 3 poster). The detailed list can be found in Table 31.

Table 31. Citations for presentations made during the period March 1 - August 31, 2021. Center scientists are listed in bold. Cohort students are identified by an asterisk (*).

Presentation	Funding	Type
Bender* A, Kathryn Cruz*, Michael Goebel, Douglas Krause, **Eric Lewallen, Carolina Bonin Lewallen.** 2021. Estimating effective population size and historical demography of leopard seals (*hydruga leptonyx*) in the antarctic peninsula. Hampton University School of Science Symposium, Virtual, April 2021. (*) Second place, graduate student presentation	Direct: Cohort 3	Oral
Bender*, Arona, Douglas Krause. Initial analysis of the foraging tactics and social behavior of Antarctic fur seals (*Arctocephalus gazella*) from animal-borne HD video footage. 2021. NERTO Final Presentation, Southwest Fisheries Science Center, La Jolla, CA (Virtual Talk), August 6th, 2021.	Direct: Cohort 3	Oral
Bonin, C.A. 2021. Epigenomics of dolphin skin. Virtual HBCU-UP/CREST PI-PD Meeting. Feb 4 & 5 2021. Recorded presentation with live Q&A.	Leveraged	Oral
Bonin, C.A., Roots, A., Cruz, K*. 2021. Investigating the epigenomic adaptations in dolphin skin. Hampton University Science Symposium. April 1 2021. Virtual live presentation.	Direct: Cohort 3	Oral
Cervera* J.C and R. Araujo. 2021. Australian pine (*Casuarina equisetifolia*) invasion of Florida mangroves. SEMANGLARES IV. Red Colombiana de Estuarios y Manglares. Online conference presentation. July 26, 2021	Direct: Cohort 3	Oral

Cervera*, J.C. 2021. Modeling mangrove shift in response to sea-level rise in Miami-Dade County. University of Miami's 2021 Coastal Resilience Virtual Symposium. April 7, 2021.	Direct: Cohort 3	Oral
Cervera*, J.C. 2021. Essential fish habitat mapping tool. Invited Student Virtual Talk. NOAA EPP Forum. April 8, 2021.	Direct: Cohort 3	Oral
Hildebrandt*, S., **Gibson**, D., Spires, J., McLaughin, S. 2021. Investigating The Impacts of Oyster-Conditioned-Water on Crassostrea virginica Larval Direct Setting Efficiency. Hampton University School of Science Symposium, Virtual, April 2021. (*) First place, graduate student presentation	Direct: Cohort 2	Oral
Hill. R. T. 2021. Webinar, "Microbial symbionts and nutrient cycling in marine sponges." Opening talk in "Advances in Microbial Biotechnology and the Use of Next-Generation Sequencing Platforms". United National University, Program for Biotechnology in Latin America and the Caribbean. 15 March, 2021	Leveraged	Oral
Legrand E, Tsvetan Bachvaroff, Tracey B. Schock, and **J. Sook Chung** 2021. Transcriptomic and expression analysis of the genes involved in ecdysteroidogenesis and cholesterol uptake in the Y-organ of the blue crab, *Callinectes sapidus*. 2021 National Shellfish Association conference	Leveraged	Oral
Leslie*, Jaelyn, Douglas Krause 2021. Assessing the mass and body condition of leopard and fur seals using aerial images. NERTO Final Presentation, Southwest Fisheries Science Center, La Jolla, CA (Virtual Talk), August 6th, 2021.	Direct: Cohort 4	Oral
Louis V. Plough, Ben B. Lee, **Eric J. Schott,** Andrew Kough, Donald C. Behringer, Jamie Boijko, Tsvetan Bachvaroff, and **J. Sook Chung** 2021. Population Genomic Analysis of the Blue Crab, *Callinectes sapidus*, Across its Range: Insights Into Gene Flow, Local Adaptation, and the Potential for Geographic Source Tracking. 2021 National Shellfish Association conference (Virtual)	Leveraged	Oral
Nash*, Jonathan, Heidi Sosik. Quantifying the distribution of gelatinous invertebrates and their habitat conditions on the Northeast US Shelf through imagery and associated environmental data. PEP Research Symposium, August 2021.	Direct: Cohort 5	Oral
T. Bachvaroff, L. Plough and **J. Sook Chung** 2021. Cracking the Genome of the Blue Crab, *Callinectes sapidus*. 2021 National Shellfish Association conference	Leveraged	Oral
Leslie*, Jaelyn, Susan G. Barco, Alexander Costidis, **Tunde Adebola, Carolina Bonin Lewallen** 2021. The potential long-term impact of the 2013 morbillivirus outbreak in common bottlenose dolphin (*tursiops truncatus*) strandings in Virginia (USA). Hampton University School of Science Symposium, Virtual, April 2021.	Direct: Cohort 4	Poster
O. Pares*, A. Fowler, M. Zhao, and **E Schott**. 2021. NSA poster National Shellfish Association (March 2021, virtual). Title: The Potential for Blue Crab Prey to be Host of the Crab Pathogen, CsRV1.	Direct: TAB	Poster
Tolin*, Amani Shawn Dash, **Benjamin Cuker.** 2021. Evaluating the Impacts of Water Quality and Interspecific Interactions on the Larval Recruitment of Eastern Oysters (*Crassostrea virginica*) in the Hampton River. Hampton Univ. School of Science Symposium, Virtual, Apr. 2021.	Direct: Cohort 3	Poster

*September 1, 2021 - February 28, 2022 (*No Cost Extension Year*)

During this reporting period, Center Scientists made 8 total presentations at conferences. These included 6 oral and 2 poster presentations. All of these were directly funded and presented by cohort students. The detailed list can be found in Table 32.

Table 32. Citations for presentations made during the period Sept. 1, 2021 - Feb. 28, 2022. Center scientists are listed in bold. Cohort students are identified by an asterisk (*).

Presentation	Funding	Type
Haughton*, S. Jensen, P. **Pitula, J.** 2022. Evaluating Physiological and Immune Responses of Tanner Crab (*Chionoecetes bairdi*) to *Hematodinium* sp. Infection. Invited speaker, IUPAC Global Women's Breakfast event (a global networking event), Feb. 2022.	Direct: Cohort 3	Oral
Henson*, M., **Horodysky, A.** 2022. Linking growth rate to metabolic rate in fish species of the Mid-Atlantic Bight. Presented at the Ocean Sciences Meeting 2022 (ASLOMP), Feb. 2022.	Direct: Cohort 1	Oral
Leslie*, J., **Bonin, A.** 2022. Assessing the changes in mass and body condition of leopard seals (*Hydrurga Leptonyx*) using aerial images. Presented at the Ocean Sciences Meeting 2022 (ASLOMP), Feb. 2022.	Direct: Cohort 4	Oral
Nash*, J. et al. 2022. Quantifying the distribution of gelatinous invertebrates and their habitat conditions on the Northeast US Shelf through imagery and associated environmental Data. Presented at the Ocean Sciences Meeting 2022 (ASLOMP), Feb. 2022.	Direct: Cohort 5	Oral
Pares* O., Fowler A., Zhao M., **Stevens B., Schott E.** 2021. Life History and Reproductive Strategies of *Callinectes* sp. in a Tropical Urban Estuary Presented at the 151st American Fisheries Society Annual Meeting	Direct: Cohort 5	Oral
Thalmann*, HL, B Laurel, and **JA Miller.** 2022. Catching the Heatwave: Juvenile Pacific Cod diet composition and growth in response to anomalous warming in Gulf of Alaska nursery habitats. 2022 Alaska Marine Science Symposium. Virtual Meeting. January 2022. Oral Presentation. (Best Student Oral Presentation).	Direct: Cohort 1	Oral
Rubalcava*, K., **Chigbu, P.** 2021. Assessment of the abundance of brown shrimp **(***Farfantepenaeus aztecus*) in the Maryland Coastal Bays in relation to Environmental Factors. American Fisheries Society Annual Meeting, November 6-10, 2021, Baltimore MD. Poster Presentation.	Direct: Cohort 2	Poster
Silver*, A. and Alade, L. 2022. Working Group Collaboration to Explore Growth Parameters of American Plaice (*Hippoglossoides platessoides*) in the Georges Bank and Gulf of Maine for 2022 Research Track Assessment. Presented at ASLO for Education and Outreach Posters, Honolulu, Hawaii, March, 2022. Poster Presentation	Direct: Cohort 3	Poster

*March 1, 2022 – August 31, 2022 (*No Cost Extension Year*)

During this reporting period, Center Scientists made 41 total presentations at conferences. These included 26 oral and 15 poster presentations. Thirty-nine (39) were directly funded (25 oral, 14 poster), while 2 were the result of leveraged funding (1 oral, 1 poster). Thirty-five (35) presentations were made by cohort students (22 oral, 13 poster). The detailed list can be found in Table 33.

Table 33. Citations for presentations made during the period March 1 - August 31, 2022 (No Cost Extension Year). Center scientists are listed in bold. Cohort students are identified by an asterisk (*).

Presentation	Funding	Type
Barry*, T. 2022. Spatial data compilation for anadromous fishes protected under the Endangered Species Act. NOAA EPP/MSI Annual Forum. April 5-8, 2022. Tallahassee, FL.	Direct: Cohort 3 Student	Oral
Bender*, A.N., Krause, D., Goebel, M.**, Lewallen, E., Bonin, C.** 2022. Estimating effective population size and historical demography of leopard seals (*Hydruga leptonyx*) in the Antarctic Peninsula. Association for the Sciences of Limnology and Oceanography (ASLO), Ocean Sciences Meeting (OSM); Virtual Feb 24- Mar 4 2022.	Direct: Cohort 3 Student	Oral
Bender*, A.N., Krause, D., Goebel, **M., Lewallen, E., Bonin, C.** 2022. Genetic approaches to monitor effects of climate change on leopard seals in the Antarctic Peninsula. NOAA EPP/MSI Forum, Florida A&M Univ., Tallahassee, FL, April 2022.	Direct: Cohort 3 Student	Oral
Best-Otubu*. C. 2022. Estimating food web structural responses to water alterations in the Biscayne Bay using Ewe Models. American Fisheries Society Annual Meeting. Spokane, WA 8/21/2022- 8/25/2022.	Direct: Cohort 5 Student	Oral
Chigbu, P., Babcock, E., Gibson, D., Hoskins-Brown, D., Jagus, R., Miller, J., Smith, S., Sexton, M., Young, V. 2022. Contributions of NOAA LMRCSC in enhancing workforce diversity in the marine science. Presented at the AFS meeting, August 20-25, 2022, Spokane, WA.	Direct: reporting record of LMRCSC	Oral
Cohn*, L., Feist, B., Whitmire, C., and Conway, F. 2022. Using GIS to illustrate rockfish conservation area closure impacts on the US West Coast from 2008-2021. Society for Applied Anthropology Conference Presentation, March 2022.	Direct: Cohort 5 Student	Oral
Coleman*, N.C., Lankowicz, K.M., O'Brien, M.H.P., **Secor,** D.H. 2022. Using Adaptive Resolution Imaging Sonar (ARIS) to estimate the fall spawning run of Atlantic sturgeon in the Nanticoke River-Marshyhope Creek. Oral Presentation at American Fisheries Society Tidewater Division. March 24-26. Nag's head, North Carolina.	Direct: Cohort 2 Student	Oral
Coleman*, N.C., O'Brien, M.H.P., Lankowicz, K.M**., Secor, D.H.** 2022. ARIS Sonar imaging of adult Atlantic Sturgeon in the Nanticoke-Marshyhope System. American Fisheries Society 152nd Annual Meeting. August, Spokane, Washington.	Direct: Cohort 2 Student	Oral
Czajkowski*, C., **McIntosh, D.** 2022. Efficacy of two disinfectant technologies for use in post-harvest treatment of oysters, Presented at NOAA EPP/MSI Forum, Florida A&M Univ., Tallahassee, FL, April 2022	Direct: Cohort 3 Student	Oral
Haughton*, S. 2022. Evaluating physiological and immune responses of Tanner crab to *Hematodinium* sp. Infection. NOAA EPP/MSI Annual Forum. April 5-8, 2022. Tallahassee, FL.	Direct: Cohort 3 Student	Oral
Henson*, M., Schweitzer, C., **Horodysky, A.** 2022. Linking metabolic rate to growth rate in fishes of the Mid-Atlantic region. NOAA EPP/MSI Forum, Florida A&M University, Tallahassee, FL, April 2022. Oral	Cohort 1 Student	Oral
Johnson*, T., Almuhaideb, E., Meredith, J.**, Rosales, D., Chigbu, P., Dasilva, L., Parveen, S.,** Richards, G. 2022. Prevalence of *Shewanella* species in Chesapeake Bay Oyster and Seawater. Association of Research Directors (ARD) meeting. April 2-5, 2022. Atlanta, GA.	Direct: Cohort 4 Student	Oral

Johnson*, T., Almuhaideb, E., Meredith, J., **Rosales, D., Chigbu, P., Dasilva, L., Parveen, S**., Richards, G. 2022. Prevalence of *Shewanella* spp. in Chesapeake Bay Oyster and Seawater. NOAA EPP/MSI Annual Forum. April 5-8, 2022. Tallahassee, FL.	Direct: Cohort 4 Student	Oral
Johnson*, T**., Parveen,** S., Meredith, J., Almuhaideb, E., **Rosales D., Chigbu, P., Dasilva, L.** 2022. Incidence and Pathogenic Potential of *Shewanella* species in oysters and seawater collected from the Chesapeake and Maryland Coastal Bays. IAFP annual meeting, July 30-August4, 2022. Pittsburgh, PA.	Direct: Cohort 4 Student	Oral
Johnson*, T**., Parveen,** S., Meredith, J., Almuhaideb, E., **Rosales D., Chigbu, P., Dasilva, L.** 2022. Occurrence of *Shewanella* species in oyster and seawater collected from the Chesapeake Bay. AFS annual meeting. August 21-25, 2022. Spokane, WA.	Direct: Cohort 4 Student	Oral
Leslie*, Jaelyn, Collier, Jahia, Morris, Halia, Barco, Susan**, Adebola, Tunde, and Bonin, Carolina.** 2022. The potential long-term impacts of the 2013 morbillivirus outbreak on common bottlenose dolphins (*Tursiops truncatus*) stranding frequency and body condition from Virginia, NOAA EPP/MSI Education and Science Forum; Tallahassee, Florida, April 6-8 2022.	Direct: Cohort 4 Student	Oral
Miller, J. A., Almeida, Z. A., Thalmann*, H., Rogers, L., Laurel, B. 2022. Thermal effects on early life stages of Gulf of Alaska Pacific Cod: shifts in phenology 2022 American Fisheries Society Meeting, Spokane, WA	Direct: Cohort 4 Student	Oral
Nash*, J. 2022. Quantifying the distribution of gelatinous invertebrates and their habitat conditions on the Northeast US Shelf through imagery and associated environmental Data. NOAA EPP/MSI Forum, Florida A&M University, Tallahassee, FL, April 2022. Oral	Direct: Cohort 5 Student	Oral
Reeves*, T., Schweitzer, C., **Horodysky, A.** 2022. Effect of environment on pigmentation in the grass shrimp, *Palaemonetes pugio*. NOAA EPP/MSI Forum, Florida A&M Univ., Tallahassee, FL, Apr. 2022.	Direct: Cohort 5 Student	Oral
Rubalcava*, K. **Chigbu P.** 2022. Abundance and distribution of Brown Shrimp (*Farfantepenaeus aztecus*) in Maryland Coastal Lagoons. 2022 American Fisheries Society Meeting, Spokane, WA	Direct: Cohort 2 Student	Oral
Smith, S., Elliott, C., Gissandaner, C. 2022. Blue carbon sequestered in Delaware Tidal Marsh Soils. Presented at the Association of 1890 Research Directors Research Symposium, Atlanta, GA, April 2022	Leveraged	Oral
Teat*, M., Bland, A., Maina*, J., Venello, T., **Ozbay, G.** 2022. Oyster restoration, species diversity, and water quality in Rehoboth Bay, Delaware. Presented at NOAA EPP/MSI Forum, Florida A&M University, Tallahassee, FL, April 2022 - RCCE - 3rd Place Oral ($250)	Direct: Cohort 5 Student	Oral
Teat*, M., Bland, A., Maina, J., Venello, T., **Ozbay, G.** 2022. Oyster restoration, species diversity, and water quality in Rehoboth Bay, Delaware. Presented at the Association of 1890 Research Directors Research Symposium, Atlanta, GA, April 2022	Direct: Cohort 5 Student	Oral
Teat*, M.**,** Bland, A., Maina, J., Venello, T., **Ozbay, G.** 2022. Oyster restoration, species diversity, and water quality in Rehoboth Bay, Delaware. Presented at the American Fisheries Society Meeting, Spokane, WA, August 2022	Direct: Cohort 5 Student	Oral

Thalmann*, H., Laurel, B., **Miller, J. A.** 2022. ICES PICES Early Career Science Conference: Effects of thermal variability on juvenile Pacific Cod diet and trophic position in Gulf of Alaska nursery habitats, St. John's, NL, CA	Direct: Cohort 4 Student	Oral
Thalmann*, H., Laurel, B., Rew, M. B., Almeida, Z. A., **Miller, J. A.** 2022. Quantifying Pacific Cod metabolic rate using otolith carbon isotopes and microchemistry. 2022 American Fisheries Society Meeting, Spokane, WA	Direct: Cohort 4 Student	Oral
Andrade*, E., Allison, R., Bland, A., Gadde, M., Nakazwe, M., Venello, T., **Ozbay, G. 2**022. Investigating the relationship between physical water quality parameters and chlorophyll-*a* in Rehoboth Bay, Delaware. Presented at NOAA EPP/MSI Forum, Florida A&M University, Tallahassee, FL, April 2022	Direct: Cohort 4 Student	Poster
Andrade*, E., Allison, R., Bland, A., Gadde, M., Nakazwe, M., Venello, T., **Ozbay, G.** 2022. Investigating the relationship between physical water quality parameters and chlorophyll-*a* in Rehoboth Bay, Delaware. Presented at the American Fisheries Society Meeting, Spokane, WA, August 2022 - Best Water Quality Poster AFS-WQ section ($100)	Direct: Cohort 4 Student	Poster
Andrade*, E., Allison, R., Bland, A., Gadde, M., Nakazwe, M., Venello, T., **Ozbay, G.** 2022. Investigating the relationship between physical water quality parameters and chlorophyll-*a* in Rehoboth Bay, Delaware. Presented at the Association of 1890 Research Directors Research Symposium, Atlanta, GA, April 2022	Direct: Cohort 4 Student	Poster
Cohn*, L., Harvey, C., Conway, F., Feist, B., and Whitmire, C. 2022. Using GIS to illustrate the intersection between climate change, energy and fisheries. Poster presentation at 2022 NOAA EPP Forum, Tallahassee, FL	Direct: Cohort 5 Student	Poster
Goffe*, S., **Chigbu, P., Ishaque, A.B., Cullen, D.** 2022. Population dynamics of Pinfish (*Lagodon rhomboides*) in the Maryland Coastal Bays. NOAA EPP Forum 2022, Tallahassee, FL	Direct: Cohort 4 Student	Poster
Hawkins*, P., Sharma, I. 2022. Ecophysiology of marine bacterial isolates from Trunk River. NOAA EPP/MSI Forum, Florida A&M University, Tallahassee, FL, April 2022.	Direct: Cohort 4 Student	Poster
Layton*, J., Candelmon, A., Semmens, B., Pattengill-Semmens, C., Stock, B., Waterhouse, L., McCoy, C., Johnson, B., **S., Heppell, S.** 2022. Impacts of increased temperatures on early life history stages of Nassau Grouper. NOAA EPP Forum 2022, Tallahassee, FL	Direct: Cohort 4 Student	Poster
Richardson*, D. 2022. Genomic annotation of an alkaphilic methanogen. NOAA EPP/MSI Forum, Florida A&M University, Tallahassee, FL, April 2022.	Direct: Cohort 5 Student	Poster
Richardson, C., **Chigbu, P., Ishaque, A.** 2022. Variations in the fatty acid trophic markers of fishes in Coastal Lagoons. Presented at the AFS meeting, August 20-25, 2022, Spokane, WA.	Leveraged	Poster
Rubalcava*, K., Townsend, H., **Chigbu, P.** 2022. An ecosystem model to assess the resiliency of a Lagoonal Estuary to anthropogenic pressures. 2022 NOAA EPP Forum, Tallahassee, FL	Direct: Cohort 2 Student	Poster
Tait*, N.**, Adebola, T.** 2022. Developing a coupled human ecological system for modeling Chesapeake Bay shellfish fisheries. NOAA EPP/MSI Forum, Florida A&M University, Tallahassee, FL, April 2022.	Direct: Cohort 5 Student	Poster

Thalmann*, H., Laurel, B., **Miller, J. A.** 2022. Juvenile Pacific Cod foraging and growth in response to marine heatwaves in the Gulf of Alaska. 2022 NOAA EPP Forum, Tallahassee, FL	Direct: Cohort 4 Student	Poster
Wade*, K., **Cullen, D.** 2022. Environmental factors influence Jonah and Rock crab distributions in the northwest Atlantic. Presented at American Fisheries Society, Spokane, WA, August 2022. Poster Presentation	Direct: Cohort 5 Student	Poster
Wade*, K.**, Cullen, D.** 2022. Sediment type habitat associations in Jonah and Rock crabs in Mid-Atlantic. Presentation at the NOAA EPP/MSI Biennial Education and Science Forum. Presented at NOAA EPP Forum, April 2022.	Direct: Cohort 5 Student	Poster
Wong-Ala*, J. A. T., K., Wren, J., Ciannelli, L., Robinson, S., Kobayashi, D, Rykaczewski, R. 2022. Transport of *Toxoplasma gondii* oocysts in coastal areas inhabited by the Hawaiian monk seal. 2022 NOAA EPP Forum, Tallahassee, FL	Direct: Cohort 5 Student	Poster

List of Publications that acknowledge the grant (Arranged by Year and Performance Period)

Center Scientists produced 172 total publications over the course of the award. Forty-four (44) were the result of direct funding, and 29 acknowledged the award. Thirty-six (36) included cohort students as authors. The numbers of publications are summarized by reporting period in Table 34, and the complete lists can be found in Table 35 - Table 46.

Table 34. Summary of publications produced by LMRCSC scientists September 1, 2016-August 31, 2022

Reporting period	Total Publications	Directly Funded Publications	Acknowledges Center	Student Authors	Leveraged Publications
Sept. 2016-Feb. 2017	0	0	0	0	0
Mar.-Aug. 2017	12	3	2	2	9
Sept. 2017-Feb. 2018	15	2	0	1	13
Mar.-Aug. 2018	16	5	2	1	11
Sept. 2018-Feb. 2019	8	3	3	2	5
Mar.-Aug. 2019	13	4	2	2	9
Sept. 2019-Feb. 2020	13	2	2	1	11
Mar.-Aug. 2020	21	6	5	5	15
Sept. 2020-Feb. 2021	30	7	5	6	23
Mar.-Aug. 2021	18	5	3	4	13
*Sept. 2021-Feb. 2022	14	4	1	5	10
*Mar.-Aug. 2022	8	2	1	1	6

Beyond	4	3	3	3	1
Total	172	44	29	36	129

**No Cost Extension Year*

September 1, 2016- February 28, 2017

During the period, September 1, 2016 - February 28, 2017, LMRCSC did not produce any publications based on results of the new award as it was only just beginning.

March 1, 2017 to August 31, 2017

During the period, March 1 - August 31, 2017, LMRCSC scientists produced eleven (11) peer reviewed publications. Of the total, two resulted from direct funding while nine resulted from leveraged funds. Two cohort students were included among the authors. The complete list of these publications is available in Table 35.

Table 35. Publications produced March 1-August 31, 2017. LMRCSC scientist names are in bold; student authors are marked with an asterisk (*).

Citation	Funding	Description of support	DOI	Acknowledged LMRCSC	NOAA Library Repository #
Allman AL, Williams EP, **Place AR**. 2017. Growth and enzyme production in blue crabs (*Callinectes sapidus*) fed cellulose and chitin supplemented diets. Journal of Shellfish Research. 36(1):283-291. https://doi.org/10.2983/035.036.0132	Leveraged		10.2983/035.036.0132		
Bond ME, Valentin-Albanese J, **Babcock EA**, Abercrombie D, Lamb NF, Miranda A, Pikitch EK, Chapman DD. 2017. Abundance and size structure of a reef shark population within a marine reserve has remained stable for more than a decade. Marine Ecology Progress Series. 576:1-10. https://doi.org/10.3354/meps12241	Leveraged		10.3354/meps12241		
Cooke SJ, Lennox RJ, Bower SD, **Horodysky AZ**, Treml MK, Stoddard E, Donaldson LA, Danylchuk AJ. 2017. Fishing in the dark: The science and management of recreational fisheries at night. Bulletin of Marine Science. 93(2):519-538. https://doi.org/10.5343/bms.2015.1103	Direct	Horodysky is supported by the NOAA Living Marine Resources Cooperative Science Center	10.5343/bms.2015.1103	yes	

Feng XJ, Williams EP, **Place AR**. 2017. High genetic diversity and implications for determining population structure in the blue crab *Callinectes sapidus*. Journal of Shellfish Research. 36(1):231-242. https://doi.org/10.2983/035.036.0126	Leveraged		10.2983/035.036.0126		
Gruss A, Rose KA, Simons J, Ainsworth CH, **Babcock EA**, Chagaris DD, De Mutsert K, Froeschke J, Himchak P, Kaplan IC et al. 2017. Recommendations on the use of ecosystem modeling for informing ecosystem-based fisheries management and restoration outcomes in the Gulf of Mexico. Marine and Coastal Fisheries. 9(1):281-295. https://doi.org/10.1080/19425120.2017.1330786	Leveraged		10.1080/19425120.2017.1330786		
Gruss A, Thorson JT, **Babcock EA**, Tarnecki JH. 2018. Producing distribution maps for informing ecosystem-based fisheries management using a comprehensive survey database and spatio-temporal models. ICES Journal of Marine Science. 75(1):158-177. https://doi.org/10.1093/icesjms/fsx120	Leveraged		10.1093/icesjms/fsx120		
Peters, R., **Chigbu P**. Spatial and temporal patterns of abundance of juvenile black sea bass (*Centropristis striata*) in Maryland Coastal Bays. Fishery Bulletin, 115 (4): 504-516. https://doi.org/10.7755/FB.115.4.7	Direct		10.7755/FB.115.4.7		https://repository.library.noaa.gov/view/noaa/31781
Hill JM, Williams EP, Masters B, **Place AR**. 2017. Multiple paternity in the blue crab (*Callinectes sapidus*) assessed with microsatellite markers. Journal of Shellfish Research. 36(1):273-276. https://doi.org/10.2983/035.036.0130	Leveraged		10.2983/035.036.0130		
Lawrence* A, Green* S, **Chung JS**. 2017. Isolation and tissue distribution of an insulin-like androgenic gland hormone (iag) of the male red deep-sea crab, *Chaceon quinquedens*. Marine Drugs. 15(8). https://doi.org/10.3390/md15080241	Direct	Cohort 1 and 2 students	10.3390/md15080241	yes	https://repository.library.noaa.gov/view/noaa/25613
Liu CL, **Place AR, Jagus R.** 2017. Use of antibiotics for maintenance of axenic	Leveraged		10.3390/md15080242		

cultures of A*mphidinium carterae* for the analysis of translation. Marine Drugs. 15(8). https://doi.org/10.3390/md15080242					
Place AR, Plough LV. 2017. The genetic enablement of the blue crab *Callinectes sapidus*. Journal of Shellfish Research. 36(1):227-229. https://doi.org/10.2983/035.036.0125	Leveraged		10.2983/035.036.0125		
Williams E, **Place A**, Bachvaroff T. 2017. Transcriptome analysis of core dinoflagellates reveals a universal bias towards "Gc" Rich codons. Marine Drugs. 15(5). https://doi.org/10.3390/md15050125	Leveraged		10.3390/md15050125		

September 1, 2017- February 28, 2018

During the period September 1, 2017 - February 28, 2018, LMRCSC scientists produced 15 peer-reviewed publications. Of the total, one was the result of direct funding and 14 were the result of leveraged funds. One cohort student was included among the authors. The complete list of these publications is available in Table 36.

*Table 36. Publications produced September 1, 2017-February 28, 2018. LMRCSC scientist names are in bold; student authors are marked with *.*

Citation	Funding	Description of support	DOI	Acknowledged LMRCSC	NOAA Library Repository #
Barker BD, **Horodysky AZ**, Kerstetter DW. 2018. Hot or not? Comparative behavioral thermoregulation, critical temperature regimes, and thermal tolerances of the invasive lionfish *Pterois* sp. versus native western north Atlantic reef fishes. Biological Invasions. 20(1):45-58. https://doi.org/10.1007/s10530-017-1511-4	Leveraged		10.1007/s10530-017-1511-4		
Bembe S, Liang D, **Chung JS**. 2017. Optimal temperature and photoperiod for the spawning of blue crab, *Callinectes sapidus*, in captivity. Aquaculture Research. 48(11):5498-5505. https://doi.org/10.1111/are.13366	Leveraged		10.1111/are.13366		
Bonin CA, **Lewallen EA**, van Wijnen AJ, Cremer MJ, Simoes-Lopes PC. 2017. Habitat preference and behaviour of the Guiana dolphin (*Sotalia guianensis*) in a well-preserved estuary off southern Brazil.	Leveraged	Center supported scientist	10.17582/journal.pjz/2017.49.6.2235.2242	no	

Pakistan Journal of Zoology. 49(6):2235-2242. https://doi.org/10.17582/journal.pjz/2017.49.6.2235.2242					
Carlton JT, Chapman JW, Geller JB, **Miller JA**, Carlton DA, McCuller MI, Treneman NC, Steves BP, Ruiz GM. 2017. Tsunami-driven rafting: Transoceanic species dispersal and implications for marine biogeography. Science. 357(6358):1402-1405. https://doi.org/10.1126/science.aao1498	Leveraged		10.1126/science.aao1498		
Carlton JT, Chapman JW, Geller JB, **Miller JA**, Ruiz GM, Carlton DA, McCuller MI, Treneman NC, Steves BP, Breitenstein RA et al. 2018. Ecological and biological studies of ocean rafting: Japanese tsunami marine debris in North America and the Hawaiian Islands. Aquatic Invasions. 13(1):1-9. https://doi.org/10.3391/ai.2018.13.1.01	Leveraged		10.3391/ai.2018.13.1.01		
Fields AT, Fischer GA, Shea SKH, Zhang HR, Abercrombie DL, Feldheim KA, **Babcock EA**, Chapman DD. 2018. Species composition of the international shark fin trade assessed through a retail-market survey in Hong Kong. Conservation Biology. 32(2):376-389. https://doi.org/10.1111/cobi.13043	Leveraged		10.1111/cobi.13043		
Goes M, **Babcock E**, Bringas F, Ortner P, Goni G. 2017. The impact of improved thermistor calibration on the expendable bathythermograph profile data. Journal of Atmospheric and Oceanic Technology. 34(9):1947-1961. https://doi.org/10.1175/jtech-d-17-0024.1	Leveraged		10.1175/jtech-d-17-0024.1		
Gruss A, Chagaris DD, **Babcock EA**, Tarnecki JH. 2018. Assisting ecosystem-based fisheries management efforts using a comprehensive survey database, a large environmental database, and generalized additive models. Marine and Coastal Fisheries. 10(1):40-70. https://doi.org/10.1002/mcf2.10002	Leveraged		10.1002/mcf2.10002		
Gruss A, Thorson JT, Sagarese SR, **Babcock EA**, Karnauskas M, Walter JF, Drexler M. 2017. Ontogenetic spatial distributions of red grouper (*Epinephelus mono*) and gag grouper (*Mycteroperca microlepis*) in the US Gulf of Mexico. Fisheries Research. 193:129-142. https://doi.org/10.1016/j.fishres.2017.04.006	Leveraged		10.1016/j.fishres.2017.04.006		
Lennox RJ, Alos J, Arlinghaus R, **Horodysky A**, Klefoth T, Monk CT, Cooke SJ. 2017. What makes fish vulnerable to	Direct	Center supported scientist	10.1111/faf.12219	no	

capture by hooks? A conceptual framework and a review of key determinants. Fish and Fisheries. 18(5):986-1010. https://doi.org/10.1111/faf.12219					
Lycett KA, Chung JS, **Pitula JS**. 2018. The relationship of blue crab (*Callinectes sapidus*) size class and molt stage to disease acquisition and intensity of *Hematodinium perezi* infections. Plos One. 13(2). https://doi.org/10.1371/journal.pone.0192237	Leveraged		10.1371/journal.pone.0192237		
O'Farrell* H, Gruss A, Sagarese SR, **Babcock EA**, Rose KA. 2017. Ecosystem modeling in the Gulf of Mexico: Current status and future needs to address ecosystem-based fisheries management and restoration activities. Reviews in Fish Biology and Fisheries. 27(3):587-614. https://doi.org/10.1007/s11160-017-9482-1	Leveraged		10.1007/s11160-017-9482-1		
Ta N, **Miller JA**, Chapman JW, Pleus AE, Calvanese T, Miller-Morgan T, Burke J, Carlton JT. 2018. The western Pacific barred knifejaw, *Oplegnathus fasciatus* (Temminck & Schlegel, 1844) (Pisces: Oplegnathidae), arriving with tsunami debris on the Pacific Coast of North America. Aquatic Invasions. 13(1):179-186. https://doi.org/10.3391/ai.2018.13.1.14	Leveraged		10.3391/ai.2018.13.1.14		
Tewfik A, **Babcock EA**, Gibson J, Perez VRB, Strindberg, S. 2017. Benefits of a replenishment zone revealed through trends in focal species at Glover's Atoll, Belize. Marine Ecology Progress Series. 580:37-56. https://doi.org/10.3354/meps12290	Leveraged		10.3354/meps12290		
Wilson MT, Dougherty A, Matta ME, Mier KL, **Miller, JA**. 2018. Otolith chemistry of juvenile walleye pollock *Gadus chalcogrammus* in relation to regional hydrography: Evidence of spatially split cohorts. Marine Ecology Progress Series. 588:163-178. https://doi.org/10.3354/meps12425	Leveraged		10.3354/meps12425		

March 1, 2018 - August 31, 2018

During the period March 1-August 31, 2018, LMRCSC scientists produced 16 peer-reviewed publications. Of the total, five were the result of direct funding and 11 were the result of leveraged funds. Two cohort students were included among the authors. The complete list of these publications is available in Table 37.

Table 37. Publications produced March 1-August 31, 2018. LMRCSC scientist names are in bold; student authors are marked with an asterisk (*).

Citation	**Funding**	**Description of support**	**DOI**	**Acknowledged LMRCSC**	**NOAA Library Repository #**
Bembe S, Zmora N, Williams E, Place AR, Liang D, **Chung JS**. 2018. Effects of temperature and photoperiod on hemolymph vitellogenin levels during spawning events of the blue crab, *Callinectes sapidus*, in captivity. Aquaculture Research. 49(6):2201-2209. https://doi.org/10.1111/are.13676	Leveraged		10.1111/are.13676		
Bond ME, Valentin-Albanese J, **Babcock EA**, Hussey NE, Heithaus MR, Chapman DD. 2018. The trophic ecology of caribbean reef sharks (*Carcharhinus perezi*) relative to other large teleost predators on an isolated coral atoll. Marine Biology. 165(4). https://doi.org/10.1007/s00227-018-3322-2	Leveraged		10.1007/s00227-018-3322-2		
Cardenosa D, Fields AT, **Babcock EA**, Zhang HR, Feldheim K, Shea SKH, Fischer GA, Chapman DD. 2018. CITES-listed sharks remain among the top species in the contemporary fin trade. Conservation Letters. 11(4). https://doi.org/10.1111/conl.12457	Leveraged		10.1111/conl.12457		
Chintapenta LK, Coyne KJ, Pappas* A, Lee K, Dixon C, Kalavacharla V, **Ozbay G**. 2018. Diversity of diatom communities in Delaware tidal wetland and their relationship to water quality. Frontiers in Environmental Science. 6. https://doi.org/10.3389/fenvs.2018.00057	Direct	Cohort 1 student	10.3389/fenvs.2018.00057	no	23805
Flowers EM, Johnson AF, Aguilar R, **Schott EJ**. 2018. Prevalence of the pathogenic crustacean virus *Callinectes sapidus* reovirus 1 near flow-through blue crab aquaculture in Chesapeake Bay, USA. Diseases of Aquatic Organisms. 129(2):135-144. https://doi.org/10.3354/dao03232	Leveraged		10.3354/dao03232		

Gruss A, Drexler MD, Ainsworth CH, Roberts JJ, Carmichael RH, Putman NF, Richards PM, Chancellor E, **Babcock EA**, Love MS. 2018b. Improving the spatial allocation of marine mammal and sea turtle biomasses in spatially explicit ecosystem models. Marine Ecology Progress Series. 602:255-274. https://doi.org/10.3354/meps12640	Leveraged		10.3354/meps12640,-Improving		
Gruss A, Perryman HA, **Babcock EA**, Sagarese SR, Thorson JT, Ainsworth CH, Anderson EJ, Brennan K, Campbell MD, Christman MC et al. 2018c. Monitoring programs of the US Gulf of Mexico: Inventory, development and use of a large monitoring database to map fish and invertebrate spatial distributions. Reviews in Fish Biology and Fisheries. 28(4):667-691. https://doi.org/10.1007/s11160-018-9525-2	Leveraged		10.1007/s11160-018-9525-2		
Hurst TP, **Miller JA**, Ferm N, Heintz RA, Farley EV. 2018. Spatial variation in potential and realized growth of juvenile pacific cod in the southeastern Bering Sea. Marine Ecology Progress Series. 590:171-185. https://doi.org/10.3354/meps12494	Leveraged		10.3354/meps12494		
Lewis NI, Wolny JL, Achenbach JC, Ellis L, **Pitula JS**, Rafuse C, Rosales* DS, McCarron P. 2018. Identification, growth and toxicity assessment of *Coolia meunier* (Dinophyceae) from nova scotia, canada. Harmful Algae. 75:45-56. https://doi.org/10.1016/j.hal.2018.04.001	Direct	Cohort 1 student	10.1016/j.hal.2018.04.001	no	
Mayor ED, **Chigbu P**. 2018. Mysid shrimp dynamics in relation to abiotic and biotic factors in the coastal lagoons of Maryland, mid-west Atlantic, USA. Marine Biology Research. 14(6):621-636. https://doi.org/10.1080/17451000.2018.1472384	Direct	LMRCSC Center Director	10.1080/17451000.2018.1472384	yes	
Miller JA, Carlton JT, Chapman JW, Geller JB, Ruiz GM. 2018a. Transoceanic dispersal of the mussel *Mytilus galloprovincialis* on Japanese tsunami marine debris: An approach for evaluating rafting of a coastal species at sea. Marine Pollution Bulletin. 132:60-69. https://doi.org/10.1016/j.marpolbul.2017.10.040	Leveraged		10.1016/j.marpolbul.2017.10.040		

Miller JA, Gillman R, Carlton JT, Murray CC, Nelson JC, Otani M, Ruiz GM. 2018b. Trait-based characterization of species transported on Japanese tsunami marine debris: Effect of prior invasion history on trait distribution. Marine Pollution Bulletin. 132:90-101. https://doi.org/10.1016/j.marpolbul.2017.12.064	Leveraged		10.1016/j.marpolbul.2017.12.064		
Morales-Nunez AG, **Chigbu P**. 2018. First record of *Ianiropsis cf. serricaudis* in Maryland Coastal Bays, USA (Crustacea, Peracarida, Janiridae). Zookeys. (747):115-139. https://doi.org/10.3897/zookeys.747.22754	Direct	LMRCSC Center Director	10.3897/zookeys.747.22754	yes	24306
Ogburn MB, Bangley CW, Aguilar R, Fisher RA, **Curran MC**, Webb SF, Hines AH. 2018. Migratory connectivity and philopatry of cownose rays *Rhinoptera bonasus* along the Atlantic Coast, USA. Marine Ecology Progress Series. 602:197-211. https://doi.org/10.3354/meps12686	Leveraged		10.3354/meps12686		
Oseji OF, **Chigbu P**, Oghenekaro E, Waguespack Y, Chen NH. 2018. Spatiotemporal patterns of phytoplankton composition and abundance in the Maryland Coastal Bays: The influence of freshwater discharge and anthropogenic activities. Estuarine Coastal and Shelf Science. 207:119-131. https://doi.org/10.1016/j.ecss.2018.04.004	Direct	LMRCSC Center Director	10.1016/j.ecss.2018.04.004	no	
Roy S, **Jagus R**, Morse D. 2018. Translation and translational control in dinoflagellates. Microorganisms. 6(2). https://doi.org/10.3390/microorganisms6020030	Leveraged		10.3390/microorganisms6020030		

September 1, 2018- February 28, 2019

During the period September 1, 2018 - February 28, 2019, LMRCSC scientists produced eight peer-reviewed publications. Of the total, three were the result of direct funding and five were the result of leveraged funds. Two cohort students were included among the authors. The complete list of these publications is available in

Table 38.

Table 38. Publications produced September 1, 2018 - February 28, 2019. LMRCSC scientist names are in bold; student authors are marked with an asterisk (*).

Citation	Funding	Description of support	DOI	Acknowledged LMRCSC	NOAA Library Repository #
Babcock EA, Tewfik A, Burns-Perez V. 2018. Fish community and single-species indicators provide evidence of unsustainable practices in a multi-gear reef fishery. Fisheries Research. 208:70-85. https://doi.org/10.1016/j.fishres.2018.07.003	Leveraged		10.1016/j.fishres.2018.07.003		
Forrestal FC, Schirripa M, Goodyear CP, Arrizabalaga H, **Babcock EA**, Coelho R, Ingram W, Lauretta M, Ortiz M, Sharma R et al. 2019. Testing robustness of CPUEe standardization and inclusion of environmental variables with simulated longline catch datasets. Fisheries Research. 210:1-13. https://doi.org/10.1016/j.fishres.2018.09.025	Leveraged		10.1016/j.fishres.2018.09.025		
Gruss A, Drexler MD, Chancellor E, Ainsworth CH, Gleason JS, Tirpak JM, Love MS, **Babcock EA**. 2019a. Representing species distributions in spatially-explicit ecosystem models from presence-only data. Fisheries Research. 210:89-105. https://doi.org/10.1016/j.fishres.2018.10.011	Leveraged		10.1016/j.fishres.2018.10.011		
Morales-Nunez AG, Chigbu P. 2019. Abundance, distribution, and species composition of amphipods associated with macroalgae from shallow waters of the Maryland Coastal Bays, USA. Marine Biodiversity. 49(1):175-191. https://doi.org/10.1007/s12526-017-0779-z	Direct	LMRCSC Center Director	10.1007/s12526-017-0779-z	yes	
Ramirez* MD, **Miller JA**, Parks E, Avens L, Goshe LR, Seminoff JA, Snover ML,	Direct	Cohort 2 student	10.3354/meps12796	yes	

Heppell SS. 2019. Reconstructing sea turtle ontogenetic habitat shifts through trace element analysis of bone tissue. Marine Ecology Progress Series. 608:247-262. https://doi.org/10.3354/meps12796					
Schweitzer* CC, Lipcius RN, **Stevens BG.** 2018. Impacts of a multi-trap line on benthic habitat containing emergent epifauna within the Mid-Atlantic Bight. ICES Journal of Marine Science. 75(6):2202-2212. https://doi.org/10.1093/icesjms/fsy109	Direct	Cohort 2 student	10.1093/icesjms/fsy109	yes	https://repository.library.noaa.gov/view/noaa/28290
Stevens BG. 2018. The Ship, the Saint, and the Sailor: The long search for the legendary kad'yak. United States: West Margin Press.	Leveraged		No DOI		
Walters TL, Lamboley LM, Lopez-Figueroa NB, Rodriguez-Santiago AE, **Gibson DM**, Frischer ME. 2019b. Diet and trophic interactions of a circumglobally significant gelatinous marine zooplankter, *Dolioletta gegenbauri* (Uljanin, 1884). Molecular Ecology. 28(2):176-189. https://doi.org/10.1111/mec.14926	Leveraged		10.1111/mec.14926		

March 1, 2019- August 31, 2019

During the March 1 - August 31, 2019, LMRCSC scientists produced 13 peer-reviewed publications. Of the total, four were the result of direct funding and nine were the result of leveraged funds. One cohort student was included among the authors. The complete list of these publications is available in Table 39.

Table 39. Publications produced March 1 - August 31, 2019. LMRCSC scientist names are in bold; student authors are marked with an asterisk (*).

Citation	Funding	Description of support	DOI	Acknowledged LMRCSC	NOAA Library Repository #
Brill RW, **Horodysky AZ**, Place AR, Larkin MEM, Reimschuessel R. 2019. Effects of dietary taurine level on visual function in European sea bass (*Dicentrarchus labrax*). Plos One. 14(6). https://doi.org/10.1371/journal.pone.0214347	Direct	Center Supported Scientist	10.1371/journal.pone.0214347	no	https://repository.library.noaa.gov/view/noaa/24449

Chung JS, Huang XS, Bachvaroff TR, Lawrence* A, **Pitula JS, Jagus R**. 2019. Reovirus infection changes transcript levels of eukaryotic translation initiation factor 4e (eif4e) family members and eif4e-binding protein (4e-bp) in the blue crab *Callinectes sapidus*. Journal of Shellfish Research. 38(1):23-34. https://doi.org/10.2983/035.038.0102	Direct	Cohort 2 student	10.2983/035.038.0102	yes	
Cruz-Marrero* W, **Cullen DW**, Gay NR, **Stevens BG.** 2019. Characterizing the benthic community in Maryland's offshore wind energy areas using a towed camera sled: Developing a method to reduce the effort of image analysis and community description. Plos One. 14(5). https://doi.org/10.1371/journal.pone.0215966	Direct	Cohort 2 Student	10.1371/journal.pone.0215966	no	https://repository.library.noaa.gov/view/noaa/24455
Curran MC, Wilber DH. 2019. Seasonal and interannual variability in flatfish assemblages in a Southeastern USA estuary. Estuaries and Coasts. 42(5):1374-1386. https://doi.org/10.1007/s12237-019-00561-x	Leveraged		10.1007/s12237-019-00561-x		
Fucich D, Marsan D, Sosa A, **Chen F**. 2019. Complete genome sequence of subcluster 5.2 *Synechococcus* sp. strain cb0101, isolated from the Chesapeake Bay. Microbiology Resource Announcements. 8(35). https://doi.org/10.1128/MRA.00484-19	Leveraged		10.1128/MRA.00484-19		
Gonsior M, Powers LC, Williams E, Place A, **Chen F**, Ruf A, Hertkorn N, Schmitt-Kopplin P. 2019. The chemodiversity of algal dissolved organic matter from lysed *Microcystis aeruginosa* cells and its ability to form disinfection by-products during chlorination. Water Research. 155:300-309. https://doi.org/10.1016/j.watres.2019.02.030	Leveraged		10.1016/j.watres.2019.02.030		
Gruss A, Walter JF, **Babcock EA**, Forrestal FC, Thorson JT, Lauretta MV, Schirripa MJ. 2019b. Evaluation of the impacts of different treatments of spatio-temporal variation in catch-per-unit-effort standardization models. Fisheries Research. 213:75-93. https://doi.org/10.1016/j.fishres.2019.01.008	Leveraged		10.1016/j.fishres.2019.01.008		
Matta ME, **Miller JA**, Short JA, Heiser TE, Hurst TP, Rand KM, Ormseth OA. 2019. Spatial and temporal variation in otolith elemental signatures of age-0 pacific cod (*Gadus macrocephalus*) in the Gulf of Alaska. Deep-Sea Research Part Ii-Topical Studies in Oceanography. 165:268-279. https://doi.org/10.1016/j.dsr2.2017.08.015	Leveraged		10.1016/j.dsr2.2017.08.015		

Schweitzer* CC, **Stevens BG**. 2019. The relationship between fish abundance and benthic community structure on artificial reefs in the Mid-Atlantic Bight, and the importance of sea whip corals *Leptogorgia virgulata*. PeerJ. 7. https://doi.org/10.7717/peerj.7277	Direct	Cohort 2 student	10.7717/peerj.7277	yes	https://repository.library.noaa.gov/view/noaa/23232
Spitznagel MI, Small HJ, Lively JA, Shields JD, **Schott EJ**. 2019. Investigating risk factors for mortality and reovirus infection in aquaculture production of soft-shell blue crabs (*Callinectes sapidus)*. Aquaculture. 502:289-295. https://doi.org/10.1016/j.aquaculture.2018.12.051	Leveraged		10.1016/j.aquaculture.2018.12.051		
Tizabi D, Sosa A, Bachvaroff T, **Hill RT**. 2019. Draft genome sequences of three sponge-associated Actinomycetes exhibiting antimycobacterial activity. Microbiology Resource Announcements. 8(34). https://doi.org/10.1128/MRA.00858-19	Leveraged		10.1128/MRA.00858-19		
Walters TL, **Gibson DM**, Frischer ME. 2019a. Cultivation of the marine pelagic tunicate *Dolioletta gegenbauri* (Uljanin 1884) for experimental studies. Jove-Journal of Visualized Experiments. (150). https://doi.org/10.3791/59832	Leveraged		10.3791/59832		
Zan JD, Li ZY, Tianero MD, Davis J, **Hill RT**, Donia MS. 2019. A microbial factory for defensive kahalalides in a tripartite marine symbiosis. Science. 364(6445):1056-+. https://doi.org/10.1126/science.aaw6732	Leveraged		10.1126/science.aaw6732		

September 1, 2019- February 29, 2020

During the September 1, 2019 - February 28, 2020, LMRCSC scientists produced thirteen (13) peer reviewed publications. Of the total, two were the result of direct funding and eleven were the result of leveraged funds. One cohort student was included among the authors. The complete list of these publications is available in Table 40.

Table 40. Publications produced September 1, 2019-February 28, 2020. LMRCSC scientist names are in bold; student authors are marked with an asterisk (*).

Citation	Funding	Description of support	DOI	Acknowledged LMRCSC	NOAA Library Repository #
Bonin CA, van Wijnen AJ, **Lewallen EA**. 2019. MicroRNA applications in marine biology. Current Molecular Biology Reports. 5(4):167-175. https://doi.org/10.1007/s40610-019-00124-w	Leveraged		10.1007/s40610-019-00124-w		
Curran MC, Richlen ML. 2019. Harmful algal blooms (habs): Track them like a scientist. Science activities. 56(3):77-87. https://doi.org/10.1080/00368121.2019.1691968	Leveraged		10.1080/00368121.2019.1691968		
Oghenekaro EU, **Chigbu P**. 2019. Dynamics of mesozooplankton assemblage in relation to environmental factors in Maryland Coastal Bays. Water,2019, 11(10), 2133. https://doi.org/10.3390/w11102133	Direct	LMRCSC Center Director	10.3390/w11102133	yes	https://repository.library.noaa.gov/view/noaa/28289
Ou HL, Li MY, Wu SF, Jia LL, **Hill RT**, Zhao J. 2020. Characteristic microbiomes correlate with polyphosphate accumulation of marine sponges in South China Sea areas. Microorganisms. 8(1). https://doi.org/10.3390%2Fmicroorganisms8010063	Leveraged		10.3390%2Fmicroorganisms8010063		
Oseji, FO, Fan C, Chigbu P. 2019. Composition and dynamics of phytoplankton in the Coastal Bays of Maryland, USA revealed by microscopic counts and diagnostic pigment analyses. Water 2019, 11(2): 368. https://doi.org/10.3390/w11020368	Direct		10.3390/w11020368		https://repository.library.noaa.gov/view/noaa/28291

Pecher WT, Al Madadha ME, DasSarma P, Ekulona F, **Schott EJ**, Crowe K, Gut BS, DasSarma S. 2019. Effects of road salt on microbial communities: Halophiles as biomarkers of road salt pollution. Plos One. 14(9). https://doi.org/10.1371/journal.pone.0221355	Leveraged		10.1371/journal.pone.0221355		
Schlenker LS, Welch MJ, Meredith TL, Mager EM, Lari E, **Babcock EA**, Pyle GG, Munday PL, Grosell M. 2019. Damsels in distress: Oil exposure modifies behavior and olfaction in bicolor damselfish (*Stegastes partitus*). Environmental Science & Technology. 53(18):10993-11001. https://doi.org/10.1021/acs.est.9b03915	Leveraged		10.1021/acs.est.9b03915		
Sharma R, Porch CE, **Babcock EA**, Maunder MN, Punt AE. 2019. Recruitment: Theory, estimation, and application in fishery stock assessment models. Fisheries Research. 217:1-4. https://doi.org/10.1016/j.fishres.2019.03.015	Leveraged		10.1016/j.fishres.2019.03.015		
Stipek C, Santos R, **Babcock E**, Lirman D. 2020. Modelling the resilience of seagrass communities exposed to pulsed freshwater discharges: A seascape approach. Plos One. 15(2). https://doi.org/10.1371/journal.pone.0229147	Leveraged		10.1371/journal.pone.0229147		
Tewfik A, **Babcock EA**, Appeldoorn RS, Gibson J. 2019. Declining size of adults and juvenile harvest threatens sustainability of a tropical gastropod, *Lobatus gigas*, fishery. Aquatic Conservation-Marine and Freshwater Ecosystems. 29(10):1587-1607. https://doi.org/10.1002/aqc.3147	Leveraged		10.1002/aqc.3147		
Tewfik A, **Babcock EA**, Phillips M. 2020. Spiny lobster fisheries status across time and a mosaic of spatial management regimes. ICES Journal of Marine Science. 77(3):1002-1016. https://doi.org/10.1093 /icesjms/fsaa008	Leveraged		10.1093/icesjms/fsaa008		
Wenker* RP, **Stevens BG**. 2020. Sea whip coral *Leptogorgia virgulata* in the Mid-Atlantic Bight: Colony complexity, age, and growth. PeerJ. 8. https://doi.org/10.7717/peerj.8372	Direct	Cohort 1 student	10.7717/peerj.8372	yes	https://repository.library.noaa.gov/view/noaa/28288

Zhang F, Jonas L, Lin HZ, **Hill RT**. 2019. Microbially mediated nutrient cycles in marine sponges. Fems Microbiology Ecology. 95(11). https://doi.org/10.1093/femsec/fiz155	Leveraged		10.1093/femsec/fiz155		
Zheng Q, Wang Y, Lu JY, Lin WX, **Chen F**, Jiao NZ. 2020. Metagenomic and metaproteomic insights into photoautotrophic and heterotrophic interactions in a *Synechococcus* culture. Mbio. 11(1). https://doi.org/10.1128/mBio.03261-19	Leveraged		10.1128/mBio.03261-19		

March 1, 2020 - August 31, 2020

During the March 1 - August 31, 2020, LMRCSC scientists produced 21 peer-reviewed publications. Of the total, six were the result of direct funding and fifteen (15) were the result of leveraged funds. Five cohort students were included among the authors. The complete list of these publications is available in
Table 41.

Table 41. Publications produced March 1 - August 31, 2020. LMRCSC scientist names are in bold; student authors are marked with an asterisk (*).

Citation	Funding	Description of support	DOI	Acknowledged LMRCSC	NOAA Library Repository #
Arai K, Graves JE, **Secor DH**. 2020. Sub-annual cohort representation among young-of-the-year recruits of the western stock of Atlantic bluefin tuna. Fisheries Research. 225. https://doi.org/10.1016/j.fishres.2019.105476	Leveraged		10.1016/j.fishres.2019.105476		
Barcia LG, Argiro J, **Babcock EA**, Cai Y, Shea SKH, Chapman DD. 2020. Mercury and arsenic in processed fins from nine of the most traded shark species in the hong kong and china dried seafood markets: The potential health risks of shark fin soup. Marine Pollution Bulletin. 157. https://doi.org/10.1016/j.marpolbul.2020.111281	Leveraged		10.1016/j.marpolbul.2020.111281		
Cardenosa D, Fields AT, **Babcock EA**, Shea SKH, Feldheim KA, Chapman DD. 2020. Species composition of the largest shark fin retail-market in mainland China. Scientific Reports. 10(1). https://doi.org/10.1038/s41598-020-69555-1	Leveraged		10.1038/s41598-020-69555-1		

Chung JS. 2020. Role of hepatopancreas trehalose-6-phosphate synthase in carbohydrate levels of the blue crab *Callinectes sapidus* in feeding and emersion. Journal of Shellfish Research. 39(2):449-459. https://doi.org/10.2983/035.039.0226	Leveraged		10.2983/035.039.0226		
Cullen DW, Stevens BG. 2020. A brief examination of underwater video and hook-and-line gears for sampling black sea bass (*Centropristis striata*) simultaneously at 2 Mid-Atlantic sites off the Maryland coast. Journal of Northwest Atlantic Fishery Science. 51:1-13. https://doi.org/10.2960/J.v51.m725	Direct	LMRCSC Post-Doctoral Fellow	10.2960/J.v51.m725	yes	https://repository.library.noaa.gov/view/noaa/31783
Cusick KD, Polson SW, Duran G, **Hill RT**. 2020. Multiple megaplasmids confer extremely high levels of metal tolerance in *Alteromonas* strains. Applied and Environmental Microbiology. 86(3). https://doi.org/10.1128%2FAEM.01831-19	Leveraged		10.1128%2FAEM.01831-19		
Edje BO, **Ishaque AB, Chigbu P**. 2020. Spatial and temporal patterns of delta C-13 and delta N-15 of suspended particulate organic matter in Maryland Coastal Bays, USA. Water. 12(9). https://doi.org/10.3390/w12092345	Leveraged		10.3390/w12092345		
Fucich D, **Chen F**. 2020. Presence of toxin-antitoxin systems in picocyanobacteria and their ecological implications. ISME Journal. 14(11):2843-2850. https://doi.org/10.1038/s41396-020-00746-4	Leveraged		10.1038/s41396-020-00746-4		
Hasenei A, Kerstetter DW, **Horodysky AZ**, Brill RW. 2020. Physiological limits to inshore invasion of Indo-Pacific lionfish (*Pterois* spp.): Insights from the functional characteristics of their visual system and hypoxia tolerance. Biological Invasions. 22(6):2079-2097. https://doi.org/10.1007/s10530-020-02241-5	Leveraged		10.1007/s10530-020-02241-5		
Hoskins-Brown DL. 2020. Tales of landings and legacies: African Americans in Georgia's coastal fisheries. Culture Agriculture Food and Environment. 42(1):36-50. https://doi.org/10.1111/cuag.12248	Leveraged		10.1111/cuag.12248		
Kerr LA, Whitener ZT, Cadrin SX, Morse MR, **Secor DH**, Golet W. 2020. Mixed stock origin of Atlantic bluefin tuna in the US rod and reel fishery (Gulf of Maine) and implications for fisheries management. Fisheries Research. 224. https://doi.org/10.1016/j.fishres.2019.105461	Leveraged		10.1016/j.fishres.2019.105461		

Kerr LA, Whitener ZT, Cadrin SX, Morse MR, **Secor DH**, Golet W. 2020. Mixed stock origin of Atlantic bluefin tuna in the US rod and reel fishery (Gulf of Maine) and implications for fisheries management. Fisheries Research. 224. https://doi.org/10.1016/j.fishres.2019.105461	Leveraged		10.1016/j.fishres.2019.105461		
Lee BB, **Schott EJ**, Behringer DC, Bojko J, Kough A, Plough LV. 2020. Rapid genetic identification of the blue crab *Callinectes sapidus* and other *Callinectes* spp. Using restriction enzyme digestion and high resolution melt (hrm) assays. Frontiers in Marine Science. 7. https://doi.org/10.3389/fmars.2020.00633	Leveraged		10.3389/fmars.2020.00633		
Markin EL, **Secor DH**. 2020. Growth of juvenile Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) in response to dual-season spawning and latitudinal thermal regimes. Fishery Bulletin. 118(1):74-86. https://doi.org/10.7755/FB.118.1.7	Leveraged		10.7755/FB.118.1.7		
Martinez-Rivera* S, Long WC, **Stevens BG**. 2020. Physiological and behavioral sexual maturity of female red deep-sea crabs *Chaceon quinquedens* (Smith, 1879) (Decapoda: Brachyura: Geryonidae) in the Mid-Atlantic Bight. Journal of Crustacean Biology. 40(3):330-340. https://doi.org/10.1093/jcbiol/ruaa007	Direct	Cohort 2 student	10.1093/jcbiol/ruaa007	yes	28503
Martinez-Rivera* S, **Stevens BG**. 2020. Embryonic development and fecundity of the red deep-sea crab *Chaceon quinquedens* (Smith, 1879) (decapoda: Brachyura: Geryonidae) in the Mid-Atlantic Bight determined by image analysis. Journal of Crustacean Biology. 40(3):230-236. https://doi.org/10.1093/jcbiol/ruaa017	Direct	Cohort 2 student	10.1093/jcbiol/ruaa017	yes	
Miller JA, Hurst TP. 2020. Growth rate, ration, and temperature effects on otolith elemental incorporation. Frontiers in Marine Science. 7. https://doi.org/10.3389/fmars.2020.00320	Leveraged		10.3389/fmars.2020.00320		
Schweitzer* CC, **Horodysky AZ,** Price* AL**, Stevens BG**. 2020. Impairment indicators for predicting delayed mortality in black sea bass (*Centropristis striata*) discards within the commercial trap fishery. Conservation Physiology. 8. https://doi.org/10.1093/conphys/coaa068	Direct	Cohort 2 Sstudent	10.1093/conphys/coaa068	yes	https://repository.library.noaa.gov/view/noaa/31784
Secor DH, O'Brien MHP, Gahagan BI, Watterson JC, Fox DA. 2020. Differential migration in Chesapeake Bay striped bass. Plos One. 15(5).	Leveraged		10.1371/journal.pone.0233103		

https://doi.org/10.1371/journal.pone.0233103					
Stevens BG. 2020. The ups and downs of traps: Environmental impacts, entanglement, mitigation, and the future of trap fishing for crustaceans and fish. ICES Journal of Marine Science. https://doi.org/10.1093/icesjms/fsaa135	Direct	LMRCSC DRS	10.1093/icesjms/fsaa135	yes	https://repository.library.noaa.gov/view/noaa/31785
Thalmann* HL, Daly EA, Brodeur RD. 2020. Two anomalously warm years in the Northern California Current: Impacts on early marine steelhead diet composition, morphology, and potential survival. Transactions of the American Fisheries Society. 149(4):369-382. https://doi.org/10.1002/tafs.10244	Direct	Cohort 1 student	10.1002/tafs.10244	no	

September 1, 2020 - February 28, 2021

During the September 1, 2020 - February 28, 2021, LMRCSC scientists produced 30 peer reviewed publications. Of the total, seven were the result of direct funding and 23 were the result of leveraged funds. Six cohort students were included among the authors. The complete list of these publications is available in
Table 42.

Table 42. Publications produced September 1, 2020 - February 28, 2021. LMRCSC scientist names are in bold; student authors are marked with an asterisk (*).

Citation	Funding	Description of support	DOI	Acknowledged LMRCSC	NOAA Library Repository #
Aquino GAG, Cabaitan PC, **Secor DH**. 2021. Locomotor activity and growth response of glass eel *Anguilla marmorata* exposed to different salinity levels. Fisheries Science. 87(2):253-262. https://doi.org/10.1007/s12562-021-01493-x	Leveraged		10.1007/s12562-021-01493-x		
Bangley CW, Curtis TH, **Secor DH**, Latour RJ, Ogburn MB. 2020. Identifying important juvenile dusky shark habitat in the northwest Atlantic Ocean using acoustic telemetry and spatial modeling. Marine and Coastal Fisheries. 12(5):348-363. https://doi.org/10.1002/mcf2.10120	Leveraged		10.1002/mcf2.10120		

Cartolano MC, **Babcock EA**, McDonald MD. 2020. Evidence that gulf toadfish use pulsatile urea excretion to communicate social status. Physiology & Behavior. 227. https://doi.org/10.1016/j.physbeh.2020.113182	Leveraged		10.1016/j.physbeh.2020.113182		
Chung JS, Christie A, Flynn E. 2020. Molecular cloning of crustacean hyperglycemic hormone (chh) family members (chh, molt-inhibiting hormone and mandibular organ-inhibiting hormone) and their expression levels in the Jonah crab, *Cancer borealis*. General and Comparative Endocrinology. 295. https://doi.org/10.1016/j.ygcen.2020.113522	Leveraged		10.1016/j.ygcen.2020.113522		
Cruz-Marrero* W, Harms-Tuohy CA, Appeldoorn RS, **Stevens BG**. 2020. Comparison of video camera sled with diver surveys for queen conch *Lobatus gigas* density estimates in the west coast of Puerto Rico. Bulletin of Marine Science. 96(4):641-654. https://doi.org/10.5343/bms.2019.0087	Direct	Cohort 2 student	10.5343/bms.2019.0087	no	https://repository.library.noaa.gov/view/noaa/48762
Cullen DW, Guida V. 2021. Use of geographically weighted regression to investigate spatial non-stationary environmental effects on the distributions of black sea bass (*Centropristis striata*) and scup (*Stenotomus chrysops*) in the Mid-Atlantic Bight, USA. Fisheries Research. 234. https://doi.org/10.1016/j.fishres.2020.105795	Direct	LMRCSC Post-Doctoral Fellow	10.1016/j.fishres.2020.105795	yes	
Curran MC, Robertson A. 2020. Chemistry made easy: Teaching students about the link between marine chemistry and coral reef biodiversity. Current: The Journal of Marine Education. p. 1-11. https://doi.org/10.5334/cjme.39	Leveraged		10.5334/cjme.39		
Curran MC, Wiggins JJ, Wilber DH. 2020. Flatfish habitat use of a small Southeastern US tidal creek: Long- and short-term occupancy patterns. Estuaries and Coasts.	Leveraged		10.1007/s12237-021-00903-8		

https://doi.org/10.1007/s12237-021-00903-8					
Edje BO, **Chigbu P**. 2021. Carbon and nitrogen stable isotopes of copepods in a tidal estuarine system in Maryland, USA. Regional Studies in Marine Science. 42:101620. https://doi.org/10.1016/j.rsma.2021.101620	Leveraged		10.1016/j.rsma.2021.101620		
Enchelmaier AC, **Babcock EA**, Hammerschlag N. 2020. Survey of fishes within a restored mangrove habitat of a subtropical bay. Estuarine Coastal and Shelf Science. 244. https://doi.org/10.1016/j.ecss.2018.11.009	Leveraged		10.1016/j.ecss.2018.11.009		
Fandel AD, Garrod A, Hoover AL, Wingfield JE, Lyubchich V, **Secor DH**, Hodge KB, Rice AN, Bailey H. 2020. Effects of intense storm events on dolphin occurrence and foraging behavior. Scientific Reports. 10(1). https://doi.org/10.1038/s41598-020-76077-3	Leveraged		10.1038/s41598-020-76077-3		
Fucich D, Xu Y, Sosa A, Jia Y, Zhang R, Jiao N, **Chen F**. 2021. Complete genome sequences of Chesapeake Bay *Synechococcus* strains cbw1002 and cbw1006 isolated in winter. Genome Biology and Evolution. 13(2). https://doi.org/10.1093/gbe/evab009	Leveraged		10.1093/gbe/evab009		
Huang X, Green* S, **Chung JS**. 2021. The presence of an insulin-like peptide-binding protein (ilpbp) in the ovary and its involvement in the ovarian development of the red deep-sea crab, *Chaceon quinquedens*. General and Comparative Endocrinology. 301. https://doi.org/10.1016/j.ygcen.2020.113653	Direct	Cohort 1 student	10.1016/j.ygcen.2020.113653	yes	https://repository.library.noaa.gov/view/noaa/31780
Hutchison ZL, **Secor DH**, Gill AB. 2020. The interaction between resource species an electromagnetic fields associated with electricity production by offshore wind farms. Oceanography. 33(4):96-107. https://doi.org/10.5670/oceanog.2020.409	Leveraged		10.5670/oceanog.2020.409		

Itakura H, O'Brien MHP, **Secor D.** 2021. Tracking oxy-thermal habitat compression encountered by Chesapeake Bay striped bass through acoustic telemetry. ICES Journal of Marine Science. https://doi.org/10.1093/icesjms/fsab009	Leveraged		10.1093/icesjms/fsab009		
Jung H, Ventura T, **Chung JS**, Kim WJ, Nam BH, Kong HJ, Kim YO, Jeon MS, Eyun SI. 2020. Twelve quick steps for genome assembly and annotation in the classroom. Plos Computational Biology. 16(11). https://doi.org/10.1371/journal.pcbi.1008325	Leveraged		10.1371/journal.pcbi.1008325		
Lycett KA, Shields JD, **Chung JS, Pitula JS**. 2020. Population structure of the blue crab *Callinectes sapidus* in the Maryland Coastal Bays. Journal of Shellfish Research. 39(3):699-713. https://doi.org/10.2983/035.039.0316	Leveraged		10.2983/035.039.0316		
O'Brien MHP, **Secor DH**. 2021. Influence of thermal stratification and storms on acoustic telemetry detection efficiency: A year-long test in the us southern mid-atlantic bight. Animal Biotelemetry. 9(1):8. https://doi.org/10.1186/s40317-021-00233-3	Leveraged		10.1186/s40317-021-00233-3		
Olsen NA, **Stevens BG**. 2020. Size at maturity, shell conditions, and morphometric relationships of male and female Jonah crabs in the Middle Atlantic Bight. North American Journal of Fisheries Management. 40(6):1472-1485. https://doi.org/10.1002/nafm.10509	Direct	LMRCSC DRS	10.1002/nafm.10509	yes	
Parveen S, Jacobs J, **Ozbay G**, Chintapenta LK, Almuhaideb E, Meredith J, Ossai S, Abbott A, Grant A, Brohawn K et al. 2020. Seasonal and geographical differences in total and pathogenic *Vibrio parahaemolyticus* and *Vibrio vulnificus* levels in seawater and oysters from the Delaware and Chesapeake Bays determined using several methods. Applied and Environmental Microbiology. 86(23). https://doi.org/10.1128/aem.01581-20	Leveraged		10.1128/aem.01581-20		

Ramirez* MD, Popovska T, **Babcock EA**. 2021. Global synthesis of sea turtle von Bertalanffy growth parameters through Bayesian hierarchical modeling. Marine Ecology Progress Series. 657:191-207. https://doi.org/10.3354/meps13544	Direct	Cohort 2 student	10.3354/meps13544	yes	https://repository.library.noaa.gov/view/noaa/48764
Schweitzer* CC, **Horodysky AZ,** Price* AL, **Stevens BG**. 2020. Impairment indicators for predicting delayed mortality in black sea bass (*Centropristis striata*) discards within the commercial trap fishery. Conservation Physiology. 8. https://doi.org/10.1093/conphys/coaa068	Direct	Cohort 2 students	10.1093/conphys/coaa068	yes	31784
Secor DH, O'Brien MHP, Gahagan BI, Fox DA, Higgs AL, Best JE. 2020. Multiple spawning run contingents and population consequences in migratory striped bass *Morone saxatilis*. Plos One. 15(11). https://doi.org/10.1371/journal.pone.0242797	Leveraged		10.1371/journal.pone.0242797		
Vinagre AS, Model JFA, Vogt EL, Manara LM, Trapp M, Da Silva RSM, **Chung JS**. 2020. Diet composition and long-term starvation do not affect crustacean hyperglycemic hormone (chh) transcription in the burrowing crab *Neohelice granulata* (Dana, 1851). Comparative Biochemistry and Physiology a-Molecular & Integrative Physiology. 247. https://doi.org/10.1016/j.cbpa.2020.110738	Leveraged		10.1016/j.cbpa.2020.110738		
Wang HL, Bier R, Zgleszewski L, Peipoch M, Omondi E, Mukherjee A, **Chen F**, Zhang CL, Kan JJ. 2020. Distinct distribution of archaea from soil to freshwater to estuary: Implications of archaeal composition and function in different environments. Frontiers in Microbiology. 11. https://doi.org/10.3389/fmicb.2020.576661	Leveraged		10.3389/fmicb.2020.576661		

Wiernicki CJ, Liang D, Bailey H, **Secor DH**. 2020a. The effect of swim bladder presence and morphology on sound frequency detection for fishes. Reviews in Fisheries Science & Aquaculture. 28(4):459-477. https://doi.org/10.1080/23308249.2020.1762536	Leveraged		10.1080/23308249.2020.1762536		
Wiernicki CJ, O'Brien MHP, Zhang F, Lyubchich V, Li M, **Secor DH**. 2020b. The recurring impact of storm disturbance on black sea bass (*Centropristis striata*) movement behaviors in the Mid-Atlantic Bight. Plos One. 15(12). https://doi.org/10.1371/journal.pone.0239919	Leveraged		10.1371/journal.pone.0239919		
Wilson MN, Laufer AE, Howard EM, Wong-Ala* J. 2021. Lessons from the trenches: Students' perspectives of their own marine transdisciplinary education. Frontiers in Marine Science. 7. https://doi.org/10.3389/fmars.2020.592368	Direct	Cohort 5 student	10.3389/fmars.2020.592368	no	
Zhang ZF, Qin F, **Chen F**, Chu X, Luo HW, Zhang R, Du S, Tian Z, Zhao YL. 2021. Culturing novel and abundant pelagiphages in the ocean. Environmental Microbiology. 23(2):1145-1161. https://doi.org/10.1111/1462-2920.15272	Leveraged		10.1111/1462-2920.15272		
Zhao M, Flowers EM, **Schott EJ**. 2021. Near-complete sequence of a highly divergent reovirus genome recovered from *Callinectes sapidus*. Microbiology Resource Announcements. 10(1):e01278-01220. https://doi.org/10.1128/mra.01278-20	Leveraged		10.1128/mra.01278-20		

March 1, 2021 - August 31, 2021

During the March 1 - August 31, 2021, LMRCSC scientists produced 18 peer-reviewed publications. Of the total, five were the result of direct funding and thirteen (13) were the result of leveraged funds. Four cohort students were included among the authors. The complete list of these publications is available in

Table 43.

Table 43. Publications produced March 1-August 31, 2021. LMRCSC scientist names are in bold; student authors are marked with an asterisk (*).

Citation	Funding	Description of support	DOI	Acknowledged LMRCSC	NOAA Library Repository #
Allison N, Cole C, **Hintz C**, Hintz K, Rae J, Finch A. 2021. Resolving the interactions of ocean acidification and temperature on coral calcification media pH. Coral Reefs. https://doi.org/10.1007/s00338-021-02170-2	Leveraged		10.1007/s00338-021-02170-2		
Blaisdell J, Thalmann* HL, Klajbor W, Zhang Y, **Miller JA**, Laurel BJ, Kavanaugh MT. 2021. A dynamic stress-scape framework to evaluate potential effects of multiple environmental stressors on Gulf of Alaska juvenile pacific cod. Frontiers in Marine Science. 8. https://doi.org/10.3389/fmars.2021.656088	Direct	Cohort 1 student	10.3389/fmars.2021.656088	no	
Bonin CA. 2021. Genetic consequences of dispersal, philopatry and reproductive behaviors. In: Campagna C, Harcourt R, editors. Ethology and behavioral ecology of Otariids and the Odobenid. Cham: Springer International Publishing. p. 223-241.	Leveraged		10.1007/978-3-030-59184-7_11		
Clementi GM, **Babcock EA**, Valentin-Albanese J, Bond ME, Flowers KI, Heithaus MR, Whitman ER, Bergmann MPMVZ, Guttridge TL, O'Shea OR et al. 2021. Anthropogenic pressures on reef-associated sharks in jurisdictions with and without directed shark fishing. Marine Ecology Progress Series. 661:175-186. https://doi.org/10.3354/meps13607	Leveraged		10.3354/meps13607		
Curran MC, Ramsey AL, Bower AS. 2021. Learning about ocean currents one track at a time. Science Activities-Projects and Curriculum	Leveraged		10.1080/00368121.2021.1885333		

Ideas in Stem Classrooms. 58(1):13-22. https://doi.org/10.1080/00368121.2021.1885333					
Da Silva LV, Ossai S, **Chigbu P, Parveen S**. 2021. Antimicrobial and genetic profiles of *Vibrio vulnificus* and *Vibrio parahaemolyticus* isolated from the Maryland Coastal Bays, United States. Frontiers in Microbiology. 12. https://doi.org/10.3389/fmicb.2021.676249	Leveraged		10.3389/fmicb.2021.676249		
Elmer LK, Madliger CL, Blumstein DT, Elvidge CK, Fernandez-Juricic E, **Horodysky AZ**, Johnson NS, McGuire LP, Swaisgood RR, Cooke SJ. 2021. Exploiting common senses: Sensory ecology meets wildlife conservation and management. Conservation Physiology. 9. https://doi.org/10.1093/conphys/coab002	Leveraged		10.1093/conphys/coab002		
Frischer ME, Lamboley LM, Walters TL, Brandes JA, Arneson E, Lacy LE, Lopez-Figueroa NB, Rodriguez-Santiago AE, **Gibson DM**. 2021. Selective feeding and linkages to the microbial food web by the doliolid *Dolioletta gegenbauri*. Limnology and Oceanography. 66(5):1993-2010. https://doi.org/10.1002/lno.11740	Direct	LMRCSC Program Director at HU	10.1002/lno.11740	yes	https://repository.library.noaa.gov/view/noaa/48763
Griffin* EK, Rosel PE, Balmer BC, Perrtree RM, **Cox TM**. 2021. Using photo-identification and genetic data to examine fine-scale population structure of common bottlenose dolphins (*Tursiops truncatus*) in the estuarine waters surrounding Savannah, Georgia. Aquatic Mammals. 47(3):245-256. https://doi.org/10.1578/AM.47.3.2021.245	Direct	Cohort 1 student	10.1578/am.47.3.2021.245	yes	
Jesse JA, Agnew MV, Arai K, Armstrong CT, Hood SM, Kachmar ML, Long JT, McCarty AJ, Ross MO, Rubalcava* KD et al. 2021. Effects of infectious diseases on population dynamics of marine organisms in Chesapeake Bay. Estuaries and Coasts.	Direct	Cohort 3 student	10.1007/s12237-021-00915-4	no	

https://doi.org/10.1007/s12237-021-00915-4					
Lawrence* A, **Stevens BG**, Shank B, **Chung JS**. 2021. Morphometric and physiological maturity of male Jonah crab, *Cancer borealis* Stimpson, 1859 (Decapoda: Brachyura: Cancridae), in southern New England, USA. Journal of Crustacean Biology. 41(3). https://doi.org/10.1093/jcbiol/ruab030	Direct	Cohort 2 student	10.1093/jcbiol/ruab030	yes	
Morales-Nunez AG, **Chigbu P**. 2021. *Carinacuma umesi*, a new genus and species of bodotriid cumacean (Crustacea: Malacostraca: Peracarida) from shallow waters of the Maryland Coastal Bays, Mid-Atlantic region, USA. Peerj. 9. https://doi.org/10.7717/peerj.11740	Leveraged		10.7717/peerj.11740		
Omori KL, Tribuzio CA, **Babcock EA**, Hoenig JM. 2021. Methods for identifying species complexes using a novel suite of multivariate approaches and multiple data sources: A case study with Gulf of Alaska rockfish. Frontiers in Marine Science. 8. https://doi.org/10.3389/fmars.2021.663375	Leveraged		10.3389/fmars.2021.663375		
Redding SG, Cooper LW, Castonguay M, Wiernicki C, **Secor DH**. 2020. Northwest Atlantic mackerel population structure evaluated using otolith delta -O18 composition. ICES Journal of Marine Science. 77(7-8):2582-2589. https://doi.org/10.1093/icesjms/fsaa117	Leveraged		10.1093/icesjms/fsaa117		
Secor DH, O'Brien MHP, Coleman* N, Horne A, Park I, Kazyak DC, Bruce DG, Stence C. 2021. Atlantic sturgeon status and movement ecology in an extremely small spawning habitat: The Nanticoke River-Marshyhope Creek, Chesapeake Bay. Reviews in Fisheries Science & Aquaculture. https://doi.org/10.1080/23308249.2021.1924617	Leveraged		10.1080/23308249.2021.1924617		

Williams EP, Bachvaroff TR, Place AR. 2021. A global approach to estimating the abundance and duplication of polyketide synthase domains in dinoflagellates. Evolutionary Bioinformatics. 17. https://doi.org/10.1177/11769343211031871	Leveraged		10.1177/11769343211031871		
Ye H, Wilder MN, Dircksen H, **Chung JS**. 2021. Editorial: Recent advances in crustacean endocrinology. Frontiers in Endocrinology. 12. https://doi.org/10.3389/fendo.2021.730642	Leveraged		10.3389/fendo.2021.730642		

*September 1, 2021 - February 28, 2022 (*No Cost Extension Year*)

During the September 1, 2021 - February 28, 2022, LMRCSC scientists produced 14 peer reviewed publications. Of the total, four were the result of direct funding and ten were the result of leveraged funds. Five cohort students were included among the authors. The complete list of these publications is available in Table 44.

Table 44. Publications produced September 1, 2021 - February 28, 2022. (No Cost Extension Year). LMRCSC scientist names are in bold; student authors are marked with an asterisk (*).

Citation	Funding	Description of support	DOI	Acknowledged LMRCSC	Repository #
Bachvaroff TR, McDonald RC, Plough LV, **Chung JS**. 2021. Chromosome-level genome assembly of the blue crab, *Callinectes sapidus*. G3 Genes|Genomes|Genetics. 11(9). https://doi.org/10.1093/g3journal/jkab212	Leveraged		10.1093/g3journal/jkab212		
Chen Q, **Chen F**, Gonsior M, Li Y, Wang Y, He C, Cai R, Xu J, Wang Y, Xu D et al. 2021. Correspondence between DOM molecules and microbial community in a subtropical coastal estuary on a spatiotemporal scale. Environment International. 154:106558.	Leveraged		10.1016/j.envint.2021.106558		

https://doi.org/10.1016/j.envint.2021.106558					
Karlovic TC, Gomes RR, Paiva PC, **Babcock EA**, Dias JF. 2021. Functionality and effectiveness of marine protected areas in southeastern Brazilian waters for demersal elasmobranchs. Frontiers in Marine Science. 8. https://doi.org/10.3389/fmars.2021.694846	Leveraged		10.3389/fmars.2021.694846		
Legrand E, Bachvaroff T, Schock TB, **Chung JS**. 2021. Understanding molt control switches: Transcriptomic and expression analysis of the genes involved in ecdysteroidogenesis and cholesterol uptake pathways in the y-organ of the blue crab, *Callinectes sapidus*. PLOS ONE. 16(9):e0256735. https://doi.org/10.1371/journal.pone.0256735	Leveraged		10.1371/journal.pone.0256735		
O'Farrell* HB, **Babcock EA**. 2021. Shortfin mako hot sets - defining high bycatch conditions as a basis for bycatch mitigation. Fisheries Research. 244. https://doi.org/10.1016/j.fishres.2021.106123	Direct	Cohort 1 student	10.1016/j.fishres.2021.106123	yes	
Cole C, Finch AA, **Hintz C**, Hintz K, Yu Y, Eimf, Allison N. 2021. The kd sr/ca in cultured massive *Porites* spp. corals are reduced at low seawater pCO2. Geochimica et Cosmochimica Acta. 314:55-67. https://doi.org/10.1016/j.gca.2021.09.007	Leveraged		10.1016/j.gca.2021.09.007		
Ortega P, Vitorino HA, Green* S, Zanotto FP, **Chung JS**, Moreira RG. 2022. Experimental effects of cadmium on physiological response of *Callinectes danae* (Crustacea, Portunidae) from environments with different levels of cd contamination. Comparative Biochemistry and Physiology C-Toxicology & Pharmacology. 251. https://doi.org/10.1016/j.cbpc.2021.109210	Direct	Cohort 1 student	10.1016/j.cbpc.2021.109210	no	

Marin Jarrin J, Shanks A, **Miller JA**. 2022. The biology and ecology of sandy beach surf zones. In: Sílvia C. Gonçalves SMFF, editor. Sandy beaches as endangered ecosystems Boca Raton: CRC Press. p. 26-53. https://doi.org/10.1201/9780429053252	Leveraged		10.1201/9780429053252-2		
Krause DJ, **Bonin CA**, Goebel ME, Reiss CS, Watters GM. 2022. The rapid population collapse of a key marine predator in the northern Antarctic Peninsula endangers genetic diversity and resilience to climate change. Frontiers in Marine Science. 08. https://doi.org/10.3389/fmars.2021.796488	Leveraged		10.3389/fmars.2021.796488		
Liu CL, Dasi EA, Watson AM, Place AR, **Jagus R**. 2022. Eif2 alpha phosphorylation in response to nutritional deficiency and stressors in the aquaculture fish, *Rachycentron canadum*. Journal of Marine Science and Engineering. 10(5). https://doi.org/10.3390/jmse10050709	Leveraged		10.3390/jmse10050709		
Boyer J, Rubalcava* K, Booth S, Townsend H. 2022. Proof-of-concept model for exploring the impacts of microplastics accumulation in the Maryland Coastal Bays ecosystem. Ecological Modelling. 464. https://doi.org/10.1016/j.ecolmodel.2021.109849	Direct	Cohort 3 student	10.1016/j.ecolmodel.2021.109849	no	https://repository.library.noaa.gov/view/noaa/48765
Lin HZ, Li YT, **Hill RT**. 2022. Microalgal and bacterial auxin biosynthesis: Implications for algal biotechnology. Current Opinion in Biotechnology. 73:300-307. https://doi.org/10.1016/j.copbio.2021.09.006	Leveraged		10.1016/j.copbio.2021.09.006		
Lawrence* A, Green* S, Wang T, Bachvaroff T, **Chung JS**. 2022. Seasonal changes in the expression of insulin-like androgenic hormone (iag) in the androgenic gland of the Jonah crab, *Cancer borealis*. Plos One. 17(2).	Direct	Cohort 1 and 2 students	10.1371/journal.pone.0261206	no	https://repository.library.noaa.gov/view/noaa/48766

https://doi.org/10.1371/journal.pone.0261206					
Flowers KI, **Babcock EA**, Papastamatiou YP, Bond ME, Lamb N, Miranda A, Nunez R, Valentin-Albanese J, Clementi GM, Kelley MC et al. 2022a. Varying reef shark abundance trends inside a marine reserve: Evidence of a Caribbean reef shark decline. Marine Ecology Progress Series. 683:97-107. https://doi.org/10.3354/meps13954	Leveraged		10.3354/meps13954		

*March 1, 2022 – August 31, 2022 (*No Cost Extension Year*)

During the September 1, 2021 - February 28, 2022, LMRCSC scientists produced eight peer reviewed publications. Of the total, two were the result of direct funding and six were the result of leveraged funds. One cohort student was included among the authors. The complete list of these publications is available in

Table 45.

Table 45. Publications produced March 1-August 31, 2022 (No Cost Extension Year). LMRCSC scientist names are in bold; student authors are marked with an asterisk (*).

Citation	Funding	Description of support	DOI	Acknowledges LMRCSC	NOAA Library Repository #
Zhao ML, Xu L, Bowers H, **Schott EJ**. 2022. Characterization of two novel toti-like viruses co-infecting the atlantic blue crab, *Callinectes sapidus*, in its northern range of the United States. Frontiers in Microbiology. 13. https://doi.org/10.3389/fmicb.2022.855750	Leveraged		10.3389/fmicb.2022.855750		

Secor DH, O'Brien MHP, Coleman* N, Horne A, Park I, Kazyak DC, Bruce DG, Stence C. 2022. Atlantic sturgeon status and movement ecology in an extremely small spawning habitat: The Nanticoke River-Marshyhope Creek, Chesapeake Bay. Reviews in Fisheries Science & Aquaculture. 30(2):195-214. https://doi.org/10.1080/23308249.2021.1924617	Direct	Cohort 2 student	10.1080/23308249.2021.1924617	no	
Tavares CPD, Zhao ML, Vogt EL, Model JFA, Vinagre AS, da Silva UDT, Ostrensky A, **Schott EJ**. 2022. High prevalence of csrv2 in cultured *Callinectes danae*: Potential impacts on soft-shell crab production in Brazil. Journ. of Invertebrate Pathology. 190. https://doi.org/10.1016/j.jip.2022.107739	Leveraged		10.1016/j.jip.2022.107739		
Tewfik A, **Babcock EA**, Phillips M, Moreira-Ramirez JF, Polanco F, Marroquin J, Castillo M, Gomez NA, McNab R. 2022. Simple length-based approaches offer guidance for conservation and sustainability actions in two Central American small-scale fisheries. Aquatic Conservation-Marine and Freshwater Ecosystems. 32(8):1372-1392. https://doi.org/10.1002/aqc.3827	Leveraged		10.1002/aqc.3827		
Adebola T, Hart D, **Chigbu P**. 2022. Bathymetric trends in the body size, and diet of *Astropecten americanus* in the northwest Atlantic Ocean. Estuarine Coastal and Shelf Science. 269. https://doi.org/10.1016/j.ecss.2022.107814	Leveraged		10.1016/j.ecss.2022.107814		
Schultz EA, LaCasella EL, Lewis KA, **Hoskins-Brown DL**, Dutton PH. 2022. Genetic stock structure and differentiation of green turtle, *Chelonia mydas*, rookeries on St. Croix, US Virgin Islands. Chelonian Conservation and Biology. 21(1):106-111. https://doi.org/10.2744/CCB-1522.1	Direct	LMRCSC Program Director at SSU	10.2744/ccb-1522.1	yes	
Wang T, He K, Blaney L, **Chung JS**. 2022. 17 beta-estradiol (e2) may be involved in the mode of crustacean female sex hormone (cfsh) action in the blue crab, *Callinectes sapidus*. Frontiers in Endocrinology. 13. https://doi.org/10.3389/fendo.2022.962576	Leveraged		10.3389/fendo.2022.962576		

Tizabi D, Bachvaroff T, **Hill RT**. 2022. Comparative analysis of assembly algorithms to optimize biosynthetic gene cluster identification in novel marine actinomycete genomes. Frontiers in Marine Science. 9. https://doi.org/10.3389/fmars.2022.914197	Leveraged		10.3389/fmars.2022.914197		

Beyond August 31, 2022

Manuscript preparation is ongoing for the results of the FY16 award. Since the close of the award period, four additional manuscripts have been published. Three of these were the result of direct funding while one was the result of leveraged funds. Three cohort students were included among the authors of these publications. The list of publications that were finalized after August 31, 2022 are in Table 46.

Table 46. Publications produced after August 31, 2022. LMRCSC scientist names are in bold; student authors are marked with an asterisk (*).

Citation	Funding	Description of support	DOI/NOAA Library Repository #	Acknowledged LMRCSC	Repository #
Horodysky AZ, Schweitzer CC, Brill RW. 2022. Applied sensory physiology and behavior. Fish Physiology. Academic Press. https://doi.org/10.1016/bs.fp.2022.04.002	Leveraged		10.1016/bs.fp.2022.04.002		
King* BD. 2022. Social Identities, Intersectionality, and the Experiences of Women and Women of Color in Marine, Aquatic, and Fisheries Science Professions. Fisheries. https://doi.org/10.1002/fsh.10838	Direct	Cohort 2 Student	10.1002/fsh.10838	yes	
King* BD. 2022. Mental models reveal diverse perspectives on marine resources management across racial/ethnic and gender social identities. Conservation Science and Practice, e12827. https://doi.org/10.1111/csp2.12827	Direct	Cohort 2 Student	10.1111/csp2.12827	yes	https://repository.library.noaa.gov/view/noaa/48767

Wade* KJ, Shertzer KW, Craig JK, Williams EH. 2023. Correlations in recruitment patterns of Atlantic reef fishes off the southeastern United States based on multi-decadal estimates from stock assessments. Regional Studies in Marine Science. 57:102736. https://doi.org/10.1016/j.rsma.2022.102736	Direct	Cohort 5 Student	10.1016/j.rsma.2022.102736	yes	

VIII. Evaluation

Administrative, Education and Training, and Scientific/Research

Were the Goals And Objectives Attained?

We believe the goals and objectives of the award have been achieved. The following tables include the proposed products from the Implementation Plan and how they have been accomplished. Table 47 contains the accomplishments regarding Education and Training. Table 48 contains the accomplishments regarding Research. Table 9 contains the accomplishments regarding Administration.

Table 47. Proposed and accomplished products and outcomes from the Education goals.

	2016/17		**2017/18**		**2018/19**		**2019/20**		**2020/21**		**2021/22 (*No Cost Extension Year*)**	
Activities/Programs	Proposed	Accomplished	Proposed	Accomplished	Proposed	Accomplished	Proposed	Accomplished	Proposed	Accomplished	Proposed	Accomplished
# B.S. Students trained in NOAA related	10 (8*)	14(14*)	15(12*)	25(25*)	24 (22*)	29(29*)	26 (24*)	25(25*)	22(20*)	21(21*)	15 (12*)	14(14*)
# B.S. Students who graduate in NOAA	0 (0*)	0	1 (1*)	0	5 (4*)	4(4*)	11(9*)	9(9*)	8 (6*)	5(5*)	9 (7*)	7 (7*)
# M.S. Students who graduate in NOAA	0 (0*)	0	2 (1*)	1	5 (4*)	3(2*)	7(6*)	6(5*)	6(5*)	4(3*)	7 (6*)	7(5*)
# Ph.D. Students graduating in NOAA	0*	0	2*	0	4*	3(3*)	2*	3(3*)	1*	3(3*)	5*	2(2*)
# of internships (e.g. NERTO) at NOAA facilities	10	3	12	6	12	12	12	9	12	7	12	24
# of seminars offered via Virtual	>10	0	>10	5	>10	0	>10	7	>10	5	>10	4
# of professional development workshops	4	0	4	5	4	4	4	5	4	10	4	9

# of URM students in development activities that will lead them to attain degrees and/or employment	5*	8*	9*	14*	13*	18*	13*	18*	12*	24*	5*	16*
Amount of leveraged funds ($) for education and training	500K	$438,222	500K	$672,360	500K	$204,658	500K	$888,001	500K	$821,079	500K	$843,037
# of student presentations at conferences (average)	15	7	20	40	20	44	20	27	20	13	20	43
# of student co-authored publications	5	0	5	2	10	5	10	6	10	12	10	6

Table 48. Proposed and accomplished products and outcomes in the area of Research.

Activities	**2016/17**		**2017/18**		**2018/19**		**2019/20**		**2020/21**		**2021/22 (No Cost Extension Year)**		**Total**
	Proposed	Accomplished	Proposed	Accomplished	Proposed	Accomplished	Proposed	Accomplished	Proposed	Accomplished	Proposed	Accomplished	
1. Science Meeting date	June	4/2/17	June	6/21/18	June	6/14/19	June	4/29/20	June	4/6-4/7/21	None	n/a	
2. # of collaborative research projects (TAB Proposals) funded	6 to 10	8	6 to 10	11	6 to 10	7	6 to 10	10	6 to 10	2	None	n/a	38
3. # of new & continuing proposals funded (leveraged funding)	10	41	12	45	12	51	12	41	12	46	None	n/a	
4. # of scientific presentations at conferences	50 (15*-90)	9(7*)	50 (15*-90)	46(40*)	50 (15*-90)	53(44*)	50 (15*-90)	39(27*)	50 (15*-90)	14(13*)	None	47(43*)	
5. # of theses & dissertations produced	0	0	4	0	9	7	9	10	7	10		8	35
6. # of peer-reviewed publications	5*-30	2(0*)	5*-30	6(2*)	5*-30	7(5*)	5*-30	8(6*)	5*-30	12(12*)		6(6*)	
7. Amount of leveraged funds ($)	$3 M	$3,864,463	$3 M	$4,259,602	$3 M	$4,362,798	$3 M	$3,731,129	$3 M	$4,689,252	None	n/a	$25,537,981

8. # of NOAA scientists serving as mentors and advisors for student research each year	>20	13	>20	19	>20	17	>20	39	>20	49		39	
9. # of intra-institutional partnerships in support of NOAA's mission	Average of 4	4	Average of 4	12	Average of 4	5	Average of 4	10	Average of 4	12		14	
10. # of projects involving use of NOAA data in research and tool development	At least 3		At least 3		At least 3		At least 3		At least 3				18
12. # of times LMRCSC publications have been cited	Will be documented												1313 total, 188 from directly funded pubs, 1125 from leveraged pubs
13. # of students, faculty or staff who receive recognition for their research	Will be documented												24 Students, 3 Faculty

Table 49. Proposed and accomplished products in the area of Administration.

Activities	2016/17		2017/18		2018/19		2019/20		2020/21		2021/22 (No Cost Extension Year)		Total
	Proposed	Accomplished	Proposed	Accomplished	Proposed	Accomplished	Proposed	Accomplished	Proposed	Accomplished	Proposed	Accomplished	
Submission of monthly invoices to UMES	Monthly	Avg. time between invoices = 3.2 months	Monthly	Avg. time between invoices = 1.2 months	Monthly	Avg. time between invoices = 0.95 months	Monthly	Avg. time between invoices = 2.33 months	Monthly	Avg. time between invoices = 1.06 months	Monthly	Avg. time between invoices = 3.46 months	
Successful execution of sub-awards (< 60 days of receiving award notification from NOAA EPP)	Oct. or earlier		Oct. or earlier		Oct. or earlier		Oct. or earlier		Oct. or earlier		None proposed in No-Cost Extension	n/a	

Evaluate budget to ensure center funds are expended in accordance with budgets approved by NOAA EPP and in compliance with federal and state guidelines	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	
Holding of LMRCSC Science meetings at NOAA facilities	Summer	4/2/17	Summer	6/21/18	Summer	6/14/18	Summer	4/29/20	Summer	4/6-7/21	None proposed in No-Cost Extension	n/a	
Funding of collaborative research projects via TAB review process	Spring	Spring	Spring	Spring	Spring	Summer	Spring	Fall	Spring	Summer	None proposed in No-Cost Extension	n/a	
Submission of semi-annual reports	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	Every 6 mths	
Submission of student tracker data	Sept.	Tracker not available	Sept.	Sept.	Sept.	March, Sept.	Sept.	Sept.	Sept.	Sept.	Sept.	Sept.	
Executive Committee meetings	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Mont hly	
Updating of the LMRCSC Website	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Week ly	
Meeting of the LMRCSC Education/Outreach Committee	Once every 4 months	0	Once every 4 months	4 meetings	Once every 4 months	5 meetings	Once every 4 months	5 meetings	Once every 4 months	6 meetings	Once every 4 months	3 meeti ngs	
# of special summer programs per year to recruit and train students, particularly from URM groups in NOAA mission relevant higher education programs	3-5	4	3-5	4	3-5	4	3-5	3	3-5	4	3-5	3	
# of featured articles in print or digital media per year referencing LMRCSC	At least 50		At least 50		At least 50		At least 50		At least 50				>45

Challenges and Responsive Actions

Research and educational activities were impacted negatively by the covid-19 pandemic. Closure of universities for some months prevented students from working in the lab and conducting field research. There were also challenges with identifying NERTO opportunities and processing NERTO applications for some of the Center students. Students had to attend lectures, conduct thesis/dissertation committee meetings, and participate in NERTO internships virtually.

Dissemination of CSC Project Results

Peer Reviewed Journal Publications

Summary of Publications list from section VII:

Center Scientists produced 172 total publications over the course of the award. Forty-four (44) were the result of direct funding. Thirty-six (36) included cohort students as authors. The numbers of publications are summarized by reporting period in Table 34, and the complete lists can be found in Table 35 – Table 46.

Other Publications, Articles, and Book Chapters

The LMRCSC has produced 12 other publications in addition to the peer-reviewed items listed above. These include one book, 10 book chapters, and one technical report. Of these, one book chapter, and one technical report were directly funded and authored by cohort students. The complete list is in Table 50. The LMRCSC also produced 35 theses and dissertations. A complete list is found in Table 51.

Table 50. Other publications produced by the LMRCSC

Citation	Type	Funding	Description
Archer, R., Davis, F., Gragg, R., **Ebanks, S.** 2018. HBCUs Broadening Participation in Geosciences (a journey through InTeGrate). David Gosselin, Springer	Book Chapter	Leveraged	
Babcock E.A., and Cortes E. 2017. Bayesian surplus production models for shortfin mako sharks: are the results consistent when using different software packages? ICCAT Collective Volume of Scientific Papers SCRS/2017/055	Book chapter	Leveraged	
Bonin, C. A. 2022. Genetic consequences of dispersal, philopatry and reproductive behaviors In: Ethology and Behavioral Ecology of Eared Seals and the Walrus. Harcourt, R. & Campagna, C. editors. Springer.	Book Chapter	Leveraged	
Bonin, C.A. 2020. The Genetic consequences of philopatry, dispersal and reproductive behaviors. In: Ethology and Behavioral Ecology of Otariids and the Odobenid. C. Campagna & R. Harcourt. Springer, 2020. ISBN 978-3-030-59183-0.	Book Chapter	Leveraged	
Cuker, B. E., **Crawford, M.K**., and R. Chambers. 2017. Renewable Energy and Environmental Sustainability, D. Gosselin, Ed., InTeGrate's Earth-focused Modules and Courses Peer Reviewed Collection, https://serc.carleton.edu/163286	Book	Leveraged	
Cuker, B., et al. Diet for a sustainable ecosystem: The science for recovering the health of the Chesapeake Bay and its People; Chapter The Chesapeake Bay Oyster: Cobblestone to Keystone Kimberly S. Reece, Eugene M. Burreson, Deidre M. Gibson, Sierra S. Hildebrandt, Ileana Fenwick Pages 127-153 Springer Nature.	Book Chapter	Leveraged	

Cuker, B., **Gibson, D.** Preparing a Workforce for the New Blue Economy: Chapter "Building an inclusive and equitable new blue economy", Elsevier.	Book Chapter	Leveraged	
Hoskins-Brown. Protein from Pluff Mud: Oysters, Shrimp and Crab. In: Social Roots: Reconnecting Low country Foodways with the Landscape (editor Sarah Ross) in review.	Book Chapter	Leveraged	
Marin Jarrin, J.R., Shanks, A.L. & **Miller, J.A**. 2022. The Biology and Ecology of Sandy Beach Surf Zones. In Sandy Beaches as Endangered Ecosystems: Environmental Problems, Possible Assessment and Management Solutions. edited by Sílvia C. Gonçalves, Susana M.F. Ferreira	Book Chapter	Leveraged	
O,Farrell*, H. and **E. A. Babcock.** 2017 Evaluation of environmental conditions as predictors for mako shark CPUE using generalized linear mixed modeling and quantile regression. ICCAT Collective Volume of Scientific Papers SCRS/2017/057	Book chapter	Direct	Cohort 1 student
Rosenberger, A., C. Zimmerman, D. Noakes, R. Taylor, E. Keeley, J. Musick, R. Phillips, **A. Horodysky**, M. Neilson, T. Ray, & J. Neilson. Salmonidae. In: Diversity of North American Freshwater Fishes: Natural History, Ecology, and Conservation, Volume II.	Book Chapter	Leveraged	
Thalmann*, H.L., Daly, E.A., Brodeur, R.D. 2019. Quantifying thermal impacts on Columbia River Steelhead marine growth using bioenergetics models. North Pacific Anadromous Fish Commission. Technic al Report No. 15: 161-163.	Technical Report	Direct	CSC Cohort 1 student

Table 51. Theses and dissertations produced by cohort students.

Name (Last, First)	Degree	COHORT Number	Institution	Citation of Thesis or Dissertation
Bender, Arona	M.S.	3	HU	Bender, A. 2022. Genetic approaches for monitoring the effects of climate change on leopard seals in the Antarctic Peninsula. M.S. Thesis, Hampton Univ.
Cervera, Juan	M.S.	3	UM-RSMAS	Cervera, J. 2021. Modeling Mangrove Shift in Response to Sea-Level Rise in Miami-Dade County. M.S. Thesis, University of Miami, Rosenstiel School of Marine and Atmospheric Science.
Cruz Marrero, Wilmelie	Ph.D.	3	UMES	Cruz Marrero, W. 2020. Utilizing a camera sled for the assesment of benthic resources: Estimating community diversity in Maryland and population status of queen conch in

				Puerto Rico. Ph.D. Dissertation, University of Maryland Eastern Shore
Denson, Latreese	Ph.D.	2	UM-RSMAS	Denson, L. 2021. The Effect of Environmental Variation at Differing Spatial and Temporal Scales on Stock Assessment Inputs and Outputs with a Focus on King Mackerel in the U.S. Gulf of Mexico. Ph.D. Dissertation, University of Miami, Rosenstiel School of Marine and Atmospheric Science.
Drayton, Davielle	M.S.	2	SSU	Drayton, D. 2020. Microplastic accumulation at oyster (*Crassostrea virginica*) reefs in Savannah, GA. M.S. Thesis, Savannah State University.
Fenwick, Ileanna	B.S.	1	HU	Fenwick, I. 2020. Assessing Eastern Oyster, *Crassostrea virginica*, Spat Abundance in the Hampton River (Senior Thesis. Dr. Deidre Gibson was her advisor)
Frey, Benjamin	M.S.	3	UMCES	Frey, B. 2022. Validation of Age and Growth Using Microconstituent Analysis of Fish Hardparts. M.S. Thesis, University of Maryland Center for Environmental Science
Galvez, Brian	M.S.	1	DESU	Galvez, B. 2019. Trophic Ecology of Juvenile Weakfish (*Cynoscion regalis*) in the Delaware Bay Using Stomach Content and Stable Isotope Analyses. M.S. Thesis, Delaware State University.
Geiger, Savannah	M.S.	4	SSU	Geiger, S. 2021. An Analysis of Distribution and Abundance of Microplastics in Water and Sediments from the Lower Wassaw Sound Estuary and Gray's Reef National Marine Sanctuary. M.S. Thesis, Savannah State Univ.
Green, Shadaesha	Ph.D.	1	UMCES	Green, S. 2022. Understanding the Reproductive Biology and Endocrinology of the Female Red Deep-Sea Crab, *Chaceon quinquedens*. Ph.D. Dissertation, University of Maryland Center for Environmental Science
Griffin, Emily	M.S.	1	SSU	Griffin, E. 2018. Stock Structure of Common Bottlenose Dolphins (*Tursiops truncatus*) Through Photo-Identification

				and Genetic Analyses. M.S. Thesis, Savannah State Univ.
Hanif, Ammar	Ph.D.	1	UMCES	Hanif, A. 2019. Diet and stomach microbiota of Gulf menhaden, a key filter feeding forage fish species. Ph.D. Dissertation, Univ. of Maryland Center for Env. Sci.
Hildebrandt, Siera	M.S.	2	HU	Hildebrandt, S. 2021. Investigating the impacts of Oyster Conditioned Water on *Crassostrea virginica* Utilizing Direct Setting Techniques in the Hampton River, Hampton, VA. M.S. Thesis, Hampton Univ.
Howard, Kristafer	M.S.	5	SSU	Howard, K. 2022. Understanding the Effect Terrapin Excluder Devices Have on Blue Crab (*Callinectes sapidus*) Catch in Georgia Waters. M.S. Thesis, Savannah State Univ.
King, Brittany	Ph.D.	2	OSU	King, B. 2021. Underrepresentation of Racial and Ethnic Groups in Marine and Fisheries Science Professions. Ph.D. Dissertation, Oregon State University
Kleponis, Nicole	M.S.	2	DESU	Kleponis, N. 2019. Red-throated loon distribution in the Delaware Bay. M.S. thesis, Delaware State University.
Lawrence, Amanda	M.S.	2	UMCES	Lawrence, A. 2020. Investigating morphometric and physiological maturity in the male jonah crab, *Cancer borealis.* M.S. Thesis, University of Maryland Center for Environmental Science.
Layton, Janelle	B.S.	2	HU	Layton, J. 2020. The Feeding Ecology of Pacific Lampreys Assessed by Gut Fullness, (Senior Thesis, Dr. Eric Lewallen was her advisor)
Leslie, Jaelyn	M.S.	4	HU	Leslie, J. 2022. Investigating the Prevalence of Dolphin Strandings on the Virginia coast. M.S. Thesis, Hampton University.
Martinez-Rivera, Stephanie	Ph.D.	1	UMES	Martinez-Rivera, S. 2018. Reproductive biology of red deep-sea crab in the Mid-Atlantic Bight
Mayes, Cristin	M.S.	1	HU	Mayes, C. 2020. The Impact of Increasing Sea Surface Temperatures on Piscivore and Planktivore Species Dynamics: An Ecosystem-Based Modeling Approach. M.S. Thesis, Hampton University

McLean, Josette	M.S.	2	HU	McLean, J. 2021. Genetic-based methods for assessing prey composition and feeding ecology of Pacific lampreys. M.S. Thesis, Hampton University.
Milton, Isaiah	B.S.	1	HU	Milton, I. 2020. Assessing Viability of microRNAs as Biomarkers for Blue Crab Health, *Callinectes sapidus*, and Comparison of Crustacean miRNAs (Senior Thesis, Dr. Carolina Lewallen was his advisor)
Moreno, Victoria	M.S.	4	OSU	Moreno, V. 2021. Understanding Adaptive Capacity to Environmental Change: An Analysis of Community Perceptions and Policy Responses to Ocean Acidification and other marine stressors on the West Coast, M.S. Thesis, Oregon State University.
Munguia, Angie	M.S.	1	OSU	Munguia, A. 2019. Feeding Ecology and Food Web Linkages of Yearling Chinook Salmon (*Oncorhynchus tshawytscha*) Emigrating Through the Lower Columbia River and Estuary.
Munoz Ruiz, Enid	M.S.	2	UMES	Munoz-Ruiz, E. 2020. Assessment of microplastic fibers in *Placopecten magellanicus*. M.S. Thesis, University of Maryland Eastern Shore
O'Farrell, Halie	Ph.D.	1	UM-RSMAS	O'Farrell, H. 2021. Modeling Shark Bycatch Mitigation Strategies in Longline Fisheries Ph.D. Dissertation, University of Miami, Rosenstiel School of Marine and Atmospheric Science.
Pappas, Amanda	M.S.	1	DESU	Pappas, A. 2020. Winter Bloom Dynamics and Molecular Analysis of Benthic Sediments for the Toxic Dinoflagellate, *Dinophysis acuminata*, at Torquay Canal, Rehoboth Bay, Delaware, USA. M.S. Thesis, Delaware State University.
Pelekai, Keala	M.S.	3	OSU	Pelekai, K. 2021. Evaluation of Pacific Lamprey *Entosphenus tridentatus* Anatomical Structures as Records of Age and Isotope Histories. M.S. Thesis, Oregon State Univ.
Price, Andre	M.S.	2	UMES	Price, A. 2019. Comparing Localized Feeding Ecology of Black Sea Bass (*Centropristis striata*) at Natural and Artificial Reefs Using Gut Content and Stable Isotope Analyses. M.S. Thesis, Univ. of Maryland Eastern Shore

Ramirez, Matthew	Ph.D.	2	OSU	Ramirez, M. 2019. It's in Their Bones: Ecological Drivers of Kemp's Ridley Sea Turtle (*Lepidochelys kempii*) Somatic Growth and Population Dynamics.
Rodriguez, Jorge	Ph.D.	2	UMES	Rodriguez, J. 2019. Use of Glycan Epitopes to Characterize *Mytilus edulis* Hemocytes and Their Molecular Interactions with *Protoeces maculatus* and *Himasthia quinssetensis*. Ph.D. Dissertation, Univ. of Maryland Eastern Shore.
Rosales, Detbra	Ph.D.	1	UMES	Rosales, D. 2020. Assessing the microbial, phytoplankton community and associated water quality in the Delaware and Maryland Coastal Bays. Ph.D. Dissertation, University of Maryland Eastern Shore.
Schweitzer, Cara	Ph.D.	2	UMES	Schweitzer, C. 2019. The effects of Commercial Trap Fishing on Benthic Structural Habitat and Fish Abundance in the Mid-Atlantic: Case study of Black Sea Bass *Centropristis striata*. Ph.D. Dissertation, University of Maryland Eastern Shore.
Wenker, Rebecca	M.S.	1	UMES	Wenker, R. 2019. Sea Whip Coral (*Leptogorgia virgulata*) in the Mid-Atlantic Bight: Colony Complexity, Age, and Growth. M.S. Thesis, Univ. of Maryland Eastern Shore.

Presentations

Over the course of the award period, center scientists and students delivered 282 presentations including 178 oral and 104 poster presentations. Of those, 208 (128 oral and 80 poster) included the results of directly funded research. Cohort students delivered a total of 174 of these presentations (99 oral and 75 poster). An additional 109 presentations included cohort student authors who were not the presenter. A summary of these presentations separated by reporting period, presentation type, and funding type are found in Table 21. A summary of presentations by LMRCSC scientists and students from September 1, 2016 to August 31, 2022.

Social Media and Press Releases and Other Media Communications

The LMRCSC has been featured in over 60 articles. Its Facebook page has more than 590 followers; its Twitter has more than 258 followers.

IX. Independent External Review Outcomes, Recommendation and Center Actions

Organization, Management and Performance

Recommendation 1: **Develop LMRCSC mechanisms by which undergraduate and graduate students can receive consistent mentorship (academic/research/professional development/future career paths) Center-wide in LMRCSC.**

Center Actions: The LMRCSC has developed a mechanism by which undergraduate and graduate students receive consistent mentorship using: (a) Student Development Plan Form, (b) Letter of Understanding, and (c) Faculty and Student Handbooks revised since the completion of the IERT evaluation. The LMRCSC Education Expert will coordinate all activities and plans to ensure that LMRCSC students receive consistent mentorship.

The LMRCSC has a common Letter of Understanding for undergraduate students and graduate students in which we have stipulated the expectations from all students supported at all the Center institutions. All Center supported undergraduate and graduate students sign the document.

Since the completion of the Independent External Review of the LMRCSC, the Center has finalized its **Faculty Handbook** and modified the **Student Handbook (**https://www.umes.edu/LMRCSC/Content/Student-Handbooks/**)**. Both handbooks contain information that are being used center-wide at all institutions to provide consistent academic, research and professional development mentorship of the students. Additionally, the Center will conduct faculty, staff and student **mentoring training workshop** that will be led by an expert consultant.

Recommendation 2: **Streamline, with comprehensive standard operating protocols, for the Center-wide LMRCSC process by which students could seek, apply for, and complete the EPP NERTO graduate internships. (a) Ensure equity and access where every LMRCSC graduate student will receive LMRCSC-standardized guidance for EPP NERTO graduate internship logistics. (b) Ensure the Center streamlined process allows for LMRCSC students and prospective NOAA mentors to connect and facilitate exchange of information to allow students to set up logistics (travel and living arrangements) for their EPP NERTO graduate internship experience. (c) Insure LMRCSC EPP NERTO Standardized Operating Protocol to allow measurement of Center-wide access and repeatability of all EPP NERTO graduate internship preparation, onboarding, and through to completion.**

Center Actions: The Center has developed a revised NERTO guideline and process for students and faculty with step-by-step instructions, indicating responsibilities for the student, advisor, and NOAA mentor, and a suggested timeline of activities.

Recommendation 3: Formulate a clear Center-wide recruitment plan for students. Include clear recruitment objectives and strategies that are measurable. LMRCSC must utilize standardized recruitment protocols that can be assessed to identify if correlations exist between Center recruitment activities and LMRCSC outcomes.

Center Actions: The LMRCSC has developed a Center-wide student recruitment plan with the objectives of recruiting an adequate number of qualified undergraduate and graduate students in marine and fisheries science programs to meet the proposed target number in the Center's Implementation Plan. The LMRCSC Deputy Director is designated as the responsible person for implementing the center-wide plan.

Recommendation 4: Provide a clearer role for Center Distinguished Scientist as a mentor and facilitator for student research and professional development opportunities.

Center Actions: The DRS' role has been expanded to include the following functions: (1) hold a webinar for students and faculty soon after the release of the LMRCSC's Request for Proposal (in October of each year), to discuss how to put together strong TAB proposals; (2) lead the development of a center-wide research project that will include students and scientists; (3) continue to organize as part of the Spring Cohort Experience Workshop, a training program for students on proposal writing, (4) serve as point of contact for initiating all student NERTOs, and (5) serve as the primary supervisor of the LMRCSC Post-doctoral Research Associate.

Recommendation 5: Develop a robust Center sustainability plan beyond NOAA EPP funding. The LMRCSC Sustainability Plan must fully answer the question, "What will happen to the LMRCSC if the NOAA funding goes away?" A Center contingency plan must be developed as a component of the Center sustainability.

Center Actions: Center scientists will continue to take advantage of the existing inter-institutional collaboration to enhance their capacity to leverage funds from various sources to support Center programs, activities and students. Center institutions will also create new programs and initiatives to support students.

Recommendation 6: Develop and publish on LMRCSC website, clear open and overarching LMRCSC Standard Operating Protocols (SOPs) within a framework integrating all LMRCSC-contributing activities across the Center. The SOPs would be addressing all seven (7) of the rated performance areas in this review.

Center Actions: Standard Operating Protocols (SOPs) for the center that includes (a) Organization, Management and Performance, (b) Education and Training, (c) Scientific Research, (d) Collaboration with Stakeholders External to the Center, (e) CSC External

Evaluation, (f) Data Collection and Public Access, and (g) Communication have been developed and are continually revised to include requirements in new Center awards.

Education and Training

Recommendation 1: Integrate social science into all student research to meet award solicitation requirement for social science integration.

Center Actions: The Center has developed a plan and schedule for LMRCSC students to interact with social scientists from NOAA and the Center and engage in discussions on how to incorporate social science in their research. The webinars will take place in the Fall (November) and Spring (April) each academic year.

LMRCSC students will be required to take a course in social science or economics that meets their program requirements. They will also be required to review and discuss the social and economic implications of their research in their thesis or dissertations. Semi-annual reports submitted to the LMRCSC by students and their research advisors will be reviewed to determine if, and the extent to which social science is integrated into the research. Social science integration will be a required metric for evaluating TAB research proposals. The Center has modified its rubrics to provide guidance to students on how to integrate social science into their research projects.

Recommendation 2: Take advantage of the TAB mini-grant as a required professional development activity for students. a) Organize the TAB into operational policies of the Center; b) Make applying for the TAB grant process a required experience for all graduate trainees to be completed within the first three years of their time in the Center. c) Make social science integration an explicit requirement for successful TAB grant funding.

Center Actions: (a) The TAB is currently an operational policy of the LMRCSC. Graduate students are required to prepare and submit a research proposal for review and feedback from the TAB. LMRCSC proposals are reviewed by NOAA Fisheries scientists and/or social scientists led by the Center's Technical Monitor, Dr. Cisco Werner. The LMRCSC Request for proposals includes revised metrics for evaluating research proposals.

Recommendation 3: Develop standardized Center-wide assessment of Education and Training outcomes that are derived from the LMRCSC support for NOAA mission aligned core competencies for living marine resources, including data science.

Center Actions: The Center has developed standardized center-wide assessment of Education and Training outcomes. Each Core Competency has been expanded into a series of learning objectives with a list of activities that meet the objective and types of documentation of those activities. Every student is required to meet at least one learning objective in each core competency area (demonstrating literacy) and several learning objectives in at least one area (demonstrating competency).

Recommendation 4: Develop a Center-wide NOAA LMRCSC protocol to fully utilize the Individualized Student Development Plan (ISDP) to support student development and collaboration among the student, faculty advisor and Center staff in supporting students' progress achieving educational outcomes and core competencies. Curate Center-level ISDP information to use in evaluation that will demonstrate award impacts.

Center Actions: The student development plan is required from all LMRCSC Students each semester. The student development plan reports student progress to the LMRCSC Center office. The information from the student development plan allows the center office to track student progress - allows the center to support students and provide mechanisms to meet benchmarks toward Studentship completion. Data collected using the Individualized Student Development Plan will be entered into a spreadsheet and used to evaluate the progress of the students, in terms of meeting the milestones, at a meeting of the Center's Executive Committee that will be held in October and April of each academic year. The advisors of the students will be involved in the progress reviews of the students.

Recommendation 5: The LMRCSC should add to the Center's website, core competencies that document content and student learning outcomes for LMRCSC cohort students. Have this information, including identifying where students fit within the four thematic areas, readily accessible on the LMRCSC website for all Center internal and external participants.

Center Actions: (a) The Center will post on the website core competencies that document content and student learning outcomes (b) The LMRCSC will add to the student profiles on the website the thematic areas in which each student is conducting research.

Recommendation 6: The LMRCSC should add a Center-wide Education and Training milestone chart to the website so that all Center students and their advisors can easily track progress and timely completion of Center requirements.

Center Actions: The Center-wide Education and Training milestone chart will be posted on the website.

Scientific Research

Recommendation 1: Develop a clear integration and implementation strategy of incorporating (economics and social science) socio-economics aspects into all of the research themes (LMRCSC Implementation Plan, page 52; and RFA 7.4.1 (6) integrating socioeconomic and behavioral science factors, page 33).

Center Actions: LMRCSC students will be required to take a course in social or economic science that meets their academic program requirements. Students will also be required to review and discuss the social and economic implications of their research in their thesis or dissertations.

Recommendation 2: Involve all undergraduate and graduate students in the Data Science training and workshop; capture and track student attainment using standard metrics that demonstrate level of mastery in NOAA mission-aligned competencies. Fully utilize and chart progress in each Individual Student Development Plan.

Center Actions: LMRCSC supported graduate students are required to take the Data Management course or enroll in the Data Carpentry workshop sponsored by the Center. Student attainment of this requirement is already being captured, and tracked using the Individual Student Development Form and the Student Tracker. An assessment instrument has been developed and administered to students to gain knowledge of the extent to which the course is beneficial to them. The Center offers a workshop on Data Science to Undergraduate students supported by the LMRCSC.

Recommendation 3: Center should revisit how it crafts research around the thematic areas. Clearly align the Center's work and the students with all thematic areas to show where the students fit in the LMRCSC.

Center Actions: Thematic Research Areas of the Center are reviewed at five-year intervals for alignment with NOAA research goals, objectives, and strategies. These are revisited annually during preparation of the TAB Request For Proposal (RFP) in order to ensure that research guidelines are consistent and up to date. Students indicate in their TAB proposals the thematic areas in which their projects fit. The Research Thematic Areas were revisited in preparation for the LMRCSC Virtual Science meeting in May 2020; and will be revisited again in April 2023.

Recommendation 4: The Center should construct and communicate strategies that are clear for student publication of research results from their LMRCSC activities.

Center Actions: (a) Graduate students will be strongly encouraged to submit an article for publication prior to graduation. This is already specified in the Letter of Understanding that the students sign annually, and it is contained in the Student Handbook that is available on LMRCSC website and distributed to students. Graduate students will be encouraged to write thesis chapters as manuscripts for publication.

Collaborations with Stakeholders External to the Center

Recommendation 1: Center should develop strategies for ease of connection/engagement access for external mentors and LMRCSC students across all of the LMRCSC thematic areas.

Center Actions: The Center will (a) provide hyperlinks on our website that will direct students to external mentors, (b) provide names of all NOAA scientists, who have served as mentors of students, on our website along with the names of students who have worked with them; and (c) include in the student handbook direction on where they can find NOAA mentors. Additionally, the Center will create opportunities for engagement and connection between NOAA scientists and LMRCSC scientists and students via the annual science meetings that are held at NOAA facilities.

Recommendation 2: The LMRCSC should develop linkages of its successful collaboration strategies with external partner to the Center Communications activities in order to effectively share the LMRCSC successes.

Center Actions: The LMRCSC has expanded its directory of stakeholders for distribution of Center newsletters to include all the external partners. Newsletters will be produced three times per year and will be distributed widely to LMRCSC external partners.

Program Evaluation by the CSC External Evaluator

Recommendation 1: Develop a clearer and more transparent strategy for the evaluation of LMRCSC students in both the attainment of core competencies and the evolution of professional development skills.

Center Actions: The center has developed evaluation instruments for assessing the attainment of the LMRCSC's core competencies by students.

Recommendation 2: Develop a Center standardized process for monitoring results when Center incorporates the recommendations from external evaluation process to track – with data – impacts for continuous improvement.

Center Actions: The center has developed a standardized process for monitoring results after incorporating the recommendations from external evaluation. Monitoring of the results will be a continuous process that will be led by the Center Director. Changes resulting from the Center taking into account recommendations from external evaluation will be tracked and discussed as agenda items during monthly meetings of the Center's Executive Committee, which is attended by the LMRCSC Project Directors. Additionally, weekly meetings of the LMRCSC staff that will include the Center Director, Assistant Director, Education Lead, Distinguished Research Scientist, Communication and Outreach Specialist, Coordinator for Budget and Data Management, and Administrative Assistant will be used to discuss quantitative and qualitative changes resulting from actions taken in response to recommendations from external evaluators.

Recommendation 3: Develop evaluation criteria for the TAB mini grant projects to evaluate the impact of the TAB on student research interests, and to capture the quality of the project, dissemination of results, and student professional development through performance in the TAB project.

Center Actions: In October 2020, the Center developed evaluation instruments for determining the impact of the TAB mini-grant projects on students, which was administered to students and their research advisors. The Distinguished Research Scientist will also complete the survey for each TAB project based on his review of the semi-annual reports from the investigators. Besides, the impacts of TAB projects will be evaluated by tracking the number of publications and presentations arising from each project, the impact factors of the journals in which the articles are published and the citation index. These metrics will be included in newsletter articles, and posted on the Center's website.

Data Collection and Public Access

Recommendation 1: Pursue publications with journal impact factors that generate high impact scores, and that are eligible for the NOAA Library Institutional Repository.

Center Actions: The LMRCSC will encourage students to publish in high Impact Factor journals (e.g. Frontiers of Marine Science), and make their publications open access. Nevertheless, some highly reputable, but lower Impact Factor journals (e.g. Journal of Crustacean Biology, Fishery Bulletin, Journal of Shellfish Research) may be more appropriate for specialized fields. The LMRCSC Communication and Outreach Specialist will submit journal articles generated by the Center, to the NOAA Library Institutional Repository monthly and as the publications become available.

Recommendation 2: Develop and execute a robust LMRCSC Center-wide data-sharing plan with well-developed content and metadata information for the award. Ensure that Center metadata collection is readily accessible on the LMRCSC's website.

Center Actions: The Center requires students and scientists funded by the LMRCSC to upload their research data and metadata at an online repository site and provide a link to the site that will be deposited in a data portal that will be created on the LMRCSC website. The DRS has developed a metadata form that will serve as a template for use by students and faculty. This form will be uploaded to the LMRCSC website.

Recommendation 3: Develop a Center-wide accessible repository for all Center data whereby Center can track and showcase use of Center research outputs and outcomes by personnel or entities external to the LMRCSC.

Center Actions: LMRCSC has created, and maintains a database of all publications generated by LMRCSC-supported research, which will be used to track numbers of publications, impact factors (IF), etc. Students and faculty are encouraged to participate in Research Gate and to submit IF scores, H-indices, numbers of citations, and other metrics. The Center will also create a tracking system that will enable us determine how many people visit LMRCSC website data portal to download products and outputs.

Recommendation 4: Develop LMRCSC future workforce data tracking tools on the Center website that could be used by wide-ranging and diverse stakeholders to demonstrate, in real-time, the LMRCSC impacts and contribution of candidates to the future workforce in the NOAA mission enterprise.

Center Actions: The LMRCSC Assistant Director updates regularly student career progression information in the tracker database as well as on the center's website.

Additionally, a separate page will be created on the website by the Coordinator for Budget and Data Management that provides students' post-graduation information.

Communications

Recommendation 1: Improve communication between LMRCSC administration at UMES, Center administration at all Center academic institutions, and LMRCSC supported fellows (student trainees).

Center Actions: In addition to the monthly Executive Committee meetings, orientation webinar and other strategies that the Center uses to communicate internally and among center institutions, communication has been improved by: (1) revising and distributing the Student Handbook; (b) completing and distributing the Faculty Handbook; (c) producing the newsletter regularly, three times in a year; (d) designating the DRS as the point of contact for initiating all NERTO internships; and (e) updating the website.

Recommendation 2: Improve and provide to the public, as well as to Center alumni, more consistent communication about LMRCSC accomplishments.

Center Actions: LMRCSC e-newsletter is produced three times a year, and disseminated to the public and alumni. LMRCSC Communication and Outreach Specialist contacts Center PIs, students and faculty to request success stories that are posted on the website and used to produce the e-newsletter. She also utilizes social media to showcase Center accomplishments.

Recommendation 3: The Center Spring Cohort Experience Workshop information should be communicated on the LMRCSC's website: modules (structure, learning objectives, instructor), as well as tools used in assessment of attained skills and or competencies by LMRCSC students.

Center Actions: The Spring Cohort Experience Workshop modules and (b) instrument for assessing skills and/or competencies attained by the students will be posted on the website.

Recommendation 4: Improve and develop a consistent submission of LMRCSC publications for greater public access through NOAA as the funding agency, and through the Center website.

Center Actions: LMRCSC publications are submitted to the NOAA Library repository and posted on the website as they become available.

Recommendation 5: Improve easily accessible and consistent LMRCSC information for greater connection of the LMRCSC students and potential NOAA mentors. Enhance ease of access for collaborations, external to the LMRCSC, through the Center website.

Center Actions: The Center will (a) provide hyperlinks on the website that will direct students to external mentors, (b) provide names of all NOAA scientists, who have served as mentors of students, on our website along with the names of students they worked with; and (c) include in the student handbook direction on where they can find NOAA mentors.

X. LMRCSC Financial Reporting

Amount Received			
Institution	**Student**	**Non-Student**	**Total**
UMES/Center	$ 4,355,938.32	$ 4,723,879.07	$ 9,079,817.39
DESU	$ 739,008.13	$ 650,994.76	$ 1,390,002.89
HU	$ 694,212.92	$ 636,477.08	$ 1,330,690.00
OSU	$ 858,601.20	$ 306,211.20	$ 1,164,812.40
SSU	$ 906,392.31	$ 735,524.13	$ 1,641,916.44
UM-RSMAS	$ 869,701.70	$ 142,224.80	$ 1,011,926.50
UMCES	$ 953,338.98	$ 635,464.41	$ 1,588,803.39
Totals	**$ 9,377,193.56**	**$ 7,830,775.44**	**$ 17,207,969.00**

Amount Invoiced (Spent)			
Institution	Student	Non-Student	Total
UMES/Center	$ 2,044,221.85	$ 4,935,145.67	$ 6,979,367.52
DESU	$ 473,173.74	$ 620,428.50	$ 1,093,602.24
HU	$ 660,339.01	$ 636,477.08	$ 1,296,816.09
OSU	$ 843,585.91	$ 306,211.20	$ 1,149,797.11
SSU	$ 821,762.89	$ 707,672.29	$ 1,529,435.18
UM-RSMAS	$ 869,689.56	$ 142,224.80	$ 1,011,914.36
UMCES	$ 871,602.36	$ 624,836.93	$ 1,496,439.29
Totals	**$ 6,584,375.32**	**$ 7,972,996.46**	**$ 14,557,371.78**

Remaining Balance			
Institution	**Student**	**Non-Student**	**Total**
UMES/Center	$ 2,311,716.47	$ (211,266.60)	$ 2,100,449.87
DESU	$ 265,834.39	$ 30,566.26	$ 296,400.65
HU	$ 33,873.91	$ -	$ 33,873.91
OSU	$ 15,015.29	$ -	$ 15,015.29
SSU	$ 84,629.42	$ 27,851.84	$ 112,481.26
UM-RSMAS	$ 12.14	$ -	$ 12.14
UMCES	$ 81,736.62	$ 10,627.48	$ 92,364.10
Totals	**$ 2,792,818.24**	**$ (142,221.03)**	**$ 2,650,597.21**

XI. LMRCSC Degree Seeking Direct-Funded Cohort Students by Year with Full Financial Accounting

FY16

LAST NAME	FIRST NAME	CH	CSC HOME INSTITUTION	TUITION	STIPEND	TRAVEL	ONE-TIME RESEARCH	NERTO	PROF DEV
PH.D. STUDENTS									
Green	Shadaesha	1	UMCES	$4,034.00	$15,416.00	$962.00	$0.00	$0.00	$0.00
Hanif	Ammar	1	UMCES	$2,604.00	$25,484.00	$958.00	$0.00	$0.00	$0.00
O'Farrell	Halie	1	UM-RSMAS	$15,200.00	$29,724.00	$780.00	$0.00	$0.00	$0.00
Rosales	Detbra	1	UMES	$0.00	$4,455.00	$0.00	$0.00	$0.00	$1,277.00
M.S. STUDENTS									
Freeman	TyRae	1	DESU	$13,505.00	$21,486.00	$0.00	$0.00	$0.00	$0.00
Galvez	Brian	1	DESU	$6,811.00	$12,923.00	$627.00	$0.00	$0.00	$0.00
Griffin	Emily	1	SSU	$17,004.00	$25,143.00	$855.00	$0.00	$1,183.00	$0.00
Lawrence	Amanda	1	UMCES	$553.00	$10,079.00	$0.00	$0.00	$0.00	$0.00
Munguia	Angie	1	OSU	$11,937.00	$21,360.00	$648.00	$0.00	$1,634.00	$0.00
B.S. STUDENTS									
Baskerville	Debra	1	UMES	$0.00	$0.00	$0.00	$0.00	$0.00	$5,731.00
Carl-Michael	James	1	DESU	$0.00	$2,100.00	$0.00	$0.00	$0.00	$0.00
Coit	Nakia	1	UMES	$3,902.00	$5,952.00	$0.00	$0.00	$0.00	$0.00
Fenwick	Ileana	1	HU	$0.00	$0.00	$0.00	$0.00	$0.00	$4,595.00
McClain	Nylah	1	UMES	$0.00	$4,202.00	$0.00	$0.00	$0.00	$0.00
Milton	Isaiah	1	HU	$0.00	$0.00	$0.00	$0.00	$0.00	$4,727.00
Oliver	India	1	UMES	$7,804.00	$826.00	$0.00	$0.00	$0.00	$0.00
Otubu	Chryston	1	UMES	$0.00	$4,595.00	$0.00	$0.00	$0.00	$138.00
Sanford	Darius	1	SSU	$0.00	$11,061.00	$3,686.00	$0.00	$0.00	$0.00
Smith	Malisa	1	UMES	$0.00	$4,400.00	$1,978.00	$0.00	$0.00	$0.00
Smith	Nefertiti	1	HU	$0.00	$4,000.00	$0.00	$0.00	$0.00	$0.00

FY17

LAST NAME	FIRST NAME	CH	CSC HOME INSTITUTION	TUITION	STIPEND	TRAVEL	ONE-TIME RESEARCH	NERTO	PROF DEV
PH.D. STUDENTS									

Almodovar-Acevedo	Laura	2	UMES	$1,907.00	$22,467.00	$0.00	$0.00	$2,838.00	$0.00
Green	Shadaesha	1	UMCES	$5,046.00	$27,548.00	$571.00	$0.00	$0.00	$856.00
Hanif	Ammar	1	UMCES	$2,495.00	$19,895.00	$0.00	$1,570.00	$0.00	$281.00
King	Brittany	2	OSU	$16,894.00	$26,326.00	$617.00	$0.00	$0.00	$957.00
Martinez-Rivera	Stephanie	1	UMES	$1,136.00	$41,327.83	$0.00	$345.00	$7,066.00	$140.00
O'Farrell	Halie	1	UM-RSMAS	$23,520.00	$32,537.00	$1,654.00	$0.00	$0.00	$985.00
Rodriguez	Jorge	2	UMES	$3,765.00	$30,513.00	$0.00	$0.00	$2,407.00	$0.00
Rosales	Detbra	1	UMES	$3,144.00	$31,611.00	$0.00	$5,483.00	$3,688.00	$2,022.00
Rubalcava	Kasondra	2	UMES	$11,887.00	$24,538.00	$0.00	$0.00	$0.00	$224.00
Schweitzer	Cara	2	UMES	$2,988.00	$27,606.00	$0.00	$13,200.00	$0.00	$5,005.00
Wilson	Adrianne	2	RSMAS	$27,320.00	$24,770.00	$947.00	$0.00	$0.00	$822.00
M.S. STUDENTS									
Drayton	Davielle	2	SSU	$917.00	$2,100.00	$0.00	$0.00	$0.00	$0.00
Galvez	Brian	1	DESU	$10,856.00	$21,000.00	$5,582.00	$0.00	$2,589.00	$591.00
Griffin	Emily	1	SSU	$5,473.00	$20,383.00	$816.00	$0.00	$0.00	$940.00
Kleponis	Nicole	2	DESU	$6,811.00	$12,923.00	$1,250.00	$0.00	$0.00	$0.00
Lawrence	Amanda	2	UMCES	$0.00	$1,977.00	$0.00	$0.00	$0.00	$0.00
Mayes	Cristin	1	HU	$10,670.00	$12,000.00	$1,205.00	$1,000.00	$5,000.00	$483.00
Munguia	Angie	1	OSU	$16,530.00	$26,764.00	$1,387.00	$0.00	$1,810.00	$2,028.00
Munoz-Ruiz	Enid	2	UMES	$6,856.00	$24,247.00	$0.00	$2,115.00	$4,484.00	$0.00
Pappas	Amanda	1	DESU	$0.00	$5,654.00	$0.00	$0.00	$0.00	$0.00
Price	Andre	2	UMES	$4,837.00	$26,997.00	$0.00	$374.00	$0.00	$2,413.00
Wenker	Rebecca	1	UMES	$5,986.00	$21,559.00	$0.00	$2,199.00	$0.00	$140.00
B.S. STUDENTS									
Coit	Nakia	1	UMES	$7,892.00	$4,850.00	$0.00	$0.00	$0.00	$3,346.00
Dorsey	Kendra	2	HU	$4,000.00	$6,250.00	$0.00	$0.00	$0.00	$0.00
Fenwick	Ileana	1	HU	$0.00	$5,000.00	$498.00	$0.00	$0.00	$4,079.00
Freeman	Dante	1	SSU	$8,390.00	$4,000.00	$3,453.00	$0.00	$0.00	$0.00
Horsey	Aris-Aja	2	UMES	$4,021.00	$0.00	$1,415.47	$0.00	$0.00	$0.00
Layton	Janelle	2	HU	$0.00	$7,500.00	$0.00	$0.00	$0.00	$0.00
Love	Desmond	2	UMES	$4,046.00	$0.00	$0.00	$0.00	$0.00	$0.00
McClain	Nylah	1	UMES	$4,021.00	$1,816.00	$0.00	$0.00	$0.00	$4,067.00
Milton	Isaiah	1	HU	$0.00	$5,000.00	$498.00	$0.00	$0.00	$3,753.00
Oliver	India	1	UMES	$8,067.00	$3,376.00	$0.00	$0.00	$0.00	$1,948.00
Otubu	Chryston	1	UMES	$8,092.00	$4,931.00	$0.00	$0.00	$0.00	$3,008.00
Sanford	Darius	1	SSU	$0.00	$608.00	$0.00	$0.00	$0.00	$0.00
Smith	Malisa	1	UMES	$8,086.00	$399.00	$0.00	$0.00	$0.00	$0.00
Smith	Nefertiti	1	HU	$4,000.00	$1,250.00	$498.00	$0.00	$0.00	$0.00
Davis	DaQuan	3	UMES	$0.00	$0.00	$0.00	$0.00	$0.00	$3,003.00

LAST NAME	FIRST NAME	CH	CSC HOME INSTITUTION	TUITION	STIPEND	TRAVEL	ONE-TIME RESEARCH	NERTO	PROF DEV
PH.D. STUDENTS									
Byrd	Anya	3	UM-RSMAS	$24,220.00	$25,487.00	$0.00	$0.00	$0.00	$386.00
Cruz-Marrero	Wilmelie	3	UMES	$1,085.00	$26,505.00	$0.00	$1,595.00	$4,282.00	$402.00
Haughton	Shanelle	3	UMES	$9,889.00	$20,458.00	$0.00	$0.00	$3,855.00	$25.00
Almodovar-Acevedo	Laura	2	UMES	$0.00	$1,160.00	$0.00	$0.00	$0.00	$454.00
Denson	LaTreece	2	RSMAS	$24,220.00	$32,820.00	$1,426.00	$0.00	$6,266.00	$1,066.00
Green	Shadaesha	1	UMCES-IMET	$1,185.00	$34,506.00	$1,058.00	$2,016.00	$1,899.00	$0.00
Hanif	Ammar	1	UMCES-IMET	$1,185.00	$6,283.00	$0.00	$3,320.00	$1,107.00	$0.00
King	Brittany	2	OSU	$14,154.00	$23,380.00	$6,022.00	$0.00	$0.00	$0.00
Martinez-Rivera	Stephanie	1	UMES	$1,742.00	$12,259.00	$0.00	$202.00	$2,977.00	$0.00
O'Farrell	Halie	1	UM-RSMAS	$0.00	$0.00	$5,146.00	$0.00	$10,000.00	$0.00
Ramirez	Matthew	2	OSU	$10,823.00	$22,179.00	$2,319.00	$0.00	$7,173.00	$1,635.00
Rodriguez	Jorge	2	UMES	$2,090.00	$27,796.00	$0.00	$0.00	$2,500.00	$258.00
Rosales	Detbra	1	UMES	$1,195.00	$12,369.00	$0.00	$11,666.00	$549.00	$50.00
Rubalcava	Kasondra	2	UMES	$13,844.00	$27,814.00	$0.00	$0.00	$3,848.00	$2,074.00
Schweitzer	Cara	2	UMES	$2,177.00	$25,901.00	$0.00	$5,895.00	$8,236.00	$0.00
Wilson	Adrianne	2	RSMAS	$20,300.00	$35,402.00	$811.00	$1,586.00	$10,000.00	$0.00
M.S. STUDENTS									
Cervera	Juan	3	UM-RSMAS	$0.00	$2,143.00	$0.00	$0.00	$0.00	$0.00
Frey	Benjamin	3	UMCES-IMET	$6,596.00	$15,794.00	$0.00	$0.00	$0.00	$365.00
MacKey	Shaneese	3	SSU	$4,089.00	$27,750.00	$3,983.00	$449.00	$0.00	$0.00
Pelekai	Keala	3	OSU	$17,286.00	$27,753.00	$1,234.00	$0.00	$0.00	$1,692.00
Drayton	Davielle	2	SSU	$3,203.00	$41,650.00	$7,645.00	$0.00	$0.00	$482.00
Galvez	Brian	1	DESU	$2,325.00	$13,731.00	$1,279.00	$835.00	$2,411.00	$0.00
Kleponis	Nicole	2	DESU	$8,304.00	$21,000.00	$2,376.00	$0.00	$1,458.00	$308.00
Lawrence	Amanda	2	UMCES-IMET	$6,453.00	$35,713.00	$101.00	$4,398.00	$5,000.00	$0.00

Mayes	Cristin	1	HU	$10,942.00	$12,000.00	$0.00	$0.00	$0.00	$0.00
Munoz-Ruiz	Enid	2	UMES	$6,395.00	$27,889.00	$0.00	$4,187.00	$0.00	$245.00
Pappas	Amanda	1	DESU	$10,555.00	$21,000.00	$461.00	$0.00	$0.00	$345.00
Price	Andre	2	UMES	$823.00	$10,844.00	$0.00	$5,236.00	$3,900.00	$0.00
Thalman	Hillary	1	OSU	$17,286.00	$27,753.00	$1,129.00	$0.00	$0.00	$1,451.00
Wenker	Rebecca	1	UMES	$2,310.00	$19,329.00	$0.00	$2,405.00	$3,335.00	$1,475.00
B.S. STUDENTS									
Barry	Teemer	3	UMES	$8,302.00	$2,023.00	$0.00	$0.00	$0.00	$0.00
Cruz	Kathryn	3	HU	$0.00	$8,750.00	$0.00	$0.00	$0.00	$0.00
Davis	DaQuan	3	UMES	$8,302.00	$3,255.00	$0.00	$0.00	$0.00	$223.00
Fielding	Semaj	3	UMES	$14,343.00	$350.00	$0.00	$0.00	$0.00	$0.00
Hammond	Erianna	3	SSU	$18,000.00	$0.00	$0.00	$0.00	$0.00	$5,332.00
Knight	Rhyan	3	UMES	$8,302.00	$1,162.00	$0.00	$0.00	$0.00	$0.00
Sanvee	Eunice	3	DESU	$0.00	$2,000.00	$0.00	$0.00	$0.00	$0.00
Simmons	Kiani	3	DESU	$0.00	$820.00	$0.00	$0.00	$0.00	$0.00
Smith	Marci-Ann	3	UMES	$0.00	$0.00	$0.00	$0.00	$0.00	$4,555.00
Washington	Tyler	3	UMES	$4,151.00	$0.00	$0.00	$0.00	$0.00	$0.00
Williams	Michael	3	SSU	$12,000.00	$0.00	$0.00	$0.00	$0.00	$0.00
Ambrose	Alexandra	2	SSU	$11,901.00	$0.00	$6,569.00	$0.00	$0.00	$0.00
Coit	Nakia	1	UMES	$8,302.00	$2,124.00	$0.00	$0.00	$0.00	$0.00
Day	Joe	2	SSU	$18,822.00	$0.00	$0.00	$0.00	$0.00	$0.00
Dorsey	Kendra	2	HU	$10,000.00	$0.00	$0.00	$0.00	$0.00	$0.00
Fenwick	Ileana	1	HU	$0.00	$7,500.00	$0.00	$0.00	$0.00	$300.00
Freeman	Dante	1	SSU	$12,000.00	$0.00	$0.00	$0.00	$0.00	$0.00
Horsey	Aris-Aja	2	UMES	$7,201.00	$1,636.00	$0.00	$0.00	$0.00	$0.00
Layton	Janelle	2	HU	$0.00	$6,250.00	$0.00	$0.00	$0.00	$0.00
McClain	Nylah	1	UMES	$8,302.00	$2,464.00	$0.00	$0.00	$0.00	$2,025.00
Milton	Isaiah	1	HU	$0.00	$7,500.00	$0.00	$0.00	$0.00	$0.00
Otubu	Chryston	1	UMES	$9,522.00	$8,218.00	$0.00	$0.00	$0.00	$412.00
Sanford	Darius	1	SSU	$0.00	$14,709.00	$5,408.00	$0.00	$0.00	$0.00
Smith	Nefertiti	1	HU	$10,000.00	$0.00	$0.00	$0.00	$0.00	$0.00

Tay	Sena	2	SSU	$9,995.00	$4,000.00	$5,815.00	$0.00	$0.00	$0.00

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LAST NAME	FIRST NAME	CH	CSC HOME INSTITUTION	TUITION	STIPEND	TRAVEL	ONE-TIME RESEARCH	NERTO	PROF DEV
PH.D. STUDENTS									
Cruz-Marrero	Wilmelie	3	UMES	$834.00	$11,587.00	$84.00	$0.00	$8,768.00	$25.00
Haughton	Shanelle	3	UMES	$12,750.00	$25,855.00	$0.00	$0.00	$1,356.00	$609.00
Silver	Ashley	3	UMES	$13,950.00	$14,095.00	$0.00	$0.00	$0.00	$0.00
Denson	LaTreece	2	RSMAS	$0.00	$0.00	$2,755.00	$0.00	$0.00	$0.00
Johnson	Tahirah	4	UMES	$9,420.00	$18,290.81	$0.00	$0.00	$0.00	$0.00
King	Brittany	2	OSU	$11,700.52	$24,707.56	$4,268.35	$0.00	$0.00	$0.00
O'Farrell	Halie	1	UM-RSMAS	$6,160.00	$3,566.00	$1,406.00	$0.00	$0.00	$0.00
Ramarui	Kyarii	4	UMCES	$10,234.00	$34,400.51	$467.40	$0.00	$0.00	$0.00
Ramirez	Matthew	2	OSU	$0.00	$1,028.00	$0.00	$0.00	$0.00	$0.00
Rubalcava	Kasondra	2	UMES	$5,887.00	$31,879.46	$0.00	$0.00	$1,732.00	$1,789.00
Wilson	Adrianne	2	RSMAS	$33,460.00	$39,645.00	$517.00	$0.00	$0.00	$0.00
M.S. STUDENTS									
Bender	Arona	3	HU	$5,731.00	$8,250.00	$0.00	$4,042.00	$0.00	$0.00
Cervera	Juan	3	UM-RSMAS	$4,060.00	$23,573.00	$0.00	$0.00	$0.00	$0.00
Frey	Benjamin	3	UMCES	$9,503.00	$29,222.87	$888.72	$904.00	$2,832.12	$0.00
Kristopher	Howard	4	SSU	$7,453.00	$0.00	$0.00	$0.00	$0.00	$0.00
MacKey	Shaneese	3	SSU	$4,485.00	$19,250.00	$998.00	$0.00	$0.00	$0.00
Pelekai	Keala	3	OSU	$19,179.00	$29,519.00	$1,042.00	$0.00	$0.00	$0.00
Rodríguez-Sanoguet	Luis	3	DESU	$6,811.00	$13,731.00	$0.00	$0.00	$0.00	$0.00
Drayton	Davielle	2	SSU	$1,339.00	$4,900.00	$1,444.00	$0.00	$0.00	$0.00
Geiger	Savannah	4	SSU	$9,420.00	$18,291.00	$0.00	$0.00	$0.00	$0.00
Goffe	Shakira	4	UMES	$6,903.00	$3,784.00	$0.00	$0.00	$0.00	$0.00
Hildebrandt	Sierra	2	HU	$11,732.00	$16,500.00	$0.00	$0.00	$0.00	$0.00
Kleponis	Nicole	2	DESU	$3,185.00	$6,462.00	$0.00	$0.00	$2,832.00	$0.00
Lawrence	Amanda	2	UMCES	$4,358.00	$16,596.00	$2,422.00	$5,425.00	$0.00	$0.00
Leslie	Jaelyn	4	HU	$6,903.00	$3,784.00	$0.00	$0.00	$0.00	$0.00

Mayes	Cristin	1	HU	$21,000.00	$33,868.00	$0.00	$0.00	$0.00	$0.00
McLean	Josette	2	HU	$11,732.00	$16,500.00	$0.00	$0.00	$0.00	$0.00
Moreno	Victoria	4	OSU	$11,572.00	$19,371.39	$25.00	$0.00	$0.00	$0.00
Munoz-Ruiz	Enid	2	UMES	$5,934.00	$24,404.00	$0.00	$0.00	$1,107.00	$25.00
Pappas	Amanda	1	DESU	$5,221.00	$8,885.00	$0.00	$0.00	$1,659.00	$0.00
Thalman	Hillary	1	OSU	$0.00	$950.00	$959.00	$4,293.00	$0.00	$0.00
Wilburn	Imani	4	UMES	$6,295.00	$0.00	$0.00	$0.00	$0.00	$0.00
B.S. STUDENTS									
Barry	Teemer	3	UMES	$9,766.00	$3,133.00	$0.00	$0.00	$0.00	$25.00
Burns	Williams	4	SSU	$3,000.96	$2,600.00	$0.00	$0.00	$0.00	$0.00
Cruz	Kathryn	3	HU	$0.00	$6,250.00	$0.00	$0.00	$0.00	$0.00
Davis	DaQuan	3	UMES	$8,558.00	$3,536.00	$0.00	$0.00	$0.00	$0.00
Fielding	Semaj	3	UMES	$8,558.00	$2,562.00	$0.00	$0.00	$0.00	$0.00
Hammond	Erianna	3	SSU	$6,000.00	$0.00	$218.00	$0.00	$0.00	$0.00
Knight	Rhyan	3	UMES	$8,558.00	$2,725.00	$0.00	$0.00	$0.00	$0.00
Sanvee	Eunice	3	DESU	$0.00	$1,740.00	$0.00	$0.00	$0.00	$0.00
Tolin	Amani	3	HU	$0.00	$3,750.00	$0.00	$0.00	$0.00	$0.00
Washington	Tyler	3	UMES	$8,558.00	$2,045.00	$0.00	$0.00	$0.00	$0.00
Day	Joe	2	SSU	$5,178.00	$0.00	$0.00	$0.00	$0.00	$0.00
Fenwick	Ileana	1	HU	$0.00	$6,575.00	$0.00	$0.00	$0.00	$0.00
Hawkins	Pa-Shun	4	HU	$0.00	$21,000.00	$0.00	$0.00	$0.00	$0.00
Layton	Janelle	2	HU	$0.00	$7,800.00	$0.00	$0.00	$0.00	$0.00
McClain	Nylah	1	UMES	$8,558.00	$2,284.00	$0.00	$0.00	$0.00	$0.00
Milton	Isaiah	1	HU	$0.00	$5,205.00	$0.00	$0.00	$0.00	$0.00
Otubu	Chryston	1	UMES	$8,558.00	$3,731.00	$0.00	$0.00	$0.00	$25.00
Rufus	Mya	4	UMES	$8,558.00	$0.00	$0.00	$0.00	$0.00	$0.00
Spaulding	Chelsea	4	SSU	$0.00	$6,320.33	$1,920.90	$0.00	$0.00	$0.00
Summer	Larry	4	UMES	$4,279.00	$301.00	$0.00	$0.00	$0.00	$0.00
Teat	Marcus	2	DESU	$0.00	$5,390.00	$0.00	$0.00	$0.00	$0.00

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LAST NAME	FIRST NAME	CH	CSC HOME INSTITUTION	TUITION	STIPEND	TRAVEL	ONE-TIME RESEARCH	NERTO	PROF DEV
PH.D. STUDENTS									
Haughton	Shanelle	3	UMES	$8,049.00	$30,869.22	$0.00	$0.00	$0.00	$0.00
Silver	Ashley	3	UMES	$12,616.00	$25,179.90	$0.00	$0.00	$0.00	$0.00
Green	Shadaesha	1	UMCES	$1,209.00	$4,459.38	$0.00	$7,152.00	$0.00	$0.00
Johnson	Tahirah	4	UMES	$1,381.00	$25,049.70	$0.00	$0.00	$0.00	$0.00
King	Brittany	2	OSU	$6,432.11	$14,019.26	$0.00	$0.00	$0.00	$0.00
Mayes	Cristin	4	UM-RSMAS	$30,380.00	$26,568.00	$0.00	$171.00	$0.00	$0.00
Otubu	Chryston	**5**	RSMAS	$34,580.00	$34,146.00	$0.00	$0.00	$0.00	$0.00
Pares	Olivia	**5**	UMCES	$14,148.00	$36,319.86	$6,451.47	$4,915.96	$0.00	$0.00
Ramarui	Kyarii	4	UMCES	$3,655.00	$42,067.05	$0.00	$2,600.00	$0.00	$0.00
Rosales	Detbra	1	UMES	$0.00	$0.00	$387.37	$0.00	$0.00	$0.00
Rubalcava	Kasondra	2	UMES	$2,412.00	$32,768.53	$0.00	$0.00	$0.00	$0.00
Wilson	Adrianne	2	RSMAS	$2,170.00	$0.00	$0.00	$0.00	$0.00	$0.00
M.S. STUDENTS									
Bender	Arona	3	HU	$12,775.00	$19,500.00	$0.00	$50.00	$0.00	$0.00
Cervera	Juan	3	UM-RSMAS	$19,460.00	$19,133.10	$0.00	$0.00	$0.00	$0.00
Cohn	Leanna	**5**	OSU	$4,891.16	$5,713.90	$0.00	$0.00	$0.00	$0.00
Delgado	Angel	**5**	UMES	$6,912.00	$402.74	$0.00	$0.00	$0.00	$0.00
Frey	Benjamin	3	UMCES	$8,994.00	$30,615.54	$0.00	$3,582.50	$0.00	$0.00
MacKey	Shaneese	3	SSU	$739.00	$19,250.00	$0.00	$160.00	$0.00	$0.00
Pelekai	Keala	3	OSU	$5,022.55	$13,367.58	$0.00	$0.00	$0.00	$0.00
Rodríguez-Sanoguet	Luis	3	DESU	$6,811.00	$8,884.59	$0.00	$0.00	$0.00	$0.00
Wade	Kaithlynn	**5**	UMES	$0.00	$805.48	$0.00	$0.00	$0.00	$0.00
Czajkowski	Caitlin	3	DESU	$15,408.00	$20,999.94	$0.00	$0.00	$0.00	$0.00
Teat	Marcus	**5**	DESU	$0.00	$6,730.78	$0.00	$0.00	$0.00	$0.00
Cleo	Lemaire	**5**	SSU	$8,179.00	$3,818.18	$0.00	$0.00	$0.00	$0.00
Coleman	Nicholas	2	UMCES	$14,694.00	$29,468.32	$0.00	$5,000.00	$0.00	$0.00
Drayton	Davielle	2	SSU	$0.00	$2,100.00	$0.00	$0.00	$0.00	$0.00
Geiger	Savannah	4	SSU	$4,406.00	$22,750.00	$0.00	$0.00	$0.00	$0.00
Goffe	Shakira	4	UMES	$9,721.00	$14,450.55	$0.00	$0.00	$0.00	$0.00

Hildebrandt	Sierra	2	HU	$12,640.00	$14,500.00	$0.00	$0.00	$0.00	$0.00
Kleponis	Nicole	2	DESU	$0.00	$1,615.38	$0.00	$0.00	$0.00	$0.00
Layton	Janelle	4	OSU	$18,293.48	$29,315.93	$0.00	$0.00	$0.00	$0.00
Leslie	Jaelyn	4	HU	$12,720.00	$18,000.00	$0.00	$50.00	$0.00	$0.00
McLean	Josette	2	HU	$12,640.00	$14,500.00	$0.00	$0.00	$0.00	$0.00
Moreno	Victoria	4	OSU	$16,947.48	$30,476.10	$0.00	$0.00	$0.00	$0.00
Tay	Sena	4	SSU	$5,170.00	$22,750.00	$0.00	$0.00	$0.00	$0.00
Wilburn	Imani	4	UMES	$13,362.00	$21,296.11	$0.00	$0.00	$0.00	$0.00
B.S. STUDENTS									
Alexandria	Tennant	**5**	SSU	$6,000.00	$12,000.00	$0.00	$0.00	$0.00	$0.00
Barry	Teemer	3	UMES	$0.00	$2,882.62	$0.00	$0.00	$0.00	$0.00
Burns	Williams	**5**	SSU	$3,050.96	$13,773.04	$0.00	$0.00	$0.00	$0.00
Davis	DaQuan	3	UMES	$4,279.00	$6,675.81	$0.00	$0.00	$0.00	$0.00
Fielding	Semaj	3	UMES	$0.00	$654.00	$0.00	$0.00	$0.00	$0.00
Kristopher	Howard	**5**	SSU	$2,954.00	$21,000.00	$0.00	$0.00	$0.00	$0.00
Nash	Jonathan	**5**	HU	$5,000.00	$0.00	$0.00	$0.00	$0.00	$0.00
Reeves	T'Kiyah	**5**	HU	$5,000.00	$0.00	$0.00	$0.00	$0.00	$0.00
Richardson	Derrick	**5**	HU	$5,000.00	$0.00	$0.00	$0.00	$0.00	$0.00
Savannah	Clax	**5**	SSU	$7,821.29	$14,178.72	$3,599.90	$0.00	$0.00	$0.00
Shaw	Michon	**5**	SSU	$6,000.00	$0.00	$0.00	$0.00	$0.00	$0.00
Tolin	Amani	3	HU	$10,000.00	$0.00	$0.00	$0.00	$0.00	$0.00
Washington	Tyler	3	UMES	$4,279.00	$0.00	$0.00	$0.00	$0.00	$0.00
Day	Joe	2	SSU	$9,075.00	$1,750.00	$0.00	$0.00	$0.00	$0.00
Glen	Colins	4	UMES	$9,597.00	$0.00	$0.00	$0.00	$0.00	$0.00
Hawkins	Pa-Shun	4	HU	$10,000.00	$12,250.00	$0.00	$0.00	$0.00	$0.00
Maria	Henson	1	HU	$5,000.00	$0.00	$0.00	$0.00	$0.00	$0.00
Rufus	Mya	4	UMES	$4,279.00	$0.00	$0.00	$0.00	$0.00	$0.00
Spaulding	Chelsea	4	SSU	$3,509.00	$4,698.98	$0.00	$0.00	$0.00	$0.00
Teat	Marcus	2	DESU	$3,216.25	$3,840.00	$0.00	$0.00	$0.00	$0.00
Volmar	Lady	4	SSU	$8,385.93	$11,963.69	$0.00	$0.00	$0.00	$0.00

FY21 (No Cost Extension Year)

LAST NAME	FIRST NAME	CH	CSC HOME INSTITUTION	TUITION	STIPEND	TRAVEL	ONE-TIME RESEARCH	NERTO	PROF DEV
				PH.D. STUDENTS					
Haughton	Shanelle	3	UMES	$1,409.00	$12,930.68	$0.00	$0.00	$0.00	$0.00
Silver	Ashley	3	UMES	$5,794.00	$25,678.67	$45.00	$0.00	$0.00	$0.00
Garcia Prieto	David	**5**	UMCES	$2,953.66	$22,296.49	$1,287.59	$17,172.15	$0.00	$0.00
Johnson	Tahirah	4	UMES	$9,157.00	$29,926.70	$5,646.13	$0.00	$0.00	$0.00
King	Brittany	2	OSU	$1,371.01	$5,988.99	$0.00	$0.00	$0.00	$0.00
Mayes	Cristin	4	UM-RSMAS	$35,408.00	$31,509.00	$1,341.10	$3,930.00	$0.00	$0.00
Otubu	Chryston	**5**	RSMAS	$26,556.00	$35,439.00	$852.34	$0.00	$7,807.66	$0.00
Pares	Olivia	**5**	UMCES	$4,739.70	$41,870.00	$4,138.84	$4,449.71	$10,341.53	$0.00
Ramarui	Kyarii	4	UMCES	$5,163.84	$39,614.87	$6,599.44	$20,000.50	$7,347.07	$0.00
Rubalcava	Kasondra	2	UMES	$1,946.00	$45,198.20	$5,778.91	$0.00	$0.00	$0.00
Wilson	Adrianne	2	RSMAS	$8,852.00	$16,353.00	$3,940.83	$0.00	$0.00	$0.00
				M.S. STUDENTS					
Bender	Arona	3	HU	$12,920.00	$13,000.00	$477.20	$0.00	$0.00	$0.00
Cohn	Leanna	**5**	OSU	$25,197.39	$38,467.72	$1,381.55	$0.00	$0.00	$0.00
Delgado	Angel	**5**	UMES	$22,680.00	$28,377.86	$41.00	$0.00	$3,757.18	$0.00
Frey	Benjamin	3	UMCES	$0.00	$16,837.16	$1,623.71	$0.00	$6,841.93	$0.00
MacKey	Shaneese	3	SSU	$0.00	$0.00	$0.00	$152.05	$0.00	$0.00
Wade	Kaithlynn	**5**	UMES	$24,098.30	$21,763.81	$4,943.72	$0.00	$3,554.92	$0.00
Andrade	Emily	4	DESU	$5,863.00	$30,000.10	$2,563.93	$0.00	$0.00	$0.00
Czajkowski	Caitlin	3	DESU	$46,999.86	$1,394.32	$0.00	$0.00	$0.00	$0.00
Teat	Marcus	**5**	DESU	$17,215.00	$31,153.95	$7,440.93	$0.00	$0.00	$0.00
Cleo	Lemaire	**5**	SSU	$16,882.00	$32,272.71	$1,371.74	$0.00	$1,883.30	$0.00
Coleman	Nicholas	2	UMCES	$3,883.90	$39,374.00	$9,530.46	$4,491.29	$0.00	$0.00
Day	Joe	**2**	SSU	$6,135.00	$31,733.32	$6,586.68	$0.00	$0.00	$0.00
Geiger	Savannah	4	SSU	$0.00	$7,000.00	$0.00	$0.00	$0.00	$0.00
Goffe	Shakira	4	UMES	$3,384.00	$21,450.05	$1,697.89	$0.00	$0.00	$0.00
Layton	Janelle	4	OSU	$17,106.40	$25,617.74	$7,790.20	$0.00	$15,276.64	$0.00
Leslie	Jaelyn	4	HU	$ 12,490.0	$ 13,000.00	$477.20	$0.00	$0.00	$0.00
Moreno	Victoria	4	OSU	$5,118.94	$7,521.57	$0.00	$0.00	$0.00	$0.00

Tay	Sena	4	SSU	$3,008.00	$25,333.32	$3,869.70	$0.00	$0.00	$0.00
Thalman	Hillary	1	OSU	$12,521.51	$23,903.82	$6,995.15	$2,404.00	$0.00	$2,700.00
Wilburn	Imani	4	UMES	$5,477.00	$21,604.97	$41.00	$0.00	$4,587.38	$0.00
Wong-Ala	Jennifer Ann Tatoi	5	OSU	$20,545.34	$37,029.74	$5,469.72	$0.00	$2,683.75	$0.00
B.S. STUDENTS									
Alexandria	Tennant	**5**	SSU	$9,356.95	$0.00	$0.00	$0.00	$0.00	$0.00
Barry	Teemer	3	UMES	$0.00	$3,871.75	$41.00	$0.00	$0.00	$0.00
Blackwood	Mikaela	**5**	UMES	$5,590.00	$0.00	$0.00	$0.00	$0.00	$0.00
Brown	Malika	**5**	UMES	$14,465.00	$53.83	$862.24	$0.00	$0.00	$0.00
Clovis	Nina	**5**	UMES	$15,475.50	$675.00	$0.00	$0.00	$0.00	$0.00
Kristopher	Howard	**5**	SSU	$1,477.00	$16,666.64	$0.00	$0.00	$0.00	$0.00
Langston	Jackson	**5**	HU	$13,000.00	$2,500.00	$0.00	$0.00	$0.00	$0.00
McKinley	Kayla	**5**	DESU	$0.00	$12,800.00	$0.00	$0.00	$0.00	$0.00
Metz	Kendall	**5**	DESU	$0.00	$12,800.00	$0.00	$0.00	$0.00	$0.00
Nash	Jonathan	**5**	HU	$45,000.00	$0.00	$477.20	$0.00	$0.00	$0.00
Reeves	T'Kiyah	**5**	HU	$20,000.00	$0.00	$477.20	$0.00	$0.00	$0.00
Richardson	Derrick	**5**	HU	$39,801.00	$0.00	$477.20	$0.00	$0.00	$0.00
Savannah	Clax	**5**	OSU	$0.00	$0.00	$2,375.77	$0.00	$0.00	$0.00
Savannah	Clax	**5**	SSU	$6,000.00	$0.00	$682.00	$0.00	$0.00	$0.00
Shaw	Michon	**5**	SSU	$12,000.00	$1,038.64	$0.00	$0.00	$0.00	$0.00
Smalls	Jasmine	**5**	UMES	$997.00	$13,370.32	$590.96	$0.00	$0.00	$0.00
Tait	Noah	**5**	HU	$6,845.00	$9,000.00	$477.20	$0.00	$0.00	$0.00
Glen	Colins	4	UMES	$29,207.00	$1,901.20	$1,423.54	$0.00	$0.00	$0.00
Hawkins	Pa-Shun	4	HU	$40,000.00	$0.00	$477.20	$0.00	$0.00	$0.00
Maria	Henson	1	HU	$10,000.00	$0.00	$477.20	$0.00	$0.00	$0.00
Teat	Marcus	2	DESU	$7,230.00	$16,153.90	$0.00	$0.00	$0.00	$0.00
Volmar	Lady	4	SSU	$9,118.37	$0.00	$1,322.41	$0.00	$0.00	$0.00

XII. Acronyms

BOV: Board of Visitors
CCA: Center Core Administration

CLIME: Climate Impacts on Marine Ecosystems
EC: Executive Committee
FESS: Fishery Economics and Social Sciences
GIS: Geographical Information Systems
HaBS: Habitats and Biological Systems
LMRCSC: Living Marine Resources Cooperative Science Center
NERTO: NOAA Experiential Research and Training Opportunity
RSETP: Rising Sophomore Experiential Training Program
SASI: Stock Assessment Support and Information
SNAP: Seafood, Nutrition, Aquaculture, and Pathology
TAB: Technical Advisory Board

Appendix 1: LMRCSC Graduates

Name (Last, First)	Degree	URM	Cohort Number	Institution	Major	Actual Grad. Date	Next Steps
Teat, Marcus	B.S.	Y	2	DESU	Environmental Science	12/1/20	Further Education: Delaware State University; M.S.; Environmental Science
Galvez, Brian	M.S.	Y	1	DESU	Fishing & Fisheries Science & Management	5/1/19	Employment: Delaware Department of Natural Resources and Environmental Control; Conservation Specialist
Kleponis, Nicole	M.S.	N	2	DESU	Life Sciences	12/1/19	Employment: State of California; Wildlife Conservation Management Planner
Pappas, Amanda	M.S.	N	1	DESU	Environmental Science	12/1/20	Employment: Academia; University of Delaware Citizens Monitoring Program; Water Quality Analyst
Dorsey, Kendra	B.S.	Y	2	HU	Marine Sciences	5/1/19	Further Education: University of Michigan-Ann Arbor; M.S.; Environmental Science
Fenwick, Ileana	B.S.	Y	1	HU	Marine Sciences	5/1/20	Further Education: University of North Carolina at Chapel Hill; Ph.D.; Marine Science
Henson, Maria	B.S.	Y	1	HU	Marine Science	5/7/22	Employment: U.S. Navy; Naval Flight School

Layton, Janelle	B.S.	Y	2	HU	Marine Sciences	5/1/20	Further Education: Oregon State University; M.S.; Marine Science
Milton, Isaiah	B.S.	Y	1	HU	Marine Sciences	8/1/20	Employment: Academia; University of California Los Angeles; Technician
Smith, Nefertiti	B.S.	Y	1	HU	Marine Sciences	5/1/19	Further Education: University of California-Irvine; Ph.D.; Evolutionary Biology
Tolin, Amani	B.S.	Y	3	HU	Marine Science	5/1/21	Further Education: University of Michigan; M.S.; Environmental Science
Bender, Arona	M.S.	Y	3	HU	Marine Science	5/7/22	Further Education: Duke University, Ph.D.; Marine Science
Leslie, Jaelyn	M.S.	Y	4	HU	Marine Science	5/7/22	Employment: University of North Carolina Chapel Hill; Research Technician
Mayes, Cristin	M.S.	Y	1	HU	Applied Mathematics	8/1/20	Further Education: University of Miami RSMAS; Ph.D.; Marine Science
McLean, Josette	M.S.	Y	2	HU	Marine Science	5/1/21	Further Education: Duke University, Ph.D.; Marine Science
Hildebrandt, Siera	M.S.	N	2	HU	Marine Science	5/1/21	Further Education: Old Dominion University; Ph.D.; Marine Biology
Moreno, Victoria	M.S.	Y	4	OSU	Public Policy	12/31/21	Fellowship: John A. Knauss Marine Policy Fellow
Munguia, Angie	M.S.	Y	1	OSU	Fishing & Fisheries Science & Management	12/1/19	Employment: Washington Department of Fish and Wildlife; Technician
Pelekai, Keala	M.S.	Y	3	OSU	Fishing & Fisheries Science & Management	6/1/21	Employment: Idaho Fish and Game; Fisheries Biologist
King, Brittany	Ph.D.	Y	2	OSU	Life Sciences	12/31/21	Employment: NOAA NCCOS; Environmental Scientist
Ramirez, Matthew	Ph.D.	Y	2	OSU	Fishing & Fisheries Science & Management	12/1/19	Employment: Academia; University of North Carolina Wilmington; Assistant Professor
Ambrose, Alexandra	B.S.	Y	2	SSU	Marine Sciences	12/1/19	Further Education: Rutgers University; M.S.; Oceanography
Burns, William	B.S.	Y	5	SSU	Marine Science	5/1/21	Further Education: Savannah State University; M.S.; Biological Science

Clax, Savannah	B.S.	Y	5	SSU	Marine Science	5/6/22	Further Education: Oregon State University; M.S.; Marine Science
Day, Joe	B.S.	Y	2	SSU	Marine Sciences	5/1/21	Further Education: Savannah State University; M.S.; Marine Biology
Freeman, Dante	B.S.	Y	1	SSU	Marine Sciences	5/1/19	Further Education: University of Miami; M.S.; Tropical Marine Ecosystem Management
Hammond, Erianna	B.S.	Y	3	SSU	Marine Sciences	5/10/22	Employment: NOAA NMFS Office of Sustainable Fisheries; Fisheries Management Specialist
Tay, Sena	B.S.	Y	2	SSU	Ocean / Marine Sciences	5/1/20	Further Education: Savannah State University; M.S.; Marine Science
Volmar, Lady	B.S.	Y	5	SSU	Marine Science	5/6/22	Employment: Private Sector; Children Dallas Aquarium; Aquarist
Drayton, Davielle	M.S.	Y	2	SSU	Marine Sciences	5/1/20	Regulatory Division, US Army Corps of Engineers
Geiger, Savannah	M.S.	N	4	SSU	Marine Science	12/10/21	Employment: Academia; STEMSeas Instructor
Griffin, Emily	M.S.	N	1	SSU	Marine Sciences	5/1/18	Further Education: University of Florida; Ph.D.; Aquatic Animal Health
Howard, Kristafer	M.S.	Y	5	SSU	Marine Science	5/6/22	Employment: Non-Profit Organization; Ogeechee Riverkeepers; Outreach and Data
Frey, Benjamin	M.S.	Y	3	UMCES	Environment al Science	5/22/22	Employment: NOAA Marine Debris Program
Lawrence, Amanda	M.S.	Y	2	UMCES	Environment al Science	8/1/20	Employment: NOAA National Seagrant Office; Fellowships Coordinator
Green, Shadaesha	Ph.D.	Y	1	UMCES	Environment al Science	5/24/22	Employment: NOAA Office of Education; Grants Specialist
Hanif, Ammar	Ph.D.	Y	1	UMCES	Environment al Science	5/1/20	Employment: NOAA NOS-NCCOS; Environmental Scientist
Barry, Teemer	B.S.	Y	3	UMES	Environment al Science	5/1/22	Further Education: Rutgers University; Ph.D.; Oceanography
Best-Otubu, Chryston	B.S.	Y	1	UMES	Environment al Science	5/1/20	Further Education: University of Miami RSMAS; Ph.D.; Fisheries Science

Coit, Nakia	B.S.	Y	1	UMES	Life Sciences	5/1/19	Further Education: Tuskegee University; D.V.M.; Veterinary Medicine
Davis, DaQuan	B.S.	Y	3	UMES	Environmental Science	5/1/21	Unknown
Fielding, Semaj	B.S.	Y	3	UMES	Environmental Science	5/20/22	Further Education: Southern University Law Center; J.D.
Knight, Rhyan	B.S.	Y	3	UMES	Marine Sciences	5/1/20	Further Education: University of Maryland Eastern Shore; M.S.; Toxicology
McClain, Nylah	B.S.	Y	1	UMES	Environmental Science	5/1/20	Further Education: University of Maryland Eastern Shore; M.S.; Marine Science
Oliver, India	B.S.	Y	1	UMES	Marine Biology & Biological Oceanography	5/1/20	Employment: US Post Office
Rufus, Mya	B.S.	Y	4	UMES	Environmental Science	12/17/21	Employment: Non-Profit Organization Conservation Legacy; Youth Empowerment Steward at Fort McHenry National Monument and Historic Shrine
Munoz Ruiz, Enid	M.S.	Y	2	UMES	Toxicology	5/1/20	Employment: Academia; University of Maryland Eastern Shore; Research Assistant
Price, Andre	M.S.	Y	2	UMES	Fishing & Fisheries Science & Management	5/1/19	Employment: NOAA Contractor Woods Hole Science Aquarium: Aquarist
Wenker, Rebecca	M.S.	N	1	UMES	Fishing & Fisheries Science & Management	5/1/19	Employment: Academia; Cooperative Center for Sattelite Earth Systems Studies; Faculty Assistant
Cruz Marrero, Wilmelie	Ph.D.	Y	3	UMES	Fishing & Fisheries Science & Management	5/1/20	Employment: NOAA CBO; Fisheries Biologist
Martinez-Rivera, Stephanie	Ph.D.	Y	1	UMES	Fishing & Fisheries Science & Management	12/1/18	Employment: NOAA NMFS SEFSC; Fisheries Biologist
Rodriguez, Jorge	Ph.D.	Y	2	UMES	Biotechnology	5/1/19	Employment: US FDA; Staff Fellow Biologist
Rosales, Detbra	Ph.D.	Y	1	UMES	Ecology	11/1/20	Employment: Academia; University of Maryland Eastern Shore; Post Doctoral Fellow

Schweitzer, Cara	Ph.D.	Y	2	UMES	Ecology	5/1/19	Employment: Academia; Hampton University; Post Doctoral Researcher
Cervera, Juan	M.S.	Y	3	UM-RSMAS	Fishing & Fisheries Science & Management	7/1/21	Employment: NOAA NCCOS; Environmental Scientist
Denson, Latreese	Ph.D.	Y	2	UM-RSMAS	Marine Sciences	7/1/21	Employment: NOAA SEFSC; Stock Assessment Scientist
O'Farrell, Halie	Ph.D.	Y	1	UM-RSMAS	Marine Sciences	2/1/21	Employment: State of Florida Fish and Wildlife Research Institute; Associate Research Scientist

Appendix 2: Incomplete Students

This table contains students who have not completed the LMRCSC program. This includes those who were supported through non-degree training programs including the Geoscience Bridge Program and Rising Sophomore Experiential Training Program. It also includes those who have left the LMRCSC for various reasons. Finally, it includes students who are in good standing with the LMRCSC and are expected to graduate having completed LMRCSC requirements (shaded blue).

Name (Last, First)	**Degree**	**Cohort Number**	**Institution**	**Years supported**	**End of support**	**Next step**	**Tuition**	**Stipend**	**Travel**	**One-time Research**	**NERTO**	**Prof. Dev.**
Baskerville, Debra	B.S.	1	UMES	0.2	8/31/17	Withdrew from the program and transferred to another univ. due to change in academic interest.	$-	$-	$-	$-	$-	$5,731
James, Carl-Michael	B.S.	1	DESU	0.3	12/17/17	Withdrew from the program for family reasons; eventually completed his degree without Center support.	$-	$2,100	$-	$-	$-	$-
Sanford, Darius	B.S.	1	SSU	2.5	8/31/19	Continuing degree at SSU	$-	$26,378	$9,094	$-	$-	$-

Smith, Malisa	B.S.	1	UMES	1	5/15/18	Withdrew from the program due to a change in academic interest	$8,086	$4,799	$1,978	$-	$-	$-
Thalmann, Hillary	Ph.D.	1	OSU	4	8/31/22	Continuing degree under other funding	$29,808	$52,607	$9,083	$6,697	$ -	$4,151
Horsey, Aris-Aja	B.S.	2	UMES	1.7	8/31/19	Suspended due to academic performance; no longer eligible to return.	$11,222	$1,636	$1,415	$ -	$-	$-
Love, Desmond	B.S.	2	UMES	0.7	5/15/18	Suspended due to academic performance; changed major.	$4,046	$-	$-	$ -	$-	$-
Shaw, Michon	B.S.	2	SSU	1.1	8/31/22	Continuing degree at SSU	$18,000	$1,045	$-	$ -	$-	$-
Coleman, Nicholas	M.S.	2	UMCES	2.3	6/30/22	Completed all requirements; diploma will be issued Dec. 2022	$18,578	$68,842	$9,530	$9,491	$-	$-
Almodovar-Acevedo, Laura	Ph.D.	2	UMES	4.3	8/31/19	Continuing degree without funding	$1,907	$23,627	$-	$-	$2,838	$454
Rubalcava, Kasondra	Ph.D.	2	UMES	5	8/31/22	Kasondra has completed all requirements except to submit her dissertation. She is expected to complete this task in Fall 2022.	$35,976	$162,198	$5,779	$-	$5,580	$4,087
Wilson, Adrianne	Ph.D.	2	UM-RSMAS	5	8/31/22	Continuing degree under other funding	$92,102	$116,170	$6,216	$1,586	$10,000	$822
Cruz, Kathryn	B.S.	3	HU	2	8/31/20	Completed degree under other funding	$-	$15,000	$ -	$-	$-	$-
Sanvee, Eunice	B.S.	3	DSU	1.3	8/31/20	Withdrawn from LMRCSC; continuing degree at DESU	$-	$3,740	$-	$-	$ -	$-
Simmons, Kiani	B.S.	3	DSU	0.6	8/31/19	Suspended due to academic performance; completed her degree without Center support.	$-	$820	$-	$-	$-	$-

Washington, Tyler	B.S.	3	UMES	2.5	2/28/21	Withdrew from program; changed major	$16,988	$2,045	$ -	$-	$-	$-
Williams, Micheal	B.S.	3	SSU	1.1	8/31/19	Unknown, no longer in contact						
Czajkowski, Caitlyn	M.S.	3	DESU	2.1	8/31/22	Completing degree under other funding.	$62,408	$22,394	$ -	$-	$-	$-
Mackey, Shaneese	M.S.	3	SSU	2.9	2/28/21	Continuing degree at SSU and working as Research Technician	$9,313	$66,250	$4,981	$761	$-	$-
Rodríguez-Sanoguet, Luis	M.S.	3	DESU	1.8	5/31/21	Withdrawn from the univ.	$13,622	$22,616	$ -	$-	$ -	$-
Byrd, Anya	Ph.D.	3	UMCES	1	8/31/19	Withdrew from program	$24,220	$25,487	$-	$-	$-	$386
Haughton, Shanelle	Ph.D.	3	UMES	3.3	12/31/21	Shanelle left LMRCSC funding when she received the NOAA EPP/MSI Graduate Fellowship. She is continuing her degree in that program.	$32,097	$90,113	$-	$-	$5,211	$634
Silver, Ashley	Ph.D.	3	UMES	2.7	8/31/22	Requested to transfer to LMRCSC II to continue degree	$32,360	$64,954	$45	$-	$ -	$ -
Collins, Glen	B.S.	4	UMES	2	8/31/22	Requested to transfer to LMRCSC II to continue degree	$38,804	$1,901	$1,424	$-	$-	$ -
Hawkins, Pa-Shun	B.S.	4	HU	1.8	6/1/22	Continuing degree at HU	$50,000	$33,250	$477	$-	$-	$ -
Spaulding, Chelsea	B.S.	4	SSU	2	8/31/21	Requested to transfer to LMRCSC II to continue degree	$3,509	$11,019	$1,921	$ -	$-	$ -
Summer, Larry	B.S.	4	UMES	1	8/31/20	Suspended due to academic performance; graduated while not supported.	$4,279	$301	$-	$-	$-	$ -
Tennant, Alexandria	B.S.	4	SSU	2	8/31/22	Requested to transfer to LMRCSC II to continue degree	$15,357	$12,960	$-	$-	$-	$ -
Andrade, Emily	M.S.	4	DESU	1	8/31/22	Requested to transfer to LMRCSC II to continue degree	$5,863	$30,000	$2,564	$-	$-	$ -

Goffe, Shakira	M.S.	4	UMES	3	8/31/22	Defended thesis Aug. 2022, expected official graduation Dec. 2022	$20,008	$39,685	$1,698	$ -	$-	$ -
Layton, Janelle	M.S.	4	OSU	2	8/31/22	Requested to transfer to LMRCSC II to continue degree	$35,400	$76,484	$7,790	$-	$15,277	$ -
Tay, Sena	M.S.	4	SSU	2.1	8/31/22	Requested to transfer to LMRCSC II to continue degree	$8,178	$48,083	$3,870	$-	$-	$ -
Wilburn, Imani	M.S.	4	UMES	3	8/31/22	Requested to transfer to LMRCSC II to continue degree	$25,134	$42,901	$41	$-	$4,587	$ -
Johnson, Tahirah	Ph.D.	4	UMES	3	8/31/22	Requested to transfer to LMRCSC II to continue degree	$19,958	$73,267	$5,646	$-	$-	$ -
Mayes, Cristin	Ph.D.	4	UM-RSMAS	3.1	8/31/22	Continuing degree under other funding	$65,788	$58,077	$1,341	$4,101	$ -	$ -
Ramarui, Kyarii	Ph.D.	4	UMCES	3	8/31/22	Requested to transfer to LMRCSC II to continue degree	$19,053	$116,082	$7,067	$22,601	$7,347	$ -
Blackwood, Mikaela	B.S.	5	UMES	0.3	12/31/21	Suspended due to academic performance; eligible to return if grades improve.	$5,590	$-	$-	$-	$-	$-
Brown, Malika	B.S.	5	UMES	1	8/31/22	Requested to transfer to LMRCSC II to continue degree	$14,465	$54	$862	$ -	$-	$-
Clovis, Nina	B.S.	5	UMES	1	8/31/22	Requested to transfer to LMRCSC II to continue degree	$15,476	$675	$-	$-	$-	$-
McKinley, Kayla	B.S.	5	DESU	0.8	6/30/22	Withdrawn from LMRCSC; changed program	$-	$12,800	$-	$-	$-	$-
Metz, Kendall	B.S.	5	DESU	0.8	6/30/22	Withdrawn from LMRCSC; changed program	$-	$12,800	$-	$-	$-	$-
Nash, Jonathan	B.S.	5	HU	1.4	6/1/22	Continuing degree at HU	$50,000	$-	$477	$-	$-	$-

Reeves, t'Kiyah	B.S.	5	HU	1.7	8/31/22	Requested to transfer to LMRCSC II to continue degree	$25,000	$-	$477	$-	$-	$-
Richardson, Derrick	B.S.	5	HU	1.4	6/1/22	Continuing degree at HU	$5,855	$58,309	$ -	$-	$4,907	$258
Cohn, Leanne	M.S.	5	OSU	1.2	8/31/22	Requested to transfer to LMRCSC II to continue degree	$30,089	$44,182	$1,382	$-	$ -	$-
Day, Joe	M.S.	5	SSU	1.1	8/31/22	Requested to transfer to LMRCSC II to continue degree	$62,408	$22,394	$-	$-	$ -	$ -
Lemaire, Cloe	M.S.	5	SSU	1.1	8/31/22	Requested to transfer to LMRCSC II to continue degree	$25,061	$36,091	$1,372	$-	$1,883	$-
Reyes Delgado, Angel	M.S.	5	UMES	1.1	8/31/22	Requested to transfer to LMRCSC II to continue degree	$29,592	$28,781	$41	$-	$3,757	$-
Tait, Noah	M.S.	5	HU	0.7	8/31/22	Requested to transfer to LMRCSC II to continue degree	$6,845	$9,000	$477	$-	$-	$-
Teat, Marcus	M.S.	5	DESU	1.2	8/31/22	Requested to transfer to LMRCSC II to continue degree	$27,661	$63,269	$7,441	$-	$-	$-
Wade, Kaitlynn	M.S.	5	UMES	1.1	8/31/22	Requested to transfer to LMRCSC II to continue degree	$24,098	$22,569	$4,944	$-	$3,555	$-
Best-Otubu, Chryston	Ph.D.	5	UM-RSMAS	2	8/31/22	Transferred to LMRCSC II to continue degree	$61,136	$69,585	$852	$-	$7,808	$ -
Garcia Prieto, David	Ph.D.	5	UMCES	1	8/31/22	Requested to transfer to LMRCSC II to continue degree	$2,954	$22,296	$1,288	$17,172	$-	$-
Pares, Olivia	Ph.D.	5	UMCES	2.5	8/31/22	Requested to transfer to LMRCSC II to continue degree	$18,888	$78,190	$10,590	$9,366	$10,342	$-
Smalls, Jasmine	Ph.D.	5	UMES	0.4	8/31/22	Requested to transfer to LMRCSC II to continue degree	$997	$13,370	$591	$-	$-	$-
Wong-Ala, Jennifer	Ph.D.	5	OSU	1	8/31/22	Transferred to LMRCSC II to continue degree	$20,545	$37,030	$5,470	$-	$2,684	$-

Adams, Keon	No Degree	GEO	UMES	0.2	8/15/22	Pursuing a A.A. in Earth and Atmospheric Sciences at Baltimore Community College						$5,950
Ajhar, Daja	No Degree	GEO	UMES	0.2	8/15/22	Pursuing a B.S. in Marine Science at Savannah State Univ.						$7,051
Armstrong, Kevin	No Degree	GEO	UMES	0.2	8/15/22	Pursuing B.S. in Environ. Science at UMES						$5,950
Baker, Elyssa	No Degree	GEO	UMES	0.2	8/15/21	Pursuing B.S. in Environ. Science at Adventist Antilles Univ.	$1,776	$3,191	$1,196			
Barias, Eymani	No Degree	GEO	UMES	0.2	8/15/22	Pursuing B.S. in Environ. Science at Florida A&M University						$7,051
Bennett, Cameron	No Degree	GEO	UMES	0.2	8/15/22	Pursuing B.S. degree in Meterology at Jackson State Univ.	$1,776	$3,191	$1,196			
Blackwood, Mikaela	No Degree	GEO	UMES	0.2	8/15/21	Pursuing B.S. in Environ. Science at UMES	$1,776	$3,191	$1,196			
Bowie, Myah	No Degree	GEO	UMES	0.2	8/15/22	Pursuing B.S. in Environ. Science at UMES						$5,950
Bullock, Daryl	No Degree	GEO	UMES	0.2	8/15/22	Pursuing B.S. in Environ. Science at UMES						$5,950
Byer, Indaya	No Degree	GEO	UMES	0.2	8/15/21	Pursuing B.S. in Environ. Science at Nova Southeastern University	$1,776	$3,191	$1,196			
Chaney, Galloway	No Degree	GEO	UMES	0.2	8/15/22	Pursuing B.S. in Environ. Science at Florida A&M University						$7,051
Colbert-Williams, Jayme	No Degree	GEO	UMES	0.2	8/15/20	Pursuing B.S. in Environ. Science at Florida A&M University	$1,776	$2,900				
Coleman, Destiny	No Degree	GEO	UMES	0.2	8/15/20	Pursuing B.S. in Environ. Science at Florida A&M University	$1,776	$2,900				
Colins, Glen	No Degree	GEO	UMES	0.2	8/15/20	Pursuing B.S. in Environ.	$1,776	$2,900				

						Science at UMES						
Dafalla, Reem	No Degree	GEO	UMES	0.2	8/15/20	Pursuing B.S. in Biology at Morgan State Univ.	$699					
Dupree, Amari	No Degree	GEO	UMES	0.2	8/15/21	Pursuing B.S. in Environ. Science at UMES	$699	$3,191	$1,196			
Felder, Miya	No Degree	GEO	UMES	0.2	8/15/20	Pursuing B.S. in Environ. Science at Virginia State University	$699	$2,900				
Harrell, Xavier	No Degree	GEO	UMES	0.2	8/15/22	Pursuing B.S. in Environ. Science at Florida A&M University						$7,051
Jeanpierre, Nyla	No Degree	GEO	UMES	0.2	8/15/20	Pursuing B.S. in Environ. Science at UMES	$699	$2,900				
Jones, Leianna	No Degree	GEO	UMES	0.2	8/15/22	Pursuing B.S. in Environ. Science at UMES						$5,950
Malugin-Ayala, Beverly	No Degree	GEO	UMES	0.2	8/15/21	Pursuing B.S. in Geology at University of Puerto Rico Mayaguez	$1,776	$3,191	$1,196			
Moody, Jamaree	No Degree	GEO	UMES	0.2	8/15/21	Pursuing B.S. in Environ. Science at UMES	$699	$3,191	$1,196			
Nwakwuo, Moses	No Degree	GEO	UMES	0.2	8/15/22	Pursuing B.S. in Computer Science at UMES						$7,051
Pharrams, Anazia	No Degree	GEO	UMES	0.2	8/15/22	Pursuing B.S. in Environ. Science at Florida A&M University						$7,051
Whatley, Ronald	No Degree	GEO	UMES	0.2	8/15/21	Pursuing B.S. in Environ. Science at UMES	$699	$3,191	$1,196			
Williams, Joel	No Degree	GEO	UMES	0.2	8/15/20	Pursuing B.S. in Environ. Science at Florida A&M University	$1,776	$2,900				
Winn, Kayla	No Degree	GEO	UMES	0.2	8/15/22	Pursuing B.S. in Environ. Science at UMES						$7,051
Tennant, Alexandria	None	GEO	UMES	0.2	8/15/21	Pursuing B.S. degree in Marine Science at SSU		$960				
Bommer, Colby	No Degree	RSTEP	UMES	0.2	8/15/18	Continuing degree at HU						$3,211

Crommarty, Khari	No Degree	RSTEP	UMES	0.2	8/15/18	Continuing degree at HU						$3,222
Jackson, Langston	No Degree	TAB	HU	0.2	8/31/22	Continuing degree at HU	$13,000	$2,500	$-	$-	$-	$ -
Smith, Marci-Ann	B.S.		UMES	3.7	8/31/19	Suspended due to academic performance; graduated while not supported.	$-	$ -	$-	$-	$-	$4,555
Freeman, TyRae	No Degree		DESU	1.2	8/31/17	Graduated without completing LMRCSC requirements	$13,505	$21,486	$-	$-	$-	$-

Appendix 3: Supported Students - Majors, Advisors, and Research Thematic Areas

Name (Last, First)	**Degree**	**Institution**	**Cohort Number**	**Major**	**Academic Research Advisor**	**Thematic Area**
James, Carl-Michael	B.S.	DESU	1	Agricultural and Resource Economics	Stacy Smith	
Simmons, Kiani	B.S.	DESU	3	Biology/Biomedical Sciences	Stacy Smith	
Sanvee, Eunice	B.S.	DESU	3	Computer & Information Sciences	Stacy Smith	
Teat, Marcus	B.S.	DESU	2	Environmental Science	Gulnihal Ozbay	
McKinley, Kayla	B.S.	DESU	5	Environmental Science	Gulnihal Ozbay	
Metz, Kendall	B.S.	DESU	5	Agriculture Education	Gulnihal Ozbay	
Teat, Marcus	M.S.	DESU	5	Environmental Science	Gulnihal Ozbay	SNAP
Kleponis, Nicole	M.S.	DESU	2	Life Sciences	Christopher Heckscher	HaBS
Pappas, Amanda	M.S.	DESU	1	Environmental Science	Gulnihal Ozbay	HaBS
Czajkowski, Caitlyn	M.S.	DESU	3	Aquaculture	Dennis McIntosh	SNAP
Andrade, Emily	M.S.	DESU	4	Environmental Science	Gulnihal Ozbay	SNAP
Galvez, Brian	M.S.	DESU	1	Fishing & Fisheries Science & Management	Stacy Smith	SASI
Rodríguez-Sanoguet, Luis	M.S.	DESU	3	Marine Biology & Biological Oceanography	Kevina Vulinec	HaBS
Dorsey, Kendra	B.S.	HU	2	Marine Sciences	Andrij Horodysky	
Smith, Nefertiti	B.S.	HU	1	Marine Sciences	Carolina Lewallen	
Layton, Janelle	B.S.	HU	2	Marine Sciences	Eric Lewallen	

Milton, Isaiah	B.S.	HU	1	Marine Sciences	Carolina Lewallen	
Tolin, Amani	B.S.	HU	3	Marine Science	Benjamin Cuker, Shawn T. Dash	
Hawkins, Pa-Shun	B.S.	HU	4	Marine Science	Indu Sharma	
Nash, Jonathan	B.S.	HU	5	Marine Science	Andrij Horodysky	
Richardson, Derrick	B.S.	HU	5	Marine Science	Deidre Gibson	
Fenwick, Ileana	B.S.	HU	1	Marine Sciences	Deidre Gibson	
Reeves, t'Kiyah	B.S.	HU	5	Marine Science	Deidre Gibson	
Cruz, Kathryn	B.S.	HU	3	Genetics/Genomics	Carolina Lewallen	
Henson, Maria	B.S.	HU	1	Marine Science	Andrij Horodysky	
Mayes, Cristin	M.S.	HU	1	Applied Mathematics	Eric Lewallen	SASI
McLean, Josette	M.S.	HU	2	Marine Science	Eric Lewallen	HaBS
Bender, Arona	M.S.	HU	3	Marine Science	Carolina Llewallen	CLIME
Leslie, Jaelyn	M.S.	HU	4	Marine Science	Carolina Lewallen	HaBS
Tait, Noah	M.S.	HU	5	Marine Science	Tunde Adebola	SASI
Hildebrandt, Siera	M.S.	HU	2	Marine Science	Deidre Gibson	HaBS
Cohn, Leanne	M.S.	OSU	5	Marine Resource Management	Flaxen Conway	CLIME
Moreno, Victoria	M.S.	OSU	4	Public Policy	Ana Spalding	FESS; CLIME
Layton, Janelle	M.S.	OSU	4	Fisheries Sciences	Scott Heppell	CLIME
Pelekai, Keala	M.S.	OSU	3	Fishing & Fisheries Science & Management	Jessica A. Miller	SASI
Munguia, Angie	M.S.	OSU	1	Fishing & Fisheries Science & Management	Jessica A. Miller	SASI
King, Brittany	Ph.D.	OSU	2	Life Sciences	Kelly Biedenweg	FESS
Wong-Ala, Jennifer	Ph.D.	OSU	5	Environmental Science	Lorenzo Ciannelli	CLIME
Thalmann, Hillary	Ph.D.	OSU	1	Fishing & Fisheries Science & Management	Jessica A. Miller	CLIME
Ramirez, Matthew	Ph.D.	OSU	2	Fishing & Fisheries Science & Management	Selina Heppell	SASI
Ambrose, Alexandra	B.S.	SSU	2	Marine Sciences	Christopher Hintz	
Williams, Micheal	B.S.	SSU	3	Marine Sciences	Dionne Hoskins-Brown	
Sanford, Darius	B.S.	SSU	1	Marine Sciences	Dionne Hoskins-Brown	
Tay, Sena	B.S.	SSU	2	Ocean / Marine Sciences	Mary C. Curran	
Hammond, Erianna	B.S.	SSU	3	Marine Sciences	Tara Cox	
Day, Joe	B.S.	SSU	2	Marine Sciences	Teah Jones	
Shaw, Michon	B.S.	SSU	2	Marine Science	Amanda Kaltenburg	

Tennant, Alexandria	B.S.	SSU	4	Marine Science	Sue Ebanks	
Freeman, Dante	B.S.	SSU	1	Marine Sciences	Tara Cox	
Burns, William	B.S.	SSU	5	Marine Science	Matthew Kenworthy	
Volmar, Lady	B.S.	SSU	5	Marine Science	Sue Ebanks	
Clax, Savannah	B.S.	SSU	5	Marine Science	Victoria Young	
Spaulding, Chelsea	B.S.	SSU	4	Marine Science	Dionne Hoskins-Brown	
Howard, Kristafer	M.S.	SSU	5	Marine Science	Dionne Hoskins-Brown	HaBS
Drayton, Davielle	M.S.	SSU	2	Marine Sciences	Dionne Hoskins-Brown	HaBS
Mackey, Shaneese	M.S.	SSU	3	Marine Sciences	Dionne Hoskins-Brown	HaBS
Day, Joe	M.S.	SSU	5	Marine Biology	Tara Cox	SASI
Tay, Sena	M.S.	SSU	4	Marine Science	Tara Cox	SASI
Lemaire, Cloe	M.S.	SSU	5	Marine Science	Christopher Hintz	HaBS
Griffin, Emily	M.S.	SSU	1	Marine Sciences	Tara Cox	SASI
Geiger, Savannah	M.S.	SSU	4	Marine Science	Sue Ebanks	HaBS
Lawrence, Amanda	M.S.	UMCES	2	Environmental Science	Jum Sook Chung	SASI
Coleman, Nicholas	M.S.	UMCES	2	Environmental Science	David Secor	SASI
Frey, Benjamin	M.S.	UMCES	3	Environmental Science	David Secor	SASI
Byrd, Anya	Ph.D.	UMCES	3	Marine Sciences	Sook Chung	SASI
Hanif, Ammar	Ph.D.	UMCES	1	Environmental Science	Rosemary Jagus	SASI
Green, Shadaesha	Ph.D.	UMCES	1	Environmental Science	Jum Sook Chung	SASI
Garcia Prieto, David	Ph.D.	UMCES	5	Marine Science	Clara Fuchsman	SASI
Pares, Olivia	Ph.D.	UMCES	5	Environmental Science	Eric Schott	SNAP
Ramarui, Kyarii	Ph.D.	UMCES	4	Environmental Science	Yantao Li	SNAP
Baskerville, Debra	B.S.	UMES	1	Biomedical	Joeseph Pitula	
Love, Desmond	B.S.	UMES	2	Environmental Science	Ali Ishaque	
Smith, Malisa	B.S.	UMES	1	Biomedical	Joseph Pitula	
Coit, Nakia	B.S.	UMES	1	Life Sciences	Joseph Pitula	
Horsey, Aris-Aja	B.S.	UMES	2	Environmental Science	Eric May	
Best-Otubu, Chryston	B.S.	UMES	1	Environmental Science	Paulinus Chigbu	
Oliver, India	B.S.	UMES	1	Marine Biology & Biological Oceanography	Joseph Pitula	
Washington, Tyler	B.S.	UMES	3	Biology	Brad Stevens	
Davis, DaQuan	B.S.	UMES	3	Environmental Science	Ligia DaSilva	
Rufus, Mya	B.S.	UMES	4	Environmental Science	Ali Ishaque	
Blackwood, Mikaela	B.S.	UMES	5	Environmental Science	Eric May	
Barry, Teemer	B.S.	UMES	3	Environmental Science	Ali Ishaque	

Brown, Malika	B.S.	UMES	5	Environmental Science	Daniel Cullen	
Collins, Glen	B.S.	UMES	4	Environmental Science	Paulinus Chigbu	
Smith, Marci-Ann	B.S.	UMES		Environmental Science	Ali ishaque	
Knight, Rhyan	B.S.	UMES	3	Marine Sciences	Paulinus Chigbu	
McClain, Nylah	B.S.	UMES	1	Environmental Science	Ali Ishaque	
Summer, Larry	B.S.	UMES	4	Environmental Science	Ali Ishaque	
Fielding, Semaj	B.S.	UMES	3	Environmental Science	Maurice Crawford	
Clovis, Nina	B.S.	UMES	5	Environmental Science	Paulinus Chigbu	
Price, Andre	M.S.	UMES	2	Fishing & Fisheries Science & Management	Bradley Stevens	SASI
Goffe, Shakira	M.S.	UMES	4	Fisheries Sciences	Paulinus Chigbu	SASI
Wilburn, Imani	M.S.	UMES	4	Fisheries Sciences	Maurice Crawford	HaBS
Wenker, Rebecca	M.S.	UMES	1	Fishing & Fisheries Science & Management	Bradley Stevens	SASI
Wade, Kaitlynn	M.S.	UMES	5	Marine Science	Daniel Cullen	SASI
Munoz Ruiz, Enid	M.S.	UMES	2	Toxicology	Ali Ishaque	HaBS
Reyes Delgado, Angel	M.S.	UMES	5	Marine Science	Paulinus Chigbu	HaBS
Johnson, Tahirah	Ph.D.	UMES	4	Environmental Science	Salina Parveen	SNAP
Smalls, Jasmine	Ph.D.	UMES	5	Marine Sciences	Salina Parveen	SNAP
Haughton, Shanelle	Ph.D.	UMES	3	Marine Sciences	Joseph Pitula	SASI
Silver, Ashley	Ph.D.	UMES	3	Marine Sciences	Paulinus Chigbu	HaBS
Martinez-Rivera, Stephanie	Ph.D.	UMES	1	Fishing & Fisheries Science & Management	Bradley Stevens	SASI
Rodriguez, Jorge	Ph.D.	UMES	2	Biotechnology	Anthony Nyame	HaBS
Schweitzer, Cara	Ph.D.	UMES	2	Ecology	Bradley Stevens	SASI
Almodovar-Acevedo, Laura	Ph.D.	UMES	2	Marine Sciences	Bradley Stevens	HaBS
Cruz Marrero, Wilmelie	Ph.D.	UMES	3	Fishing & Fisheries Science & Management	Bradley Stevens	HaBS
Rosales, Detbra	Ph.D.	UMES	1	Ecology	Joseph Pitula	HaBS
Rubalcava, Kasondra	Ph.D.	UMES	2	Marine Sciences	Paulinus Chigbu	SASI
Cervera, Juan	M.S.	UM-RSMAS	3	Fishing & Fisheries Science & Management	David Die	HaBS
Denson, Latreese	Ph.D.	UM-RSMAS	2	Marine Sciences	Elizabeth A. Babcock	SASI
Best-Otubu, Chryston	Ph.D.	UM-RSMAS	5	Fisheries Sciences	Elizabeth A. Babcock	FESS
Mayes, Cristin	Ph.D.	UM-RSMAS	4	Marine Sciences	David Die	SASI
Wilson, Adrianne	Ph.D.	UM-RSMAS	2	Marine Sciences	Elizabeth A. Babcock	SASI
O'Farrell, Halie	Ph.D.	UM-RSMAS	1	Marine Sciences	Elizabeth A. Babcock	SASI

Appendix 4: Supported Students – Race and Ethnicity, Graduation Status, and Duration of support

Name (Last, First)	Degree	Institution	Cohort Number	URM	gender	Race	Hispanic	Graduation Status	Actual Grad. Date	Years supported
James, Carl-Michael	B.S.	DESU	1	Y	M	Black or African-American	No	Unknown	5/1/19	0.3
Simmons, Kiani	B.S.	DESU	3	Y	F	Black or African-American	No	Unknown	5/1/20	0.6
Sanvee, Eunice	B.S.	DESU	3	Y	F	Black or African-American	No	Unknown		1.3
Teat, Marcus	B.S.	DESU	2	Y	M	Black or African-American	No	Yes	12/1/20	0.8
McKinley, Kayla	B.S.	DESU	5	Y	F	Black or African-American	No	Unknown		0.8
Metz, Kendall	B.S.	DESU	5	N	F	White	No	Unknown		0.8
Teat, Marcus	M.S.	DESU	5	Y	M	Black or African-American	No	No		1.2
Kleponis, Nicole	M.S.	DESU	2	N	F	White	No	Yes	12/1/19	1.9
Pappas, Amanda	M.S.	DESU	1	N	N	White	No	Yes	12/1/20	2.1
Czajkowski, Caitlyn	M.S.	DESU	3	N	F	White	No	No		2.1
Andrade, Emily	M.S.	DESU	4	Y	F	White	Yes	No		1.0
Galvez, Brian	M.S.	DESU	1	Y	M		Yes	Yes	5/1/19	2.3
Rodríguez-Sanoguet, Luis	M.S.	DESU	3	Y	M		Yes	Unknown		1.8
Dorsey, Kendra	B.S.	HU	2	Y	F	Black or African-American	No	Yes	5/1/19	1.7

Smith, Nefertiti	B.S.	HU	1	Y	F	Black or African-American	No	Yes	5/1/19	2.7
Layton, Janelle	B.S.	HU	2	Y	F	Black or African-American	No	Yes	5/1/20	2.7
Milton, Isaiah	B.S.	HU	1	Y	M	Black or African-American	No	Yes	8/1/20	2.9
Tolin, Amani	B.S.	HU	3	Y	M	Black or African-American	No	Yes	5/1/21	1.3
Hawkins, Pa-Shun	B.S.	HU	4	Y	F	Black or African-American	No	No		1.8
Nash, Jonathan	B.S.	HU	5	Y	M	Black or African-American	No	No		1.4
Richardson, Derrick	B.S.	HU	5	Y	M	Black or African-American	No	No		1.4
Fenwick, Ileana	B.S.	HU	1	Y	F	Black or African-American	Yes	Yes	5/1/20	2.7
Reeves, t'Kiyah	B.S.	HU	5	Y	F	Black or African-American, White	No	No		1.7
Cruz, Kathryn	B.S.	HU	3	N	F	White	No	Unknown		2.0
Henson, Maria	B.S.	HU	1	Y	F		Yes	Yes	5/7/22	1.3
Mayes, Cristin	M.S.	HU	1	Y	F	Black or African-American	No	Yes	8/1/20	2.9
McLean, Josette	M.S.	HU	2	Y	F	Black or African-American	No	Yes	5/1/21	1.7
Bender, Arona	M.S.	HU	3	Y	F	Black or African-American	No	Yes	5/7/22	2.3
Leslie, Jaelyn	M.S.	HU	4	Y	F	Black or African-American	No	Yes	5/7/22	1.8
Tait, Noah	M.S.	HU	5	N	M	White	No	No		0.7
Hildebrandt, Siera	M.S.	HU	2	N	F	White	No	Yes	5/1/21	1.7
Cohn, Leanne	M.S.	OSU	5	N	F	Asian	No	No		1.2

Moreno, Victoria	M.S.	OSU	4	Y	F	Black or African-American	Declined to answer	Yes	12/31/21	1.0
Layton, Janelle	M.S.	OSU	4	Y	F	Black or African-American	No	No		2.0
Pelekai, Keala	M.S.	OSU	3	Y	F	Native Hawaiian or Pacific Islander	No	Yes	6/1/21	2.8
Munguia, Angie	M.S.	OSU	1	Y	F		Yes	Yes	12/1/19	2.0
King, Brittany	Ph.D.	OSU	2	Y	F	Black or African-American	No	Yes	12/31/21	4.3
Wong-Ala, Jennifer	Ph.D.	OSU	5	Y	F	Native Hawaiian or Pacific Islander	No	No		1.0
Thalmann, Hillary	Ph.D.	OSU	1	N	F	White	No	No		4.0
Ramirez, Matthew	Ph.D.	OSU	2	Y	M		Yes	Yes	12/1/19	4.3
Ambrose, Alexandra	B.S.	SSU	2	Y	F	Black or African-American	No	Yes	12/1/19	1.0
Williams, Micheal	B.S.	SSU	3	Y	M	Black or African-American	No	Unknown		1.1
Sanford, Darius	B.S.	SSU	1	Y	M	Black or African-American	No	Unknown		2.5
Tay, Sena	B.S.	SSU	2	Y	F	Black or African-American	No	Yes	5/1/20	1.7
Hammond, Erianna	B.S.	SSU	3	Y	F	Black or African-American	No	Yes	5/10/22	2.0
Day, Joe	B.S.	SSU	2	Y	M	Black or African-American	No	Yes	5/1/21	3.8
Shaw, Michon	B.S.	SSU	2	Y	M	Black or African-American	No	No		1.1
Tennant, Alexandria	B.S.	SSU	4	Y	F	Black or African-American	No	No		2.0
Freeman, Dante	B.S.	SSU	1	Y	M	Black or African-American, Asian	No	Yes	5/1/19	0.7

Burns, William	B.S.	SSU	5	Y	M	Black or African-American, White	No	Yes	5/1/21	0.7
Volmar, Lady	B.S.	SSU	5	Y	F	Black or African-American, White	Yes	Yes	5/6/22	1.7
Clax, Savannah	B.S.	SSU	5	Y	F	Black or African-American, White, American Indian or Alaska Native	No	Yes	5/6/22	1.8
Spaulding, Chelsea	B.S.	SSU	4	Y	F	White, American Indian or Alaska Native	No	Unknown		2.0
Howard, Kristafer	M.S.	SSU	5	Y	M	Black or African-American	No	Yes	5/6/22	1.7
Drayton, Davielle	M.S.	SSU	2	Y	F	Black or African-American	No	Yes	5/1/20	1.8
Mackey, Shaneese	M.S.	SSU	3	Y	F	Black or African-American	No	No		2.9
Day, Joe	M.S.	SSU	5	Y	M	Black or African-American	No	No		1.1
Tay, Sena	M.S.	SSU	4	Y	F	Black or African-American	No	No		2.1
Lemaire, Cloe	M.S.	SSU	5	N	F	White	No	No		1.0
Griffin, Emily	M.S.	SSU	1	N	F	White	No	Yes	5/1/18	1.7
Geiger, Savannah	M.S.	SSU	4	N	F	White	No	Yes	12/10/21	2.0
Lawrence, Amanda	M.S.	UMCES	2	Y	F	Black or African-American	No	Yes	8/1/20	3.0
Coleman, Nicholas	M.S.	UMCES	2	Y	M	Black or African-American	No	No		2.5
Frey, Benjamin	M.S.	UMCES	3	Y	M	Black or African-American	No	Yes	5/22/22	3.0
Byrd, Anya	Ph.D.	UMCES	3	Y	F	Black or African-American	No	Unknown		1.0

Hanif, Ammar	Ph.D.	UMCES	1	Y	M	Black or African-American	No	Yes	5/1/20	2.8
Green, Shadaesha	Ph.D.	UMCES	1	Y	F	Black or African-American	No	Yes	5/24/22	3.8
Garcia Prieto, David	Ph.D.	UMCES	5	Y	M	White, American Indian or Alaska Native	Yes	No		1.0
Pares, Olivia	Ph.D.	UMCES	5	Y	F	White, American Indian or Alaska Native	Yes	No		2.5
Ramarui, Kyarii	Ph.D.	UMCES	4	Y	F	White, Native Hawaiian or Pacific Islander	No	No		3.0
Baskerville, Debra	B.S.	UMES	1	Y	F	American Indian or Alaska Native	No	Unknown		0.2
Love, Desmond	B.S.	UMES	2	Y	M	Black or African-American	No	Unknown		0.7
Smith, Malisa	B.S.	UMES	1	Y	F	Black or African-American	No	Unknown	5/1/19	1.0
Coit, Nakia	B.S.	UMES	1	Y	F	Black or African-American	No	Yes	5/1/19	2.3
Horsey, Aris-Aja	B.S.	UMES	2	Y	F	Black or African-American	No	Unknown		1.7
Best-Otubu, Chryston	B.S.	UMES	1	Y	M	Black or African-American	No	Yes	5/1/20	2.9
Oliver, India	B.S.	UMES	1	Y	F	Black or African-American	No	Yes	5/1/20	3.8
Washington, Tyler	B.S.	UMES	3	Y	M	Black or African-American	No	No		2.5
Davis, DaQuan	B.S.	UMES	3	Y	M	Black or African-American	No	Yes	5/1/21	2.9
Rufus, Mya	B.S.	UMES	4	Y	F	Black or African-American	No	Yes	12/17/21	2.3
Blackwood, Mikaela	B.S.	UMES	5	Y	F	Black or African-American	No	No		0.3

Barry, Teemer	B.S.	UMES	3	Y	M	Black or African-American	No	Yes	5/1/22	3.8
Brown, Malika	B.S.	UMES	5	Y	F	Black or African-American	No	No		1.0
Collins, Glen	B.S.	UMES	4	Y	M	Black or African-American	No	No		2.0
Smith, Marci-Ann	B.S.	UMES		Y	F	Black or African-American	No	Unknown	12/1/19	3.7
Knight, Rhyan	B.S.	UMES	3	Y	F	Black or African-American	No	Yes	5/1/20	3.8
McClain, Nylah	B.S.	UMES	1	Y	F	Black or African-American	No	Yes	5/1/20	2.9
Summer, Larry	B.S.	UMES	4	Y	M	Black or African-American	No	Unknown		1.0
Fielding, Semaj	B.S.	UMES	3	Y	F	Black or African-American	No	Yes	5/20/22	2.2
Clovis, Nina	B.S.	UMES	5	Y	F	Black or African-American, American Indian or Alaska Native	Yes	No		1.0
Price, Andre	M.S.	UMES	2	Y	M	Black or African-American	No	Yes	5/1/19	3.0
Goffe, Shakira	M.S.	UMES	4	Y	F	Black or African-American	No	No		3.0
Wilburn, Imani	M.S.	UMES	4	Y	F	Black or African-American	No	No		3.0
Wenker, Rebecca	M.S.	UMES	1	N	F	White	No	Yes	5/1/19	1.7
Wade, Kaitlynn	M.S.	UMES	5	N	F	White	No	No		1.1
Munoz Ruiz, Enid	M.S.	UMES	2	Y	F		Yes	Yes	5/1/20	2.7
Reyes Delgado, Angel	M.S.	UMES	5	Y	M		Yes	No		1.1
Johnson, Tahira	Ph.D.	UMES	4	Y	F	Black or African-American	No	No		3.0
Smalls, Jasmine	Ph.D.	UMES	5	Y	F	Black or African-American	No	No		0.4

Haughton, Shanelle	Ph.D.	UMES	3	Y	F	Black or African-American	No	No		3.3
Silver, Ashley	Ph.D.	UMES	3	Y	F	Black or African-American	No	No		2.7
Martinez-Rivera, Stephanie	Ph.D.	UMES	1	Y	F		Yes	Yes	12/1/18	4.9
Rodriguez, Jorge	Ph.D.	UMES	2	Y	M		Yes	Yes	5/1/19	4.3
Schweitzer, Cara	Ph.D.	UMES	2	Y	F		Yes	Yes	5/1/19	4.9
Almodovar-Acevedo, Laura	Ph.D.	UMES	2	Y	F		Yes	No		4.3
Cruz Marrero, Wilmelie	Ph.D.	UMES	3	Y	F		Yes	Yes	5/1/20	5.0
Rosales, Detbra	Ph.D.	UMES	1	Y	F		Yes	Yes	11/1/20	4.0
Rubalcava, Kasondra	Ph.D.	UMES	2	Y	F		Yes	No		5.0
Cervera, Juan	M.S.	UM-RSMAS	3	Y	M		Yes	Yes	7/1/21	1.9
Denson, Latreese	Ph.D.	UM-RSMAS	2	Y	F	Black or African-American	No	Yes	7/1/21	5.0
Best-Otubu, Chryston	Ph.D.	UM-RSMAS	5	Y	M	Black or African-American	No	No		2.0
Mayes, Cristin	Ph.D.	UM-RSMAS	4	Y	F	Black or African-American	No	No		3.1
Wilson, Adrianne	Ph.D.	UM-RSMAS	2	Y	F	Black or African-American	No	No		5.0
O'Farrell, Halie	Ph.D.	UM-RSMAS	1	Y	F	Declined to Answer	Yes	Yes	2/1/21	3.8

Appendix 5: Leveraged Funding

Funds leveraged from NOAA sources.

Source	Start date	End date	Total amount ($)	FY17	FY18	FY19	FY20	FY21	FY22 (No cost extension year)	PI	Project title	Contribution to Center
NOAA/NMFS	1/1/00		100,000							Dionne Hoskins	NOAA CMER	Support a NMFS FTE for a CMER program

NOAA S-K	9/1/15	11/27/19	358,305	84448	84448	84448	14075			Bradley Stevens	Assessment of Puerto Rico queen conch	Funds are used to pay stipend to and provide research support for Wilmelie Cruz (Ph.D. student at UMES); also provides partial salary for B. Stevens
NOAA BREP	9/1/16	5/30/19	139,925	50882	50882	38161				Bradley Stevens	Cold water corals in MAB	Funds are used to support a M.S. student Rebecca Wenker at UMES; also provides partial salary support for Brad Stevens
CIMAS	9/1/16	8/1/18	49,198							Elizabeth Babcock	Evaluation of Managt. Strategies for Fisheries Ecosystem, additional funds	Funding will help support at least one PhD student from LMRCSC
NOAA-ECOHAB	9/1/15	8/31/19	136,833	34208	34208	34208				Place, Allen	ECOHAB: Integrating Cell and Toxin Cycles of *Karlodinium veneficum* with Key Environmental Regulators: *In Situ* Studies of Predictive Determinants for Bloom Toxicity	
NOAA-Saltonstall Kennedy	6/1/15	5/31/18	299,381	99794	74845					Schott, Eric	Disease and discard mortality in the blue crab fishery: using new information about an old virus to improve management of the resource	
CIMAS	9/1/21	8/1/22	98,396						98396	Elizabeth Babcock	Bycatch estimation project	Funding supports one MS student and partial salary support for E. Babcock
NOAA Ocean Acidification Program	10/1/21	9/30/23	182,306						83557	Jennifer Leo, Jennifer Doerr, Chris Hintz, Dionne Hoskins-Brown, Matthew Johnson	Synergistic science to advance HBCU student learning in changing ecosystems: Scaling up education and the ecological effects of OA on coastal	Support for an LMRCSC grad student

											marsh systems	
NOAA Ocean Acidification Program	10/1/21	9/30/24	665,000						203194	Patricia Yager, Charlie Phillips, Thomas Bliss, Justin Manley, Dionne Hoskins-Brown, Brian Hopkinson, Marilyn Hemmingway, Ronald Johnson, Janet Reimer-Gill, Emily Hall	Managing the Impact of Coastal Acidification and Ocean Warming on Georgia's Growing Shellfish Industry	Support on climate change,aquaculture, and social science in fisheries

Funds Leveraged from other sources

Source	Start date	End date	Total amt	FY17	FY18	FY19	FY20	FY21	FY22 (No cost extension year)	PI	Project title	Contribution to Center
Univ. of Miami Institute for Advanced Study of the Americas (UMIA) 2019 UMIA Field Research Grant	Summer 2019		2000			2000				Adrianne Wilson	Population structure and growth of lane snapper, a data limited species	Cohort 2 PhD student Adrainne Wilson got experience with grant-writing, and was able to collect lane snapper samples in Belize for her dissertation work.
MAFMC/ASMFC	4/1/16	12/31/19	216394	57705	57705	57705	14426			Bradley Stevens	Hab in the MAB: black sea bass habitats	Funds are used to support research for Cara Schweizer (Ph.D. student at UMES); also provides partial salary for B. Stevens
National Park Service	9/15/18	5/30/19	32242			32242				Bradley Stevens	Oyster Spat Settlement	Funds used to support MS student Maddie Farmer and partial salary for Brad Stevens
MD Sea Grant	9/15/18	5/30/19	10000			10000				Bradley Stevens	Oyster Spat Settlement	Funds used to support MS student Maddie Farmer

Maryland Industrial Partnerships	8/1/15	7/31/17	99963	45816						Chen, F.	Developing a practical and economical system to grow microalgae with chicken manure nutrient in large pilot system (Phase 2)	
Maryland Industrial Partnerships	9/1/14	5/31/17	246999	67363						Chen, F.	Turning chicken manure into fertilizer and clean energy	
Maryland Industrial Partnerships	2/1/17	12/31/19	100000	29167	50000	20833				Chen, F., Hill, R.	Increase methane in chicken manure digesters	
Maryland Sea Grant	11/23/15	11/23/17	9999	5000	1250					Chung, J. Sook	The Blue Crab Genome Initiative	
National Institute of Standards and Tech.	1/1/16	9/30/18	237964	86532	86532	7211				Chung, J.S.	Crustacean metabolomics: Identification of potential growth and reproductive indicators for aquaculture using NMR and MS approaches	
NSF	8/1/13	7/31/18	900000	180000	165000					Cuker, B	Multicultural Diversity in the Aquatic Sciences	Funds are used to support students to ASLO conference.
Ocean Leadership	12/1/17	6/30/18	10000			10000				Dionne Hoskins-Brown	NOSB Regional Site	Provides outreach and recruitment opportunity for Center students and faculty
Sea of Change Foundation	3/1/18	12/31/18	15856		9514	6342				Dionne Hoskins-Brown	Faux habitat or foe food: How prevalent are microplastic fragments in oyster reefs and muddy estuarine sediments?	Support a high school intern for team research project with S. Mackey and D. Drayton (LMRCSC students)
NSF	7/1/17	6/30/18	359437	59906	299531					Eric Schott	Determining how Variation in life history & connectivity drive pathogen-	Funds support PIs salary, intern stipend and intern research

											host dynamics	
DPW	7/12/16	7/13/19	12988	4329	4329	3778				Eric Schott	DPW- Microbial Source Tracking as a Tool for Assessing and Managing Fecal Contamination through UB	Funds support PIs salary
NSF	3/1/19	6/30/20	15000			15000				Eric Schott	Determining how variation in life history & connectivity drive pathogen-host dynamics	Supplemental funds for summer intern
Sea Grant	11/1/17	6/30/19	9370		4865	4865				Eric Schott	Opening the door for research on a pathogenic virus of the soft clam *Mya arenaria*	Funds support PIs salary
NSF	5/31/18	5/31/20				500000				Freeman Hrabowski; Co-PI Dr. Moses Kairo & Dr. Joe Pitula	LSAMP Bridge to Doctorate	Funds are used to recruit studens to the LMRCSC and other UMES graduate programs
NSF	2/1/15	1/31/19	200000	50000	50000	20833				Gibson, D.	Cryptic Diet of the Doliolid…	Funds are used to support MS student Natalia Lopez and Research Associate Alexandra Salcedo
NSF	9/1/15	8/31/20	3000	600	600	600	600	600		Gibson, D.	Partnership in Research and Education in Materials (PREMP	Funds are used to support GRE training for 4 MES students.
Maryland Industrial Partnerships	2/1/15	10/31/17	99999	36363	6061					Hill, R.	Harvest of algal blooms for crude oil production	
Ratcliffe Foundation	6/1/15	6/30/20	209230	41846	41846	41846	31385			Hill, R.	IMET Environ. Biotechnology Incubator (EBI)	

National Institute of Standards and Tech.	1/1/16	9/30/18	510723	180255	180255	15021				Hill, R.	IMET Post-Doctoral Research Program in Environ. and Marine Science	
Ratcliffe Foundation	7/1/14	6/30/20	1200000	200000	200000	200000	1852			Hill, R.	The Ratcliffe Environ. Entrepreneurs Fellowship Program (REEF)	
NSF National Research Traineeship	9/1/19	8/31/20	36000				36000			Hillary Thalmann	Risk and Uncertainty Quantification in Marine Science	Provides stipend and tuition for H. Thalmann
NPRB Fellowhip	9/1/20	8/31/23	25000				25000			Hillary Thalmann	Thermal impacts on GOA Pacific Cod nursery residence	Provides research and travel support for H. Thalmann
NSF	7/1/16	6/30/19	300000	100000	100000	83333				Horodysky, A.	Linking environment to form and function by quantifying the effects of ocean acidification on visual and auditory neurobiology in marine fishes	Funds are used to support Horodysky and 1 LMRCSC cohort 2 student tuition.
NSF	9/1/15	8/31/18		161667	161667					P. Chigbu & A. Ishaque	GP-IMPACT: Strengthening Pathways into Geosciences through Summer Bridge and Undergraduate Training Programs	
Bonneville Power Administration	1/1/19	1/31/19	35000			26250				J. Miller	Growth and resdience of Interior Columbia River Chinook salmon in coastal waters	Funds support research associated with A. Munguia MS and J. Miller
NIST	9/1/17	8/31/18	112050		112050					J. Sook Chung	New method development for measuring low concentration of protein/peptide	Funds are used to support Amanda Lawrence (cohort 1) for stipend, tuition, travel and research

NSF	5/1/12	4/30/19	627489	89641	89641	59761				J. Sook Chung	Functional Roles of a Novel Crustacean Female Sex Hormone in Sex Differentiation and Developing Secondary Sex Features of Crustaceans	Funds support PIs salary and S. Green (Cohort 1 student) research
National Institutes of Health	9/24/12	7/31/18	645396	131267	120328					Jagus, R., Place, A	Translation regulation of gene expression in toxic dinoflagellates	
National Science Foundation	2/1/13	1/31/19	1369514	228252	228252	95105				Jagus, R., Place, A	Translation regulation of gene expression in toxic dinoflagellates	
Office of Naval Research	4/1/15	3/31/18	78000	26000	15167					Li, Y.	Liquid Hydrocarbon Production with the Electrobiome Platform	
National Science Foundation	7/1/15	6/30/18	308440	102813	85678					Li, Y.	Understanding the Prokaryotic Pathways for Triacylglycerol Synthesis and Turnover in the Plastid of Microalgae and Implications for Biofuels	
OSU Markham Award	1/1/17	1/1/19	6830	2561	3415	854				Munguia, A.	Lower Columbia River and estuary food web support for Chinook salmon	
NSF			282000	94000	94000	99635				P. Chigbu, M. Sexton	Research Experiences for Undergraduates (*REU) Site in Marine and Estuarine Science: Univ. of Maryland Eastern Shore*	Funds for student interns

NSF	9/1/16	8/31/21	5000000	1000000	1000000	1000000	1000000	1000000		P. Chigbu; M. Sexton; A. Ishaque; S. Parveen	CREST Center for the Integrated Study of Coastal Ecosystem Processes and Dynamics	Funds support PIs salaries, students, research
USDA-NIFA	9/1/14	8/31/17	479672	159891						Parveen	A Rapid, User Friendly Method for Detection of Total Vibrionaceae as an Indicator of Pathogenic *Vibrio* species in Oysters and Seawater	
USDA-NIFA					166666	166666				S. Parveen & P. Chigbu	*Shewanella* Species as Potential Emerging Pathogens in Oysters and Seawater from Apalachicola, Chesapeake and Maryland Coastal Bays	
Maryland Industrial Partnerships	2/1/15	2/1/18	152738	50913	21214					Place, A.	Plant-Based Aquafeed with Low-Leaching Taurine	
Environmental Research Services	8/1/16	12/31/17	6600	1553						Place, A.	Spatial and temporal analysis of phytoplankton in the Great Lakes over a one-year period	
NSF	12/1/12	1/31/19	686888	98127	98127	40886				R. Jagus	Translation regulation of gene expression in toxic dinoflagellates	Funds support PIs salary & intern research
Bunting Foundation	7/1/17	TBD	20000	20000						Rose Jagus	Support IMET Summer Internship	Funding supports IMET Summer Internship, 2018
Elkins Professorship	2/1/18	TBD	60000		60000					Rose Jagus	Support IMET Summer Internship	Funding supports IMET Summer Internship, 2018

Bunting Foundation	1/1/19	TBD	65000			65000				Rosemary Jagus	Support IMET Summer Internship	Funding supports IMET Summer Internship, 2019
anonymous donor	1/1/19	TBD	20000			20000				Rosemary Jagus	Support IMET Summer Internship	Funding supports IMET Summer Internship, 2019
Ratcliffe Foundation	7/1/14	6/30/20	800000	133333	133333	133333	100000			Russell Hill/Nick Hammond	Award to cultivate the leadership and business skills necessary to bring their research into commercial markets and to provide students with an enhanced appreciation of the potential business implications of their research.	Funds support graduate student stipends while training in entrepreneurial skills
Tides Foundation	5/1/16	4/30/17	25000	16667						Schott, E.	Inquiry-based exploration of urban waterfront biodiversity: DNA barcoding protocols and support for high school education	
City of Baltimore Department of Public Works	7/12/16	7/13/20	12988	3247	3247	3247	3247			Schott, E.	Microbial Source Tracking as a Tool for Assessing and Managing Fecal Contamination	
Northeastern Regional Aquaculture Center	9/1/15	8/31/18	12513	4171	4171					Schott, E.	Testing and Application of Novel Probiotic Bacteria for use in Marine Aquaculture	
NSF I-USE GEOPATHS-IMPACT Award	1/8/18	7/31/19	177512		83535	93977				Sue Ebanks	GP-IMPACT: Expanding HBCU Pathways for	

											Geoscience Education	
NSF	2/15/15	1/31/20	321910	64382	64382	64382	21461			Tara Cox, Chris Hintz	Bridge to Research in Marine Sciences: a summer Research Experiences for Undergraduates to NSF	Brings diverse early career students to the Center institution
Various Donors	7/1/16	7/30/20	215079	8779	52672	52672	48283			J. Sook Chung	Blue Crab Genome Initiative	Funds provide data for work in the lab
Alga BT	5/18/17	4/30/20	381482	52984	127161	127161	74177			Yantao Li	Research Contract with Alga BT	Funds were used to support Kia Ramarui (Cohort 4) flab expenses
France Merrick	5/1/18	4/30/21	71383		9914	23794	23794	13880		Eric Schott	Of Animals and Microbes: A Baltimore Harbor Investigations	Funds support PI's salary
NSF supplement	7/26/18	7/31/21	12798		711	4266	4266	3555		Eric Schott	Support for REU	Supports participation of a URM in the IMET internship program
NSF-OCE	8/1/18	7/31/22	741820		15455	185455	185455	185455	170000	Cuker and Lewallen	Multicultural Diversity in the Aquatic Sciences	Funds are used to support students to ASLO conference.
MIPS	8/1/18	7/31/21	250000		6944	83333	83333	76389		Russell Hill/Yantao Li	Improving algal growth via probiotic bacteria	
Ocean Leadership	12/1/18	6/30/19	10000			10000				Dionne Hoskins, Victoria Young	NOSB Regional Site	Produce the GA-SC NOSB competition
DE EPSCOR	1/1/19	12/31/24	5800000			644444	966667	966667	966667	Cherese Winstead	EPSCOR	Funding for student travel.
KIMST	1/1/19	12/31/22	115011			19169	28753	28753	28753	J. Sook Chung	Agreement on International Collaborative Research on Oceans and Fisheries	
Bailey Wildlife Foundation	1/1/19	12/31/20	189751			63250	94876	31625		Yantao Li/Allen Place	A Global Defense for Coral Reef Wildlife: Creating Carbon Negative Habitat	

NSF	2/1/19	1/31/22	300281			58388	100094	100094	41706	Feng Chen	Fate of lysis products of picocyanobacteria contributes to marine humic-like chromophoric dissolved organic matter	
Waterfront Partnership	5/1/19	6/30/21	29759			4578	13735	11446		Eric Schott	Molecular Screening for Microbes in Baltimore's Harbor 2019/2020	Funds support PI's salary and former summer intern's salary
NSF-BIO-IOS	8/1/19	7/31/24	700000			11667	140000	140000	140000	Horodysky	CAREER: Investigating environmental acidification and temp. as drivers of morphological alteration and physiological deficits in auditory systems of soniferous fishes	Reseach topics provided for LMRCSC funded student
MIPS	8/1/19	7/31/21	100000			2778	50000	45833		J. Sook Chung	Non-invasive assessment of shrimp biomass	
MD DNR	8/7/19	6/30/22	515421			14317	171807	171807	157490	David Secor	Reproductive Habitat of Chesapeake Bay Distinct Population Segment in the Nanticoke River	Funds support Nicholas Coleman (Cohort II) stipend and research
NSF-HRD	9/1/19	8/31/22	400000				133333	133333	133333	Horodysky and Gibson	Targeted Infusion Project: Mathematical Engagement for the Marine, Biological, and Environ. Realms of Science (MEMBERS)	Funds are used to support Horodysky and and Gibson, and student internships.
OSU Sea Grant	10/1/19	9/30/20	10800				900	9900		B. King	Oregon Sea Grant Robert E. Malouf Marine Studies	

											Award (Sept. 2019)	
United Way	10/1/19	3/31/21	234574				143351	91223		Russell Hill	FISH Project: Providing fresh and healthy seafood to underserved communities	Funding to support food insecurity
Aquaculture	12/1/19	2/28/20	4846				4846			Gulnihal Ozbay	Delaware Inland Bays HAB	Funds are used to support a M.S. student Amanda Pappas at DSU
Jim and Patty Rouse Foundation	1/1/20	6/30/21	3000				1263	1737		Eric Schott	Molecular screening for human pathogens in the Middle Branch, Baltimore's other waterfront	Funding supports former IMET Summer Interns
Stephenson Pope Babcock Foundation	1/1/20	12/31/21	8000				2667	4000	1333	Feng Chen	Microbial communities on microplastic particles in marine environments	Funds support IMET outreach and interns
OSU	1/1/20	12/31/21	4000				1333	2000	667	B. King	Oregon State Thurgood Marshall Graduate Award	Help support research of B. King
Anonymous Donor	1/1/20	12/31/20	20000				6667	10000	3333	Rosemary Jagus	Support IMET Summer Internship	Funding supports IMET Summer Internship, 2020
Bunting Foundation	1/1/20	12/31/20	40000				13333	20000	6667	Rosemary Jagus	Support IMET Summer Internship	Funding supports IMET Summer Internship, 2020
MIPS	2/1/20	1/31/21	100000				29167	50000	20833	Feng Chen	Algae in Livestock and Aqua Feed	
MIPS	2/1/20	1/31/21	178973				52200	89487	37286	Feng Chen	Microbial dynamics in anaerobic digesters	
USDA NIFA	2/1/20	8/31/22	200000				45161	77419	77419	Marikis Alvarez	Cooperative Research for 1890s	Support for LMRCSC staff and student travel
MIPS	2/1/20	1/31/21	100000				29167	50000	20833	Yantao Li	*In situ* astaxanthin production in microalgae	Funding supports Kia Ramarui research
Mote Marine Laboratory	5/1/20	4/30/21	136259				22710	68130	45420	Allen Place	Pushing *Karenia* over the edge with Nature Derived Flavenoids	

USFWS	5/1/20	4/30/21	20480				3413	10240	6827	Miller	Natal Origins of Pacific Lamprey	Expand resources and training for Pelekai
NSF RIA	8/1/20	7/31/23	299999				8333	100000	100000	Lewallen	Epigenomic adaptations of dolphin skin	Reseach topics and supplies provided for LMRCSC funded student
NSF	9/1/20	8/31/21	53000					17189	17189	Ciannelli	Risk and Uncertainty Quantification in Marine Science	Supports Thalmann for 1 full year, stipend and tuition
Department of Energy	9/1/20	9/20/23	3000000					972973	972973	Li, Chen, Hill	A Highly Efficient Microalgae-Based Carbon Sequestration System to Reduce CO2 Emissions from Power Plant Flue Gases	Research activity involves REU students from URM
Venable Foundation	12/120	11/30/21	10000					7500	2500	Eric Schott	Support for underrepresented minorities to participate in the IMET Summer Internship	Funding supports IMET Summer Internship, 2021
NSF LTER Program	1/1/21	12/31/22	32844					10948	16422	Merryl Alber, Dionne Hoskins-Brown	Local Ecological Knowledge in Gullah Geechee Communities	Support for social science in fisheries
NASA	1/1/21	12/31/26	158335					26389	17593	P. Chigbu	Student Airborne Science Activation for MSI (SaSa) for training students in remote sensing	Funds support student training
Anonymous Donor	1/1/21	12/31/21	20000					6667	13333	Rosemary Jagus	Contribution to the IMET Summer Internship program	Funding supports IMET Summer Internship, 2021
Bunting Foundation	1/1/21	12/31/21	50000					16667	33333	Rosemary Jagus	Contribution to the IMET Summer Internship program	Funding supports IMET Summer Internship, 2021
Charles & Lois Miller Foundation	2/1/21	1/31/22	10000					5833	4167	Russell Hill	Contribution to the IMET Summer Internship program	Funding supports IMET Summer Internship, 2021
NSF	2/23/21	2/22/24	323985					53998	107995	P. Chigbu; M. Sexton	REU Site: Univ. of Maryland	Funds support summer interns

											Eastern Shore Research Experience for Undergrad.	
Jim and Patty Rouse Foundation	4/15/21	5/15/21	3000					3000		Eric Schott	Expanding access to marine science for High School student in under-served communities with an Open House private tour	Funding supports IMET Open House, 2022
Md Sea Grant	5/1/21	4/1/22	10000					3636	6364	Eric Schott	Assessing the risk of introducing novel viruses into the Chesapeake Bay crab fishery	Research activity involves REU students from URM
NSF-OCE	5/1/21	4/30/26	60500					4033	12100	Gibson	Cold Tongue Mixing	Funds used to support student travel for research in Ghana.
Waterfront Partnership of Baltimore	6/1/21	12/1/21	17306					8653	8653	Eric Schott	Molecular Screening for Microbes in Baltimore's Harbor 2021	Created data and narrative that summer interns use in their projects
Shark Conservation Fund via Dalhousie Univ.	7/1/21	6/30/25	82500					3438	20625	Elizabeth Babcock	Unlocking the global shark meat trade	Provides partial salary support for E. Babcock
NSF-OCE	8/1/21	7/31/23	914000					38083	457000	Gibson and Cuker	Multicultural Diversity in the Aquatic Sciences	Funds are used to support students to ASLO conference.
NSF-ECCS	8/1/21	7/31/24	600235					16673	200078	Sun and Gibson	Excellence in Research: Integrated Sensor-Robot Networks for Real-time Environ. Monitoring and Marine Ecosystem Restoration in the Hampton River	Funds will be used to fund research projects for LMRCSC students.
NSF Coastlines and People	10/1/21	9/30/24	1298284						396698	Daniel Gleason. Kania Greer, Chris Hintz, Antionette Jackson, Dionne	Coastal Research Integrating Society and Environment (C-RISE)	Support on climate change and social science in fisheries

										Hoskins-Brown		
		Total		3595131	4015218	4205980	3717054	4689252	4245590			
Source	Start date	End date	**Total amount**	**FY17**	**FY18**	**FY19**	**FY20**	**FY21**	**FY22 (No cost extension year)**	**PI**	**Project title**	**Contribution to Center**
Univ. of Miami Institute for Advanced Study of the Americas (UMIA) 2019 UMIA Field Research Grant	Summer 2019		2000			2000				Adrianne Wilson	Population structure and growth of lane snapper, a data limited species	Cohort 2 PhD student Adrainne Wilson got experience with grant-writing, and was able to collect lane snapper samples in Belize for her dissertation work
MAFMC/ASMFC	4/1/16	12/31/19	$216,394	57705	57705	57705	14426			Bradley Stevens	Hab in the MAB: black sea bass habitats	Funds are used to support research for Cara Schweizer (Ph.D. student at UMES); also provides partial salary for B. Stevens
National Park Service	9/15/18	5/30/19	32242			32242				Bradley Stevens	Oyster Spat Settlement	Funds used to support MS student Maddie Farmer and partail salary for Brad Stevens
MD Sea Grant	9/15/18	5/30/19	10000			10000				Bradley Stevens	Oyster Spat Settlement	Funds used to support MS student Maddie Farmer
Maryland Industrial Partnerships	8/1/15	7/31/17	99963	45816						Chen, F.	Developing a practical and economical system to grow microalgae with chicken manure nutrient in large pilot system (Phase 2)	
Maryland Industrial Partnerships	9/1/14	5/31/17	246999	67363						Chen, F.	Turning chicken manure into fertilizer and clean energy	
Maryland Industrial Partnerships	2/1/17	12/31/19	100000	29167	50000	20833				Chen, F., Hill, R.	Increase methane in chicken manure digesters	
Maryland Sea Grant	11/23/15	11/23/17	9999	5000	1250					Chung, J. Sook	The Blue Crab Genome Initiative	

National Institute of Standards and Tech.	1/1/16	9/30/18	237964	86532	86532	7211				Chung, J.S.	Crustacean metabolomics: Identification of potential growth and reproductive indicators for aquaculture using NMR and MS approaches	
NSF	8/1/13	7/31/18	900000	180000	165000					Cuker, B	Multicultural Diversity in the Aquatic Sciences	Funds are used to support students to ASLO conference.
Ocean Leadership	12/1/17	6/30/18	10000			10000				Dionne Hoskins-Brown	NOSB Regional Site	Provides outreach and recruitment opportunity for Center students and faculty
Sea of Change Foundation	3/1/18	12/31/18	15856		9514	6342				Dionne Hoskins-Brown	Faux habitat or foe food: How prevalent are microplastic fragments in oyster reefs and muddy estuarine sediments?	Support a high school intern for team research project with S. mackey and D. Drayton (LMRCSC students)
NSF	7/1/17	6/30/18	359437	59906	299531					Eric Schott	Determining how Variation in life history & connectivity drive pathogen-host dynamics	Funds support PIs salary, intern stipend and intern research
DPW	7/12/16	7/13/19	12988	4329	4329	3778				Eric Schott	DPW-Microbial Source Tracking as a Tool for Assessing and Managing Fecal Contamination through UB	Funds support PIs salary
NSF	3/1/19	6/30/20	15000			15000				Eric Schott	Determining how variation in life history & connectivity drive pathogen-host dynamics	Supplemental funds for summer intern
Sea Grant	11/1/17	6/30/19	9370		4865	4865				Eric Schott	Opening the door for research on a pathogenic virus of the	Funds support PIs salary

											soft clam *Mya arenaria*	
NSF	5/31/18	5/31/20				500000				Freeman Hrabowski; Co-PI Dr. Moises kairo and Dr. Joe Pitula	LSAMP Bridge to Doctorate	Funds are used to recruit students to the LMRCSC and other UMES graduate programs
NSF	2/1/15	1/31/19	200000	50000	50000	20833				Gibson, D.	Cryptic Diet of the Doliolid…	Funds are used to support MS student Natalia Lopez and Research Associate Alexandra Salcedo
NSF	9/1/15	8/31/20	3000	600	600	600	600	600		Gibson, D.	Partnership in Research and Education in Materials (PREMP)	Funds are used to support GRE training for 4 MES students.
Maryland Industrial Partnerships	2/1/15	10/31/17	99999	36363	6061					Hill, R.	Harvest of algal blooms for crude oil production	
Ratcliffe Foundation	6/1/15	6/30/20	209230	41846	41846	41846	31385			Hill, R.	IMET Environ. Biotechnolo gy Incubator (EBI)	
National Institute of Standards and Tech.	1/1/16	9/30/18	510723	180255	180255	15021				Hill, R.	IMET Post-Doctoral Research Program in Environ. and Marine Science	
Ratcliffe Foundation	7/1/14	6/30/20	1200000	200000	200000	200000	1852			Hill, R.	The Ratcliffe Environ. Entrepreneu rs Fellowship Program (REEF)	
NSF National Research Traineeship	9/1/19	8/31/20	36000				36000			Hillary Thalmann	Risk and Uncertainty Quantificatio n in Marine Science	Provides stipend and tuition for H. Thalmann
NPRB Fellowhip	9/1/20	8/31/23	25000				25000			Hillary Thalmann	Thermal impacts on GOA Pacific Cod nursery residence	Provides research and travel support for H. Thalmann
NSF	7/1/16	6/30/19	300000	100000	100000	83333				Horodysky, A.	Linking environment to form and function by quantifying the effects of ocean acidification on visual and auditory neurobiolog	Funds are used to support Horodysky and 1 LMRCSC cohort 2 student tuition.

											y in marine fishes	
NSF	9/1/15	8/31/18		161667	161667					P. Chigbu & A. Ishaque	GP-IMPACT: Strengthening Pathways into Geosciences through Summer Bridge and Undergraduate Training Programs	
Bonneville Power Administration	1/1/19	1/31/19	35000			26250				J Miller	Growth and resdience of Interior Columbia River Chinook salmon in coastal waters	Funds support research associated with Munguia MS and Miller
NIST	9/1/17	8/31/18	112050		112050					J. Sook Chung	New method development for measuring low concentration of protein/peptide	Funds are used to support Amanda Lawrence (cohort 1) for stipend, tuition, travel and research
NSF	5/1/12	4/30/19	627489	89641	89641	59761				J. Sook Chung	Functional Roles of a Novel Crustacean Female Sex Hormone in Sex Differentiation and Developing Secondary Sex Features of Crustaceans	Funds support PIs salary and S. Green (Cohort 1 student) research
National Institutes of Health	9/24/12	7/31/18	645396	131267	120328					Jagus, R., Place, A	Translation regulation of gene expression in toxic dinoflagellates	
National Science Foundation	2/1/13	1/31/19	1369514	228252	228252	95105				Jagus, R., Place, A	Translation regulation of gene expression in toxic dinoflagellates	

Office of Naval Research	4/1/15	3/31/18	78000	26000	15167					Li, Y.	Liquid Hydrocarbon Production with the Electrobiome Platform	
National Science Foundation	7/1/15	6/30/18	308440	102813	85678					Li, Y.	Understanding the Prokaryotic Pathways for Triacylglycerol Synthesis and Turnover in the Plastid of Microalgae and Implications for Biofuels	
OSU Markham Award	1/1/17	1/1/19	6830	2561	3415	854				Munguia, A.	Lower Columbia River and estuary food web support for Chinook salmon	
NSF			282000	94000	94000	99635				P. Chigbu, M. Sexton	Research Experiences for Undergraduates (REU) Site in Marine and Estuarine Science: University of Maryland Eastern Shore	Funds for student interns
NSF	9/1/16	8/31/21	5000000	1000000	1000000	1000000	1000000	1000000		P. Chigbu; M. Sexton; A. Ishaque; S. Parveen	CREST Center for the Integrated Study of Coastal Ecosystem Processes and Dynamics	Funds support PIs salaries, students, research
USDA-NIFA	9/1/14	8/31/17	479672	159891						S. Parveen & P. Chigbu	A Rapid, User Friendly Method for Detection of Total Vibrionaceae as an Indicator of Pathogenic *Vibrio* species in Oysters and Seawater	

USDA-NIFA					166666	166666				S. Parveen, P. Chigbu, L. DaSilva, H. Williams	*Shewanella* Species as Potential Emerging Pathogens in Oysters and Seawater from Apalachicola, Chesapeake and Maryland Coastal Bays	
Maryland Industrial Partnerships	2/1/15	2/1/18	152738	50913	21214					Place, A.	Plant-Based Aquafeed with Low-Leaching Taurine	
Environmental Research Services	8/1/16	12/31/17	6600	1553						Place, A.	Spatial and temporal analysis of phytoplankton in the Great Lakes over a one-year period	
NSF	12/1/12	1/31/19	686888	98127	98127	40886				R. Jagus	Translation regulation of gene expression in toxic dinoflagellates	Funds support PIs salary & intern research
Bunting Foundation	7/1/17	TBD	20000	20000						Rose Jagus	Support IMET Summer Internship	Funding supports IMET Summer Internship, 2018
Elkins Professorship	2/1/18	TBD	60000		60000					Rose Jagus	Support IMET Summer Internship	Funding supports IMET Summer Internship, 2018
Bunting Foundation	1/1/19	TBD	65000			65000				Rosemary Jagus	Support IMET Summer Internship	Funding supports IMET Summer Internship, 2019
anonymous donor	1/1/19	TBD	20000			20000				Rosemary Jagus	Support IMET Summer Internship	Funding supports IMET Summer Internship, 2019
Ratcliffe Foundation	7/1/14	6/30/20	800000	133333	133333	133333	100000			Russell Hill/Nick Hammond	Award to cultivate the leadership and business skills necessary to bring their research into commercial markets and to provide students with an enhanced appreciation	Funds support graduate student stipends while training in entrepreneurial skills

											of the potential business implications of their research.	
Tides Foundation	5/1/16	4/30/17	25000	16667						Schott, E.	Inquiry-based exploration of urban waterfront biodiversity: DNA barcoding protocols and support for high school education	
City of Baltimore Department of Public Works	7/12/16	7/13/20	12988	3247	3247	3247	3247			Schott, E.	Microbial Source Tracking as a Tool for Assessing and Managing Fecal Contamination	
Northeastern Regional Aquaculture Center	9/1/15	8/31/18	12513	4171	4171					Schott, E.	Testing and Application of Novel Probiotic Bacteria for use in Marine Aquaculture	
NSF I-USE GEOPATHS-IMPACT Award	1/8/18	7/31/19	177512		83535	93977				Sue Ebanks	GP-IMPACT: Expanding HBCU Pathways for Geoscience Education	
NSF	2/15/15	1/31/20	321910	64382	64382	64382	21461			Tara Cox, Chris Hintz	Bridge to Research in Marine Sciences: a summer Research Experiences for Undergraduates to NSF	Brings diverse early career students to the Center institution
Various Donors	7/1/16	7/30/20	215079	8779	52672	52672	48283			J. Sook Chung	Blue Crab Genome Initiative	Funds provide data for work in the lab
Alga BT	5/18/17	4/30/20	381482	52984	127161	127161	74177			Yantao Li	Research Contract with Alga BT	Funds were used to support Kia Ramarui (Cohort 4) flab expenses
France Merrick	5/1/18	4/30/21	71383		9914	23794	23794	13880		Eric Schott	Of Animals and Microbes: A Baltimore Harbor Investigations	Funds support PI's salary

NSF supplement	7/26/18	7/31/21	12798		711	4266	4266	3555		Eric Schott	Support for REU	Supports participation of a URM in the IMET internship program
NSF-OCE	8/1/18	7/31/22	741820		15455	185455	185455	185455	170000	Cuker and Lewallen	Multicultural Diversity in the Aquatic Sciences	Funds are used to support students to ASLO conference.
MIPS	8/1/18	7/31/21	250000		6944	83333	83333	76389		Russell Hill/Yantao Li	Improving algal growth via probiotic bacteria	
Ocean Leadership	12/1/18	6/30/19	10000			10000				Dionne Hoskins, Victoria Young	NOSB Regional Site	Produce the GA-SC NOSB competition
DE EPSCOR	1/1/19	12/31/24	5800000			644444	966667	966667	966667	Cherese Winstead	EPSCOR	Funding for student travel.
KIMST	1/1/19	12/31/22	115011			19169	28753	28753	28753	J. Sook Chung	Agreement on Intern. Collaborative Research on Oceans and Fisheries	
Bailey Wildlife Foundation	1/1/19	12/31/20	189751			63250	94876	31625		Yantao Li/Allen Place	A Global Defense for Coral Reef Wildlife: Creating Carbon Negative Habitat	
NSF	2/1/19	1/31/22	300281			58388	100094	100094	41706	Feng Chen	Fate of lysis products of picocyanobacteria contributes to marine humic-like chromophoric dissolved organic matter	
Waterfront Partnership	5/1/19	6/30/21	29759			4578	13735	11446		Eric Schott	Molecular Screening for Microbes in Baltimore's Harbor 2019/2020	Funds support PI's salary and former summer intern's salary
NSF-BIO-IOS	8/1/19	7/31/24	700000			11667	140000	140000	140000	A. Horodysky	CAREER: Investigating environ. acidification and temperature as drivers of morphological alteration and physiological deficits in auditory systems of soniferous fishes	Reseach topics provided for LMRCSC funded student

MIPS	8/1/19	7/31/21	100000			2778	50000	45833		J. Sook Chung	Non-invasive assessment of shrimp biomass	
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NSF-HRD	9/1/19	8/31/22	400000				133333	133333	133333	A. Horodysky and D.Gibson	Targeted Infusion Project: Mathematical Engagement for the Marine, Biological, and Environ. Realms of Science (MEMBERS)	Funds are used to support Horodysky and and Gibson, and student internships.
OSU Sea Grant	10/1/19	9/30/20	10800				900	9900		Brittany King	Oregon Sea Grant Robert E. Malouf Marine Studies Award (Sept. 2019)	
United Way	10/1/19	3/31/21	234574				143351	91223		Russell Hill	FISH Project: Providing fresh and healthy seafood to underserved communities	Funding to support food insecurity
Aquaculture	12/1/19	2/28/20	4846				4846			Gulnihal Ozbay	Delaware Inland Bays HAB	Funds are used to support a M.S. student Amanda Pappas at DSU
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OSU	1/1/20	12/31/21	4000				1333	2000	667	Brittany King	Oregon State Thurgood	Help support research of B. King

											Marshall Graduate Award	
Anonymous Donor	1/1/20	12/31/20	20000				6667	10000	3333	Rosemary Jagus	Support IMET Summer Internship	Funding supports IMET Summer Internship, 2020
Bunting Foundation	1/1/20	12/31/20	40000				13333	20000	6667	Rosemary Jagus	Support IMET Summer Internship	Funding supports IMET Summer Internship, 2020
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Department of Energy	9/1/20	9/20/23	3000000					972973	972973	Li, Chen, Hill	A Highly Efficient Microalgae-Based Carbon Sequestration System to Reduce CO2 Emissions from Power Plant Flue Gases	Research activity involves REU students from URM
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Anonymous Donor	1/1/21	12/31/21	20000					6667	13333	Rosemary Jagus	Contribution to the IMET Summer Internship program	Funding supports IMET Summer Internship, 2021
Bunting Foundation	1/1/21	12/31/21	50000					16667	33333	Rosemary Jagus	Contribution to the IMET Summer Internship program	Funding supports IMET Summer Internship, 2021
Charles & Lois Miller Foundation	2/1/21	1/31/22	10000					5833	4167	Russell Hill	Contribution to the IMET Summer Internship program	Funding supports IMET Summer Internship, 2021
NSF	2/23/21	2/22/24	323985					53998	107995	P. Chigbu; M. Sexton	REU Site: Univ. of Maryland Eastern Shore Research Experience for Undergrad.	Funds support summer interns
Jim and Patty Rouse Foundation	4/15/21	5/15/21	3000					3000		Eric Schott	Expanding access to marine science for High School student in under-served communities with an Open House private tour	Funding supports IMET Open House, 2022
Md Sea Grant	5/1/21	4/1/22	10000					3636	6364	Eric Schott	Assessing the risk of introducing novel viruses into the Chesapeake Bay crab fishery	Research activity involves REU students from URM
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Shark Conservation Fund via Dalhousie Univ.	7/1/21	6/30/25	82500					3438	20625	Elizabeth Babcock	Unlocking the global shark meat trade	Provides partial salary support for E. Babcock
NSF-OCE	8/1/21	7/31/23	914000					38083	457000	Gibson and Cuker	Multicultural Diversity in the Aquatic Sciences	Funds are used to support students to ASLO conference.
NSF-ECCS	8/1/21	7/31/24	600235					16673	200078	Sun and Gibson	Excellence in Research: Integrated Sensor-Robot Networks for Real-time Environ. Monitoring and Marine Ecosystem Restoration in the Hampton River	Funds will be used to fund research projects for LMRCSC students.
NSF Coastlines and People	10/1/21	9/30/24	1298284						396698	Daniel Gleason. Kania Greer, Chris Hintz, Antionette Jackson, Dionne Hoskins-Brown	Coastal Research Integrating Society and Environment (C-RISE)	Support on climate change and social science in fisheries
		Total		3595131	4015218	4205980	3717054	4689252	4245590			

Appendix 6: Graduate Student Core Competencies

The levels of Core Competencies demonstrated are reported as 1= knowledge of application(s); 2 = use knowledge in application to generate results; 3 = improve skills to transform management in real-world systems.

Name (Last, First)	Degree	Institution	Cohort Number	Data Management	Human Dimensions/Social Science	Climate Impacts on Marine Ecosystems (CLIME)	Habitats and Biological Systems (HaBS)	Stock Assessment Support and Information (SASI)	Seafood, Nutrition, Aquaculture, and Pathology (SNAP)
Czajkowski, Caitlyn	M.S.	DESU	3	2	1	1	2	1	3
Galvez, Brian	M.S.	DESU	1	2	1	1	2	3	1
Teat, Marcus	M.S.	DESU	5	2	1	2	2	2	3
Kleponis, Nicole	M.S.	DESU	2	2	1	2	3	1	1
Pappas, Amanda	M.S.	DESU	1	2	1	2	3	1	1
Andrade, Emily	M.S.	DESU	4	2	1	2	2	1	3
Rodríguez-Sanoguet, Luis	M.S.	DESU	3	2	1	2	2	1	1
McLean, Josette	M.S.	HU	2	2	1	1	3	1	1
Leslie, Jaelyn	M.S.	HU	4	2	1	1	3	2	1
Mayes, Cristin	M.S.	HU	1	2	1	2	2	3	1
Bender, Arona	M.S.	HU	3	2	1	3	2	2	1
Tait, Noah	M.S.	HU	5	2	1	3	2	3	1
Hildebrandt, Siera	M.S.	HU	2	2	2	2	3	1	2
Moreno, Victoria	M.S.	OSU	4	2	2	1	1	1	1
Pelekai, Keala	M.S.	OSU	3	2	1	1	1	2	1
Munguia, Angie	M.S.	OSU	1	2	1	1	2	1	1
Cohn, Leanne	M.S.	OSU	5	2	1	2	1	1	1
Layton, Janelle	M.S.	OSU	4	2	1	2	1	1	1
King, Brittany	Ph.D.	OSU	2	3	3	1	1	1	1
Wong-Ala, Jennifer	Ph.D.	OSU	5	3	1	2	1	2	1
Ramirez, Matthew	Ph.D.	OSU	2	3	1	2	2	3	1
Thalmann, Hillary	Ph.D.	OSU	1	3	1	3	2	1	1
Howard, Kristafer	M.S.	SSU	5	2	3	1	3	2	1
Drayton, Davielle	M.S.	SSU	2	2	2	1	3	2	2

Mackey, Shaneese	M.S.	SSU	3	2	1	1	3	2	2
Day, Joe	M.S.	SSU	5	2	2	1	2	3	2
Tay, Sena	M.S.	SSU	4	2	2	1	3	2	2
Griffin, Emily	M.S.	SSU	1	2	1	1	2	3	1
Geiger, Savannah	M.S.	SSU	4	2	1	1	3	2	1
Lemaire, Cloe	M.S.	SSU	5						
Lawrence, Amanda	M.S.	UMCES	2	2	2	1	2	1	2
Frey, Benjamin	M.S.	UMCES	3	2	1	1	2	3	1
Coleman, Nicholas	M.S.	UMCES	2	2	1	2	2	2	1
Garcia Prieto, David	Ph.D.	UMCES	5	1	1	1	1	1	1
Hanif, Ammar	Ph.D.	UMCES	1	2	2	2	2	2	2
Green, Shadaesha	Ph.D.	UMCES	1	2	2	2	2	2	2
Pares, Olivia	Ph.D.	UMCES	5	2	2	2	2	3	3
Ramarui, Kyarii	Ph.D.	UMCES	4	2	1	2	1	1	1
Byrd, Anya	Ph.D.	UMCES	3						
Wilburn, Imani	M.S.	UMES	4	2	1	1	3	1	1
Munoz Ruiz, Enid	M.S.	UMES	2	2	1	1	3	2	2
Price, Andre	M.S.	UMES	2	2	1	2	2	3	1
Goffe, Shakira	M.S.	UMES	4	2	1	2	2	3	1
Wenker, Rebecca	M.S.	UMES	1	2	1	2	3	2	1
Wade, Kaitlynn	M.S.	UMES	5	2	1	2	2	3	1
Reyes Delgado, Angel	M.S.	UMES	5	2	1	2	3	2	1
Smalls, Jasmine	Ph.D.	UMES	5	2	1	1	2	1	3
Rodriguez, Jorge	Ph.D.	UMES	2	2	1	1	2	1	3
Johnson, Tahira	Ph.D.	UMES	4	2	1	2	2	1	3
Haughton, Shanelle	Ph.D.	UMES	3	2	1	2	2	2	3
Silver, Ashley	Ph.D.	UMES	3	2	1	2	3	2	1
Martinez-Rivera, Stephanie	Ph.D.	UMES	1	2	1	2	2	3	1
Schweitzer, Cara	Ph.D.	UMES	2	2	1	2	2	3	2
Almodovar-Acevedo, Laura	Ph.D.	UMES	2	2	1	2	3	3	1
Cruz Marrero, Wilmelie	Ph.D.	UMES	3	2	1	2	3	2	1
Rosales, Detbra	Ph.D.	UMES	1	2	1	2	3	2	2
Rubalcava, Kasondra	Ph.D.	UMES	2	3	1	3	2	3	1

Cervera, Juan	M.S.	UM-RSMAS	3	3	1	3	3	2	1
Denson, Latreese	Ph.D.	UM-RSMAS	2	3	1	2	3	3	1
Best-Otubu, Chryston	Ph.D.	UM-RSMAS	5	2	1	2	3	2	1
Mayes, Cristin	Ph.D.	UM-RSMAS	4	2	1	2	2	3	1
Wilson, Adrianne	Ph.D.	UM-RSMAS	2	2	1	2	3	3	1
O'Farrell, Halie	Ph.D.	UM-RSMAS	1	3	1	2	3	3	1

Appendix 7: External Evaluation Reports

Evaluation Report Year 1: Accomplishments and Findings from Surveys

August 15, 2017

Background and Introduction

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

Year 1. Evaluation Team Accomplishments

Over year one of the project, the evaluation team has participated in project monthly phone meetings, traveled to UMES for a meeting with the Project Director, and communicated extensively with project leadership to finalize two, initial year surveys of key audiences. Additionally, Dr. Bishop and Mr. Tuddenham met with one of the project co-PIs on-site at Oregon State University to identify potential interview subjects (graduate students) impacted by the project.

During year one and as described in the External Evaluation Plan, the evaluators moved forward with development of the surveys of year one cohort, undergraduate and graduate students (2016-2017), and scientists and faculty impacted by the project across the nation. These surveys were developed initially to encompass relevant findings from the empirical literature related to the project to establish face validity of the instruments. Finally, the instruments were circulated to the project leadership team to identify contextual factors and concerns, which were addressed in final drafts of the instruments prior to distribution. The following sections of this report summarize the responses of the Cohort 1 undergraduate and graduate students and project faculty/scientists from these two surveys, as an initial step in the five-year evaluation efforts. It should be noted that the project leadership will be providing select student records and data to the evaluation team in fall and winter 2017 (project year 2). These records will be analyzed to cross-walk and compare with the initial survey summaries, as a means to further describe the project accomplishments, and to inform and lead next steps in evaluation implementation for year two. This current report represents the completion of the year one evaluation plan by the external evaluation team.

Undergraduate and Graduate Student Responses

The evaluation team developed the survey for undergraduate and graduate students based on relevant findings from empirical research on student and career pipeline issues. The draft survey was reviewed and finalized by the LMRCSC project director and co-PIs based on contextual factors and concerns. The URL to the electronic survey was then provided to project leadership for distribution to the undergraduate and graduate students. A final list of these students was provided to the evaluation team.

Eight students from the identified list completed the surveys in early summer 2017. These students were from the 2016-2017 cohort. These student responses will be used to establish initial response patterns to the surveys, and to begin a more expansive process over time of obtaining project input and impact data from all of the students impacted by LMRCSC programming. This initial group was comprised of: 1 student from Delaware State University, 1 from Savannah State University, 1 from Oregon State University, 4 from the University of Maryland—Eastern Shore, and 1 from the University of Miami. These students were seeking BS (n=3), MS (n=3), and Ph.D. (n=2) degrees. The degree disciplines of these student respondents included: fisheries science, natural resources, environmental science, aquatic microbiology, veterinary medicine, marine biology and fisheries, marine science, and biology. One individual reported a change of major as a result of participating in an LMRCSC program.

Students were queried regarding the types of jobs they were seeking post-formal education. This list included: government agency (unspecified), fisheries biologist or researcher at NOAA, environmental scientist at NOAA, “working for NOAA, FDA, or EPA,” working with marine mammals, government or academia.

To begin to develop a context for understanding the backgrounds of the students participating in LMRCSC, they were asked to describe “how and when you started considering a career in science” (item seven). Interestingly, five of the eight respondents reported early (five years old, grade school, 5th grade) memories of a decision-making process related to science, with some reporting middle and high school. Prior research by the evaluation team on other nationally scaled STEM education programs reflects similar early patterns of motivation among eventual STEM undergraduate and graduate students. This observation supports related efforts by LMRCSC in past and current programming to impact these pre-college students and their teachers based on this link to college matriculation in the sciences and career pathways. Among the precipitating communication channels reported in career consideration, these current eight survey respondents also reported the impact of peers, of college experiences or courses, of media exposure to science careers, to internships (again supporting LMRCSC strategies) and emotional or cultural connections to the oceans. All of these observations will be tracked in future evaluation contacts with UG and GRAD student participants in LMRCSC programs.

Item eight pushed into the motivations for careers related to science, and again, revealed a clear theme from respondents. Using a constant comparative procedure to isolate related terms in narrative text, a theme of personal commitment to environmental projection and conservation ideals emerges in these responses. Students want to "make a difference" or "have an impact" by studying "something they care about." This object of student is the environment, and in some expressed cases, the marine environment. Survey respondents expressed an understanding that formal education programs are intrinsically important in the scientific enterprise: the environment is improved through education, a knowledge base, and programs that inform others about science. Again, some prior research suggests that these idealistic career motivations, emerging from both informed scientific understanding and an ethic of stewardship and social consciousness are characteristics of recent and upcoming generations of students and can serve as attractors for programs interested in recruiting STEM professionals.

Item nine asked respondents to "describe research or field experiences in which they have participated, which have been funded by the LMRCSC. Seven students provided responses, which evidence concrete and specific experiences (the responses frequently included specific names of events, personnel, or contexts, which were objective). Because of the small sample size and the tight relationship of the responses to the LMRCSC mission, the responses are included as follows, and in nearly complete form:

- I attended the AFS UMES Research Symposium in April where I presented my first poster and connected with a future graduate committee member.
- I have participated in using various methods to being the creation of a dynamic food web of the Maryland Coastal Bays. These methods include fatty acid analysis, stable isotope analysis, and gut content analysis.
- Delaware Inland Bays projects, the Maryland Coastal Bay water quality and finfish survey with MD-DNR.
- I worked with Dr. [specific name] examining and separating zooplankton.
- Shortfin mako habitat selection modeling, management strategy evaluation of shortfin mako.

- I have been able to collect my biopsy samples from bottlenose dolphins for my Master's research. I often help other graduate students with their research as well, such as grass shrimp sampling and trawling.
- I have worked in a lab counting different zooplankton species and learned how to do a nutrient analysis.

As a comment on the data analysis above and used throughout this report, Wolcott (1994) and Patton (1980) have noted that in narrative, open-ended response data, heightened specificity of detail and the use of objectively verifiable information, proper names, dates, or logical contexts contribute to a heightened likelihood of credibility and validity in the response data. An assertion that "I worked with Dr. Dasilva separating zooplankton" should thus be seen as of higher value than one such as "I worked with a teacher on a science project." This theoretical approach to handling the narrative data will heighten the credibility of these evaluation synopses over the project.

In addition to the specific projects or experiences described above, three students described (in response to item ten on mentoring) individual mentoring support they had received during this past project year. One individual noted an academic advisor who was a mentor, but did not specify the contexts or outcomes of the mentoring. The second respondent named a state government scientist, and described the mentoring to include enhancing scientific understanding of phytoplankton, assistance with finding workshops, resume development, proposal writing, and network connections to others who could support the student's work. The third respondent, a first-year undergraduate, spoke of a mentor who assists with a variety of issues, including motivation and encouragement for work, assistance in obtaining scholarships and an internship, and strong emotional support. The decrease in responses to this item raises a question about the use of the term "mentor" with these students. It may be that conceptions of that term are misunderstood. In future uses of this survey item, revisions to the language used here may be helpful in eliciting formal responses. More traditional academic terms such as advisor, chair, or professor may surface different responses. As a side note, currently the project leadership is discussing training for project mentors in year two.

Item eleven substituted "faculty member" for "mentor" in the language of the prompt, and garnered four responses (including from three different students than the previous mentoring item). This suggests that future surveys can collapse this item and use more inclusive language for individuals with whom the students may interact. Respondents identified three individuals by name and described a variety of advising, motivational support, and information and direction received from these individuals. Students seem to register with help making networking connections and finding information related to programs (workshops, internships). Clearly, from student perspectives, faculty and advisors associated to LMRCSC work are providing a rich and meaningful support structure well beyond course selection, project direction, and even orientation and information about LMRCSC (as all of the respondents indicate has happened (item thirteen)). These relational connections have been noted in the broader literature of student mentoring and support and in prior research by the evaluation team.

Item twelve asked, “if you have received LMRCSC funding for a research project or internship, please describe your project and its value to you professionally.” Six students provided highly specific and descriptive uses of LMRCSC funding. These descriptions demonstrated that the student research was in NOAA-related science and fisheries content areas, was driven by theoretical and practical questions of fisheries management and which were tightly connected to the students professional and academic goals. Several projects were thesis or dissertation related, and involved individual or multiple faculty members/scientists, and a number of external organizations and programs. This early emergence in the data of a complex network associated to the LMRCSC should be noted and should inform year two evaluation efforts to map the network connections and complex support structures provided to students. One student response seemed particularly rich in content and exemplified the full set of responses:

> *The project that I am running under LMRCSC funding is a feeding ecology study of weakfish in the Delaware Bay using stable isotope analysis. I am using stable isotopes to determine what returning and departing weakfish are eating into and from the Delaware Bay, respectively. The value of this project to my professional career is very significant. As an aspiring fisheries biologist, I am extremely excited to be able to work with fish and get out on the water to collect samples. All of the field, lab, and computer work that is and will be associated with this project is invaluable as I believe it will be the kickstart to my career as a fisheries biologist.*

Items fourteen through sixteen were intended to enrich the understanding of the types of students involved in LMRCSC activities by probing prior involvement in science programs in high school or post-secondary, as well as personal hobbies or experiences related to science. Responses from the high school prompt elicited a variety of activities, including science fair, science and technology programs, environmental clubs, FFA, and internships at informal science centers and aquariums. At the post-secondary level, seven of the eight students described a variety of field experiences as volunteers at aquariums or field stations, or through internships that involved field collection of samples. Five of the eight students identified extracurricular, community activities or hobbies that related to science. These included a variety of volunteer experiences (agency fish trawl surveys, taking children fishing, volunteering at informal science centers, committee service, or giving demonstrations in schools). Taken together, these responses, along with those to the earlier item that revealed early decisions about science careers, suggest a demographic “type” of science-informed, interested, student with early tendencies toward career selection. This student then demonstrates consistent involvement through voluntary work effort that both supports an ethical orientation to environmental stewardship, but also advanced cognitive development. Again, these emergent data should inform continued evaluation efforts across the project. The findings here suggest possible avenues for recruitment and retention of successful students to the LMRCSC program, to the extent that individuals who describe early STEM involvement and motivation may be ideal candidates for graduate and post-graduate support.

Items seventeen through twenty reveal that 3/8 of the respondents remain in communication with a key high school science teacher, and 3/8 (not the same students) have a parent or sibling employed in a science related career field (engineering and medicine). When prompted about any encouragement they had received to pursue a science related career by a parent or adult role model, the respondents described a variety of motivating rationales. Two respondents were encouraged toward science because of financial and employment stability. One was encouraged toward science because it was a field with room to have an impact. One was encouraged to pursue a career based on love or emotional draw. A final respondent experienced satisfaction in a high school internship in a marine research facility (WHOI) that stimulated the career path selection. For nearly all of these respondents (7/8), there is a strong perception that their chosen career paths will have a strong and positive potential for employment over the next decade. These data can also inform LMRCSC recruitment strategies, perhaps seeking potential students from key high school teachers who are involved in NOAA science efforts: perhaps a coordinated effort to review all NOAA funded secondary efforts to identify participating minority students.

Items twenty-two through twenty-four probed more deeply into the students LMRCSC activity during the past academic year. With regard to "most engaging or significant LMRCSC activity in which they engaged," students included REU participation, field sampling (zooplankton), a NOAA EPP Forum, making a conference presentation, and attending a workshop/fair on NOAA core science. The students viewed these experiences as significant for a variety of reasons including: enhancements in personal content knowledge, networking and meeting other scientists and other LMRCSC student participants, and the opportunity to present their own research. And finally, from item twenty-four, students provided information regarding the most beneficial university courses they had taken over the past year. Specific courses mentioned included: Advanced Ecosystems, Chemistry, Biological Oceanography, and GIS. The significance, as expected, supported the relevance of the courses to career paths and to content interests. But again with this description of courses, experiences, and significant academic and extracurricular involvement, there is a unitary focus on science that began very early with these individuals and continues into post-secondary and graduate involvement.

Items twenty-five through twenty-eight addressed more systemic level issues related to student understanding of the LMRCSC itself, of NOAA, and of the gradual evolution of a social system/network through the LMRCSC. Students described an evolving conception for NOAA mission science and fisheries science because of their connections to LMRCSC this past year. One student wrote, "My knowledge of NOAA has grown ten fold. Before I came to Savannah State University, I knew nothing about NOAA." Another wrote, "My knowledge of NOAA has been enhanced greatly. More and more, I learn about the different opportunities it has to offer students such as Sea Grant, LMRCSC, scholarships, different career fields through NOAA and NOAA Peace Corp." And two other students noted that they learned about pathways to careers through NOAA. In item twenty-six, 7/8 of the respondents reported a medium to high rate of interaction with students or professors at other LMRCSC institutions, a strong response that supports, again, the overarching system level goals that the LMRCSC delineated in the renewed five year contract. From other items in the survey, it appears these cross-project relationships are occurring in courses, workshops, and field experiences, but this will be further queried in the fall data collection. For item twenty-seven, 6/8 of the respondents reported a High or Medium level of knowledge about the LMRCSC as a NOAA EPP project/network. This same set of respondents reported receiving an orientation to the project by an advisor or faculty member, suggesting a cohesion in the responses. Finally, all of the respondents seemed Very Interested (n=3) or Interested (n=5) in continued interaction with LMRCSC and other student participants through a potential alumni organization, suggesting an avenue for project sustainability and continued participant support for this critical audience of young scientists.

Items twenty-nine and thirty asked the respondents to "look forward" and consider challenges to completing their education, and to consider what support structures or resources may help them move forward successfully. For the former, respondents identified time management, self-discipline, and financial resources as challenges to success. These suggest, perhaps, elements which could be included in formal advising support for students moving forward in the program. For the latter item, support or resources that might be helpful, respondents identified enhanced networking with professionals related to their careers with a view toward finding jobs. Additionally, one respondent suggesting tutoring with more difficult coursework, and, from a graduate student, having an undergraduate assistant to process samples, which could clearly be a win-win prospect for both of these individuals.

Summary

This opening student survey of the five year effort demonstrates early in the five year cycle for the LMRCSC that its students are already conceptualizing the Center as a larger network than their own campuses, with students, scientists, and agencies operating in an interconnected way and on a year round calendar. Students perceive a variety of support structures exist from advisors and faculty, and are already meeting and working with scientists from within and out of their campuses. This broader view, and social networking, will be helpful to these students in developing a more holistic view of the fields of science, and of the reach of NOAA and the potential for employment in a variety of academic and government institutions. While these respondents have a deep history and affinity for science careers, they still express concerns about their own efficacy in completing the goals they have set. Yet most have already identified a mentor or key advisor for specific support in this process. The LMRCSC has embedded itself in overt ways into the consciousness of these students, and has expanded their perceptions of

NOAA as a science research agency, as a conservation or environmental stewardship center, and as a potential employer. All of these observations from the data support a conclusion that LMRCSC is focused on its stated objectives, and moving toward successful completion of those and of its broader mission to support the STEM pipeline for NOAA with this population of students.

The evaluation team, through discussions with one co-PI, and through student response data, have compiled a beginning list of student participants for structured interviews to expand on the findings from this survey toward a fully-informed understanding of the accomplishments and impact of this LMRCSC on all of its student participants over this past year and the next four. As such, these survey data should be viewed currently as of interest, but with strong limitations due to response rates and sample sizes. These will be enhanced over time. Finally, the evaluation team will work with the LMRCSC leadership to enhance student survey response rates in year two. It may be that a more formalized "cohort model" for collecting student data may be advised.

Faculty/Scientist Survey Responses

As with the previously summarized student survey, a survey was developed for scientists and faculty working on the LMRCSC project and approved by the project leadership team for distribution in early summer 2017. The URL to the revised survey was provided to project leadership, who sent it to the faculty and scientists, providing a copy of the circulation list to the evaluation team.

A group of eleven scientists completed the survey, representing: Delaware State University (1); Hampton University (1), Oregon State University (3), Savannah State University (1), University of Maryland-Eastern Shore (2), University of Maryland-Center for Environmental Science (2), and the University of Miami (1). Five of these respondents serve the project as PI or Co-PIs, one as Senior Personnel, one as a teaching faculty member, three as university researchers, and one who mentors LMRCSC undergraduate interns and graduate students. It should be noted that in year two of the project, the evaluation team will make specific outreach efforts to capture feedback from NOAA scientists and personnel who have interactions with the project to enrich the overall understanding of project impact. Of the eleven individual scientists providing survey feedback, five have worked with the project from 1-5 years, two from 6-10 years, and four from 11-15 years. This longer-term experience with the project among survey respondents suggests these individuals are highly knowledgeable of the LMRCSC and thus can speak authoritatively to its scope and impact.

Item five asked respondents to indicate which activities they anticipated participating in with or for LMRCSC over the five years of this project funding cycle. The item allowed multiple responses to capture the complex connections numerous individuals have with the project. These activities and rates of participation include:

- Teaching an entire course (4)
- Teaching a part of a course (1)

- Leading student field research experiences (3)
- Conducting research (7)
- Mentoring or advising students (9)
- Managing elements of the grant (4)
- Supervising student internships (3)
- Organizing meetings, participating in EC and other teleconferences (1).

Item six asked the relative level of awareness of the history and scope of the LMRCSC. As expected, these responses correlated with the years of connection to LMRCSC, with five individuals reporting Very Aware, three reporting Aware, and two reporting Limited Awareness of the LMRCSC. For all of these individuals, they were asked (item seven) in what areas would they like to receive additional information. The responses included: workshops to which they could send students, new projects and grant opportunities, and (two responses) information about success rates of students obtaining NOAA employment and other career paths of LMRCSC graduates. This particular, last response, will be part of the tracking effort of the current project evaluation.

Item eight asked respondents to describe their career and/or funding involvement with NOAA. Ten of the eleven respondents described either direct grant funding, employment by, or work with NOAA scientists. These connections included: receiving TAB grant awards through LMRCSC, co-researching with NOAA scientists on multiple projects, receiving multiple NOAA awards for research, and one individual who had been a NOAA scientist/employee and was now in academia.

Items nine and ten probed respondents to identify primary research interests and content areas, as well as primary courses which they teach which relate to NOAA mission science. LMRCSC project goals and objectives, as well as NOAA EPP guidelines describe the necessity of continuous focus by the project on NOAA mission science, and this information will be regularly collected in the project evaluation in a variety of ways. For these respondents, their primary research responses included:

- Spatial ecology and conservation biology (marine vertebrates)
- Marine Resource Economics
- Stock assessments, ecosystem modeling, Bayesian statistics
- Marine Ecotoxicology
- Fisheries, Aquaculture, conservation
- Marine megafauna ecology, conservation
- Zooplankton Ecology
- Microbial symbioses
- Fish ecology, fisheries, climate change, reproductive life history
- Ecology of fishes, fishing impacts on habitats.

The primary course responses included:

- Coastal Zone Management, Fisheries Management, Marine Conservation Biology, Intro to Oceanography, Marine Mammalogy, GIS
- Bayesian Statistics
- Marine Ecotoxicology
- Spatial Behavioral Ecology of Marine Megafauna
- Oceanography
- Marine Microbial Ecology
- Fishery Biology
- Statistics, Fisheries Management

For all of these responses to these items, there is a clear correlation between the research and teaching of these LMRCSC involved scientists to NOAA mission science. Further, looking back to the student responses to their survey items, there is a clear interest and content expertise among the project scientists to the interests and career ambitions of the students connected to the project.

Item eleven asked respondents, “With the LMRCSC project, NOAA is interested in seeing its mission science enhanced in higher education. From a curricular perspective, which ocean or aquatic content and concepts are easiest to integrate into course curricula and which are the most difficult?” This item garnered seven responses that allow a clustering of content as relatively easier or relatively more difficult as follows. Content perceived as easier to integrate included: general fishery biology, ecology, biological needs for effective fisheries management, large data sets for climate change, global warming, stock assessments. The content areas perceived as more difficult included: stock assessment (both groupings), bio-economic modeling, physical and chemical oceanography, molecular approaches and bioinformatics, molecular biology, nuances of climate science, mathematics, and management processes. Given this observation regarding the relative difficulty of some of the science content, a question arises regarding how student background is considered in the recruitment process, as well as issues such as tutoring, remedial training or education, and other appropriate support structures for students to maximize the learning experience and success of all students.

Item twelve solicited information about funding received by LMRCSC connected scientists. As expected, the funding stream of these individuals represented a near-complete amalgam of the STEM funding agencies in the country. These included:

- NOAA (9)
- NSF (6)
- Non-Federal Agencies or Organizations (7)
- Other Federal Agencies (6)

The list of other federal agencies included: NIH, NIST, USDA, USGS, BOR, BLM, NFWF, FWS, US Corps of Engineers, and BOEM.

Item thirteen focused on the NOAA career pipeline for fisheries science. This item asked, "Looking at the challenges of early career scientists, what do you consider the areas where pre-career support or education would be most beneficial?" One cluster of responses focused on preparation for the eventual job, i.e. job search skills, grant writing, teaching and communications training. Other responses included mentoring, and the requisite support for faculty to provide this; internships and field experiences, which optimally would include time in NOAA facilities. A final response noted that earlier recruitment of (implied) high potential students would be beneficial. It should be noted that many, if not all, of these recommendations are addressed in the current LMRCSC plans. It should also be noted that many of these recommendations are identified by students in the previous survey as "highlights" or strong elements that have proven helpful to them. And finally, the recommendation on earlier recruitment seems aligned with the students reports that they already knew of their interest in STEM careers at very early points in their childhood and youth.

Item fourteen asked respondents to project out 5-10 years and consider the most significant challenges to ocean, marine, aquatic, and fisheries science careers. The reader should recall that this set of respondents have, in many cases, decades of experience in working with undergraduate and graduate students and assisting with career development issues, as well as deep connections to NOAA fisheries. The respondents almost unanimously perceive that funding limitations are the single most significant challenge in these career areas moving forward. Added to this were a lack of public interest in science, a lack of trained quantitative researchers, and political constraints at the federal level.

Item fifteen asked, "What are the primary benefits of research experiences and/or internships to undergraduate and graduate students?" The responses clustered into a tight focus on career development. Students needed these internships to see first-hand how science really works. To obtain a real-world understanding of what a job in this type of science entailed. These field internships were critical in skill formation, and in helping students see the range of content and skill areas. The internship also helped students choose their own individual pathways. It was observed that undergraduates particularly needed these internships to open doors for graduate school and for employment in the future.

Items sixteen through nineteen focused on mentoring students or working with and supervising students in various capacities, and the resources the scientists needed to do that effectively. Item sixteen asked if the faculty/scientists considered themselves to be mentors, and if so, in what ways did they carry out this responsibility. A key element that emerged in nearly all of the responses to this item was that of investing time in and with their students: meeting with them regularly; providing detailed feedback to proposals and other work; and designing work experiences that help these students understand the career, the science, and the skills necessary for success. These skills included writing proposals, planning and conducting research, and writing for publication. These skills could be addressed in the graduate seminar under discussion by the project leadership. Further, these key elements are essential to mentoring, and could become part of the mentorship training also under consideration by the project leadership.

Item seventeen asked the respondents to reflect on their own careers, and identify advice that they wish had been shared with them by a mentor early on. These responses seem highly thoughtful and personal, and well constructed. They included:

- Ask questions early and often; speak up if you think something is not right—it will only get worse the longer you stay silent.
- [Obtain a] better understanding of the publishing process.
- I wish someone had explained the culture and ethics of co-authorship to me early on. I also wish my grad school mentor had told me more about how the funding works.
- Be passionate about what I do; be persistent and work hard.
- Get involved in a big, long-term NSF funded project. Learn more about budget/accounting (sad but true: we are expected to do this but have no training.)
- Be patient, and learn how to work with all types of people; have fun.
- I received good advise in two areas: importance of strong background in molecular biology and good training in writing by working on manuscripts with my mentors.
- Written and oral communications skills are key to engaging with the public, who ultimately decide whether your work is useful. Learn management skills—personnel, budget, etc., as those skills are never taught in graduate school but are key to success as a PI. Never let a brewing problem become a major problem.
- Research and Teaching are only parts of the job. Budgeting, administration, and supervisory skills are critical.

These observations point, in part, to non-science skills that would be valuable knowledge for the LMRCSC graduates.

Item eighteen sought input on ways in which LMRCSC could provide additional support to scientists and faculty in working effectively with students. The responses were wide ranging, with no evident defined cluster or theme. Interesting or novel comments, however, included training for scientists to work with students, better alignment among the virtual courses offered, and several issues pertaining to funding for students, to include flexibility in the use of funds, and consistency in the availability of funds. This item will be continued and reviewed in the fall semester as part of the front-end assessment for annual program review information for the LMRCSC director, with all responses carried forward to review for focused themes.

Item nineteen asked respondents to describe the most enjoyable or rewarding parts of their work with LMRCSC students. This item was selected for inclusion as it may ultimately surface information helpful for recruitment of new scientists to the project as the need may arise. Responses focused on three basic points of satisfaction: seeing students' growth in skills and understanding toward graduate school or the career, seeing them graduate, and then succeed in their career entry and careers.

Item twenty sought information on LMRCSC support for scientists' professional growth and development. The responses clustered into those tangible supports derived from funding: research funds and other funding opportunities, travel funds for conferences and professional meetings, and funding for publications. Support, other than funding, included: growth and learning through collaboration with partner institutions, and support from building these collaborations and partnerships.

Item twenty-one asked respondents to consider additional opportunities that could or should be considered by the LMRCSC team, given the early stage in this new project funding cycle. These responses would be of relative importance for the project leadership and are included fully as:

- Workshops/training for faculty and students.
- Integrated research social science and ecological science in a policy framework.
- Good student recruitment.
- Increased funding opportunities for research projects, PI salary, and graduate student support.
- The LMRCSC needs more synergistic activities between the partner institutions.
- IMET provides great opportunities to learn molecular approaches. An important opportunity is provided by summer internships to undergraduates at IMET. This should be resumed.
- Not sure. I have very little (almost nothing) communicated with me about what LMRCSC is doing anymore, or what the opportunities even are. It's rather disappointing.
- Leveraging other large grant opportunities that may become available. Coordinating with NOAA to develop specific opportunities through S-K or other NOAA grant programs. We usually only respond to these, but could be involved in developing specific priorities. This has worked for creating internships with the Ocean Exploration program. We need NOAA to find additional funds for dedicated ship time.

Item twenty-two asked, again in the context of this being the first year of a new five year cycle for LMRCSC, "what additional challenges should be considered by project management moving forward? Again, given the importance of these responses as formative input to the project for the project leadership, the responses are included in full:

- Timing—while I understand that funding gets delayed by forces outside the control of the LMRCSC, it would be nice to have better timing on the TAP proposals. The amount of time from proposal to notification left little time to actually do the research.

- Spatial and quota management in a dynamic fisheries world using food systems approaches.
- Lack of effective communications.
- The focus on fisheries should be broad. Fisheries scientists are going to increasingly need to understand ecosystem health and function, best studied using molecular approaches. Too narrow a focus on traditional fisheries science will not be enough to train students for challenges over the next 20-30 years.
- Deciding who they want to engage with, and then figuring out a plan to engage with them.
- Possibility of funding being reduced or eliminated for the LMRCSC or other federal programs that provide grant funding to us. We need NOAA to consider the CSCs as part of NOAA, and to provide opportunities to students similar to those provided to NOAA employees; e.g. access to laboratories and training programs. EPP keeps making up rules and requirements that were not part of the original RFP or proposal, e.g. additional reports, spending restrictions, student requirements. That needs to stop. The documentation is becoming too much of a burden.

Items twenty-three and twenty-four solicited descriptions of any collaborative research begun or completed in the past year with other LMRCSC faculty or scientists. Interpretation of the responses was problematic due to the format of responses, but included approximately 6-8 distinct projects involving twenty-two named scientists and/or students. The projects as named clearly overlay the areas of NOAA mission science and included a variety of fishery species, marine mammals, and management issues. The evaluation team will coordinate with the LMRCSC leadership to expand the project data collection and evaluation out to these additional scientists and students in the fall of 2017. Item twenty-four indicated that two of these collaborative projects were initiated under the new LMRCSC award, and two of them were continuation projects begun under previous LMRCSC funding.

The final two items probed more deeply into the barriers and challenges of collaborative research across institutions, and also the benefits of doing this type of collaborative work and ways in which the LMRCSC might support this. Beyond the general allusion to funding and time issues, one interesting comment seemed well constructed and meaningful: *"The initial connection was difficult…[I'm not sure it is possible] but might be nice to have a full listing of all LMRCSC faculty and their areas of research so that we could figure out how to connect within the LMRCSC. It seems like the LMRCSC meetings only involve those already involved in research; whereas, more connections could be made by introducing faculty to each other to increase collaboration."*

In the area of benefits of collaborative research and the means whereby the LMRCSC might provide support, most respondents simply paraphrased or restated their responses to the prior item. Nevertheless, there were notes regarding the benefit of student involvement, of learning new ways of thinking by working with others, and developing new skills that other people have.

As a final comment—looking at both the previous student survey and this current faculty/scientist survey—one student and four scientists (who are not part of the project leadership) have indicated a willingness to continue to interact with the evaluation team, to provide a more expansive and experiential perspective on the LMRCSC moving forward into the second year. The evaluation team has also, in interviews with one co-PI (to date; interviews with the other co-PIs will be schedule in early year two of the project), identified three recent graduates who have entered their careers for interviews in the early months of year two for enhanced impact data collection.

Recommendations for Consideration by the Project Leadership

Throughout this report the evaluation team has made suggestions and observations based on the feedback obtained from undergraduate and graduate students, and from faculty/scientists. These suggestions should be viewed in the context intended: they are *reasonable* with regard to the survey data, but may in fact reflect ongoing efforts or project structures which are in place but which were not in view of the survey respondents. In a highly complex system such as the LMRCSC, many of these may already be addressed, and will emerge in future data collection efforts, or may be part of ongoing planning meetings. Nevertheless, these suggestions and observations are provided to the Project Director and Leadership to "close the loop" on the approved year one evaluation plan, and in preparation for subsequent program evaluation efforts.

The next steps in ongoing program evaluation, beginning in program year two, include:

- To identify mechanisms for communication with NOAA Scientists to obtain project feedback and input from that constituency.
- To interview select students (current and alumni) to obtain enhanced information and understanding regarding a "success profile" for an LMRCSC graduate.
- To obtain and analyze the Individual Student Development Plans (ISDPs) for the year one cohort of undergraduate and graduate students in light of year one survey data findings.
- To collect an impact assessment on the week-long graduate student seminar through multi-modal data collection, to include surveys, interviews, and direct observations by the evaluators.
- To continue participation in project communications opportunities, to identify additional opportunities to formally monitor the impact of the LMRCSC, i.e. the mentoring training, graduate student presentations, social impacts of student research, cohort development activities, other formal courses, and other opportunities.
- To continue ongoing implementation of the approved evaluation plan.

LMRCSC Evaluation Year 1 Conclusions

To formulate and summarize the year one evaluation conclusions, the evaluation team also reviewed NOAA's Education Strategic Plan as well as the LMRCSC Implementation Plan to consider how the project was meeting the goals articulated in these two documents. The results of this year's evaluation work indicates that *the LMRCSC programs are successfully addressing the Center's goals and objectives as well as accomplishing positive steps in meeting the objectives of NOAA's Education Strategic Plan.*

One of the major goals articulated in NOAA's Education Strategic Plan is *Goal 4: Future Workforce*. A diverse and highly skilled future workforce pursues careers in disciplines that support NOAA's mission. NOAA strives to cultivate a workforce that reflects the diversity of the Nation. The LMRCSC embodies this workforce commitment in increasing graduation rates of underrepresented students in NOAA-mission science, supported by research opportunities, internships, and scholarship opportunities—all of which are robustly present in the LMRCSC. The LMRCSC PIs are working together as academic center partners to "align student preparation with NOAA's scientific and workforce needs." The LMRCSC's post-secondary education and training goals, as stated in its implementation plan, echoes and specifies future workforce goals for marine and fisheries science.

Further, there is evidence that the LMRCSC is succeeding in addressing LMRCSC Education Goal 2 of the implementation plan: "Strengthening collaboration across universities and professional networks to enhance academic programs in marine and fisheries science." The survey data from both students and faculty highlight this academic collaboration, and provide indication that the LMRCSC is meeting *Objective 2.4: Link students to professional networks and employment opportunities.* Mentoring networks are in place as described by the students in the year one survey, though the distinction between mentoring and advising is somewhat unclear. Nevertheless, students mention specific, supportive individuals who have aided them on their career path and through their academic efforts.

The Individual Student Development Plans (ISDP) for year one will be provided to the evaluation team in the first quarter of year two, and therefore awaits review by the evaluators are the ISDPs. These documents are significant for detailing individual accomplishments of the students. The evaluation team anticipates reviewing these plans and considering these in the context of the current survey data, as the second year begins. The ISDPs will provide increased insight into the students' knowledge of STEM disciplines and NOAA Fisheries and Marine Sciences, as well as additional evidence to support LMRCSC efforts.

The project team has planned a weeklong seminar related to NOAA-mission science for March 5-9, 2018, at the University of Maryland Eastern Shore. Coordinating this effort given the complexities of multiple university calendars proved to be a challenge. The planned weeklong seminar will help not only with science content acquisition, but also with professional and social skills needed to be successful in the workforce, and substantively addresses grant goals. The evaluation team will work closely with project leadership to both attend this workshop and evaluate its impacts on students and scientists.

The project PI team has begun to discuss and plan ways for center-wide core competency focus in social science. While there have been discussions about the social science aims, this has not yet been fully implemented and there are challenges regarding the definition and implementation of social science impact as related to this project. Plans to address these impacts, and the human dimensions content, currently focus on the weeklong seminar and the identification of key expert presenters. Additionally, efforts are progressing to formalize the inclusion of social impact statements in student research documentation.

In summary, the evaluation team concludes that the data collected across each partnering campus, and from Cohort 1, undergraduate and graduate students, and faculty and scientists, substantially supports positive goal-attainment during year one of the LMRCSC effort. Evaluation efforts in year two will continue these current student data collection activities (continuing to monitor Cohort 1 and adding Cohort 2 students), as well as expand formal efforts to collect data from NOAA collaborating scientists, from the weeklong seminar programs, and from TAB project recipients.

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

Background and Introduction

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

Revision to Evaluation Plan

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

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

1. How has the Center award implementation activities increased the number of students and graduates trained in the competencies and skills that align with employability and graduate studies in NOAA mission-aligned areas to advance the effectiveness and impacts of the NOAA Educational Partnership Program with Minority Serving Institutions (EPP/MSI) postsecondary NOAA mission STEM future workforce program?

2. What is the evidence that the Center award implementation activities enhanced the capacity for NOAA mission-aligned research at partner institutions and other MSI's?

3. What is the evidence that the CSC management team and administrative processes enhanced the capacity of lead and partner institutions to meet the goals and objectives of the Center award in advancing the effectiveness and impacts of the NOAA EPP/MSI STEM future workforce program?

We note here the emphasis on *evidence claims* in these guiding questions, and in the related sub-questions in the NOAA EPP evaluation framework. This is consistent with the external evaluation planned and underway for the LMRCSC as implemented by Bishop and Walters. Annually, the external evaluators plan to implement select data collection through a variety of methods to obtain evidence toward assertions that the project is meeting these overarching goals. Given the comprehensive span of the project, the external evaluation annually identifies and targets select stakeholders related to the project, and select programming efforts within the LMRCSC to collect evidence that supports the overarching questions and the project goals and objectives.

Year Two Data Collection and Evaluation Focus

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

Evaluation Activities in Year Two

- Monthly management phone calls;
- Phone calls with other CSC evaluators and NOAA EPP;
- Evaluation plan revision at NOAA EPP request;
- NOAA Scientist Survey;
- Cross-CSC version of NOAA Scientist Survey;
- LMRCSC Administration and Staff Survey;

- All three evaluation team members attended the March workshop;
- Prepared initial data slides for Dr. Chigbu for NOAA EPP Forum;
- Graduate Student Post-Workshop Survey; and
- Informal interviews with LMRCSC co-PIs, staff members, graduate students, and NOAA scientists.

Impact on Students

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

The student survey included twenty-one items to capture background demographic information from the students, as well as student perceptions of the value and impact of the workshop and the broader LMRCSC effort on their progress through school, their understanding of NOAA as a potential employer, NOAA's mission-critical scientific concerns, and other issues related to college or graduate school progress. Fifteen of the student participants at the workshop volunteered to complete the survey in its entirety, which was collected confidentially and separate from LMRCSC management involvement. All of the student respondents were graduate students at the MS or PhD level (6 and 9 respectively). All of the students are matriculating in areas strongly related to NOAA mission-critical science. Eleven of the respondents were able to provide the name of a specific, NOAA scientist with whom they are currently working—which is a very strong indicator that the LMRCSC is directly linking graduate students and NOAA scientists. This is evidence which supports project performance in both the first and second focus areas of the NOAA EPP question framework cited above. (Note: the NOAA scientists who were surveyed separately, reported below, provide independently confirmed support for these students' survey responses, demonstrating the reliability of these data as evidence for support.)

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

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

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

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

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

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

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

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

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

In summary, the student responses to the post-workshop survey are credibly related to the observations of the workshop that the evaluation team recorded themselves. The workshop was highly content-focused, with numerous sessions on NOAA's mission science. The workshop incorporated intentional focus on job skills, career building and networking skills, and career pathway information. Students clearly enjoyed these sessions—as observed by the evaluators and as described in the survey. This workshop, as observed by the evaluators and described by the students, is evidence that the LMRCSC is substantially addressing NOAA EPP's concerns for preparing students for career entry and success with the job and career skills required.

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

Enhancements to NOAA Research

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

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

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

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

A key set of questions in the survey (items 6-13) were related to the involvement of these NOAA personnel in the LMRCSC, and ways which the CSC meets the needs of these scientists. It is noted that the NOAA scientists in this case are serving as proxies for NOAA research interests and concerns as reflected in the NOAA EPP guiding question two above. In response to question 6 regarding the pathways through which the NOAA scientists connected to the CSC, the scientists replied:

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

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

- Teach entire courses (1 person)
- Teach sections of courses (2 people)
- Teach part or all of a workshop (4 people)

- Conduct research connected to LMRCSC (3 people)
- Mentor or advise students from MSIs (8 people)
- Supervise student internships (4 people) or
- Provide specimens for research projects (1 person).

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

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

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

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

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

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

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

- *The ideal scientist will have to have a very diverse skill set to address the exponentially increasing amount of information and data that are, and will, become available and the likely relative reduction of government positions;*
- *Cross-disciplinary thinking: the problems fisheries face more and more involve a host of interacting issues, including ecological, economic, social, and political, in addition to pure fisheries science. Young people need to be cross-trained to be aware of the complexity of fisheries issues;*
- *In the short term, funding will likely be a challenge and job opportunities will be limited. In the longer term, scientists will rely more and more on technology. Students need good base-level skills with computers, programming, etc. They will also need to be able to learn new computer and technological skills quickly.*
- *Students will need advanced modeling skills and critical thinking about climate change.*

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

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

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

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

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

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

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

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

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

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

LMRCSC Administrative Processes

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

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

- *The LMRCSC has helped the partners with some direction on new program requirements, however, there is more the center can do to increase the communication about center goals and requirements to partner institutions;*
- *It is our responsibility to make sure our partners stay within the NOAA EPP's financial guidelines. This has been a real challenge on the new grant with NOAA changing the rules constantly and not giving clear, written instructions;*

- *By clearly articulating those goals and by communicating at least monthly to discuss challenges and solutions to meeting those goals.*

Similarly, staff members can describe ways through which the center helps its partners address NOAA mission priorities:

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

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

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

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

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

It is clear, from these responses, and from direct observations by the external evaluation team, that the LMRCSC leadership and staff team takes its commitments to the project seriously. There is evidence that the team members have a high awareness of contractual responsibilities, explore through direction communication with NOAA EPP leadership any questions or concerns and to clarify contractual language when necessary. The external evaluation team further monitors project communication among the PIs by participating in the monthly conference meetings and through review of meeting agenda and minutes. These all serve as evidence as required by the NOAA EPP guiding question framework at the beginning of this report, that the administrative and management goals and objectives are being realized and are functional in the manner described in the grant proposal. The staff members, as evidenced in survey responses, are sensitive to compliance issues, but are dedicated and visionary in responding to students, to faculty, to NOAA scientists. They are aware of NOAA mission science and career pipeline goals, and build these into programming for students, as further evidenced in the training sessions and materials cataloged from the spring 2018 student workshop.

Summary and Conclusions

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

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

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

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

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

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

Background and Introduction

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

Evaluation Plan

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

1. How has the Center award implementation activities increased the number of students and graduates trained in the competencies and skills that align with employability and graduate studies in NOAA mission-aligned areas to advance the effectiveness and

impacts of the NOAA Educational Partnership Program with Minority Serving Institutions (EPP/MSI) postsecondary NOAA mission STEM future workforce program?
2. What is the evidence that the Center award implementation activities enhanced the capacity for NOAA mission-aligned research at partner institutions and other MSI's?
3. What is the evidence that the CSC management team and administrative processes enhanced the capacity of lead and partner institutions to meet the goals and objectives of the Center award in advancing the effectiveness and impacts of the NOAA EPP/MSI STEM future workforce program?

The emphasis on *evidence claims* in these guiding questions is consistent with the external evaluation planned and underway for the LMRCSC as implemented by Bishop and Walters. Annually, the external evaluators are implementing data collection to obtain evidence that the project is meeting these overarching goals. Given the comprehensive span of the project, the external evaluation annually identifies and targets select stakeholders related to the project, and select programming efforts within the LMRCSC to collect evidence that supports the overarching questions and the project goals and objectives.

Year Three Data Collection and Evaluation Focus

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

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

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

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

NERTO Student Survey Data and Summaries

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

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

- My mentor has supported my career development by serving as a recommender for both a PhD opportunity involving fisheries analysis as well as a NOAA job opportunity;
- He introduced me to and integrated me into a federal science career environment. He involved me in weekly meetings, introduced me to colleagues in the lab, helped me make connections with people involved in research similar to mine, and was always available to support or to answer questions I had;
- Provided excellent information on the process of conducting research for the federal government.
- He proof reads all of my work and offers constructive criticism. Keeps me up to date with workshops and conferences;
- He has communicated with me about post-doctoral fellowship and other agencies I should apply for jobs with.

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

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

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

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

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

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

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

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

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

NERTO Scientist/Mentor Survey

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

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

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

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

- He had to practice new modeling and computer programming methods, such as how to develop his own likelihood formulae and estimate parameters to maximize the likelihood in the computer coding software R;
- The intern learned how to age land snapper, constructed growth curves and tested for differences between male and female growth curves;
- Field work—collecting fish, inverts, and water quality data. Lab work—preparing samples for stable isotope analysis. Analytical work—statistical modeling stable isotope ratios;
- Collecting hemolymph samples from mussels and conducting flow-cytometric analysis of hemocytes probed with fluorescent indicators of specific physiologies.

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

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

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

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

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

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

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

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

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

TAB Project Scientist Data

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

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

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

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

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

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

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

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

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

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

Item seventeen asked respondents to describe how they had encouraged or enhanced their student's career development. Responses were, again, rich and demonstrative of the scientists' awareness of early career formation among young colleagues, and their helpfulness in these TAB projects. Responses included: pushing students to present at conferences, assessing their abstracts and posters; encouraging them to publish; encouraging them to apply for NOAA fellowships and internships; CV development, grant writing; working to improve scientific thinking and writing. Clearly, these types of supportive activities are appropriate and have emerged in other research on mentoring success for science disciplines and careers.

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

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

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

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

TAB Student Data

The TAB student survey response data were far more limited, with only three students providing responses. It is likely that disruptions in the communications channel as a result of the federal government shut down this year resulted in a disruption in transmitting the surveys to students in a timely manner. Nevertheless, students will be surveyed in early April at the spring workshop at the UMES facility as a part of the LMRCSC student training event, and so there will be additional opportunities to elicit impact data from the perspective of the students themselves. The summary of the current TAB student survey will be limited based on concerns about sample sizes in these responses.

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

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

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

Undergraduate Student Survey

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

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

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

Item eight asked respondents to describe research or field experiences in which they had participated with funding from the LMRCSC. Responses were varied, as anticipated, and included lab work, an internship at a NOAA laboratory, educational outreach at an elementary school and work on a regional site of the National Ocean Sciences Bowl, using lab techniques under supervision of a PI, obtaining their degree (scholarship funds), and an REU at one of the collaborating institutions. The variety of responses is cohesive with the types of funding that are indeed available to support undergraduates, and these responses—beyond the substance of the work—denotes a familiarity with the LMRCSC program and its scope, and supports effective program communications (as an administrative function of the LMRCSC).

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

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

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

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

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

Items twenty and twenty-one asked respondents to identify any additional activities which could be offered through LMRCSC in which they would be interested, and to provide a rationale for these activities. Responses included: coding seminars, REUs, work-study projects, social mixers or other activities for collective social connectivity among LMRCSC students. Other responses included additional conferences, study abroad and community service opportunities. Respondents viewed these types of activities as important for networking and relationship building among peers, but also related to expanding their skill sets and helping them explore interests and build experiences.

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

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

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

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

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

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

Spring Student Workshop Survey

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

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

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

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

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

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

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

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

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

Evaluator Site Visits

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

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

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

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

Focus Group Discussions with LMRCSC Partners and Staff

At the site visit in March/April (the spring student workshop at UMES), the evaluators further developed observation notes around the NOAA EPP questions 3.2, 3.3 and 3.5 from interviews with the co-PIs from the partnering institutions of higher learning in the LMRCSC. These notes seem particularly valuable to document in this final report and so are included at length as follows:

Response to NOAA EPP Question 3.2:

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

Response to NOAA EPP Questions 3.3 and 3.5:

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

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

Action Items:

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

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

Questions:

1. Is the LMRCSC engaged with, or defining correctly, social science integrations as NOAA EPP wants (or social impacts)?

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

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

Conclusions

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

Primary Finding for Year 3

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

Discussion and Recommendations

The students are obtaining opportunities, through LMRCSC fiscal support, training, and linkages to scientists (university and NOAA), and mentoring, to meaningfully expand their capacity to engage NOAA mission science, to use large dataset management and analytic skills, and to enhance their connections to NOAA's workforce and an expansive and diverse network of scientists and peers who are at various stages in the career pipeline. These students and their scientist mentors perceive the value and benefits of the NERTO and TAB experiences—and clearly these experiences also benefit the scientists themselves.

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

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

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

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

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

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

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

Recommendation 6) LMRCSC leadership have compiled information regarding the Social Science Impacts/Human Dimensions of the various research projects and activities conducted under the Center. It is recommended, given NOAA's broader agency concerns for social science impacts, that these Center efforts continue and that these are communicated broadly to students, center partners and NOAA personnel. It is further recommended that a systematic review of student NERTO and TAB projects be conducted to ascertain these social science and human dimensions impacts.

Living Marine Resources Cooperative Science Center External Evaluation Year 4 Report (2019-2020)

Prepared by Tina Bishop, Ed.D. and Howard Walters, Ph.D. (College of Exploration)

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

Among the significant programs implemented under LMRCSC are the *NERTO*, a research program for graduate students to conduct original research under the cooperative supervision of a NOAA scientist in a NOAA laboratory, and a university mentor; the *TAB* research project (Technical Advisory Board, in reference to the primary review process embedded in project approval for students or related faculty); and a *Data Management for Scientists* graduate course taught online as a requirement for all students in the program. This current annual report provides summaries and observations for evaluation efforts conducted at the end of project year four for these three programs of the LMRCSC, as well as a brief synopsis of two additional evaluation efforts in this year, i.e. a site visit to Savannah State University, and development and implementation of a student recruitment planning survey (which emerged from the IERT Panel Review). Additionally, the external evaluation team made significant time commitments to preparing for and responding to the IERT Panel during year four, which is also summarized at the end of this report. This final, written report consolidates all of the annual evidence into an overarching report with recommendations and findings at the end of the project year, as has been done in the earlier years, although in light of the IERT process in year four, these recommendations and conclusions are couched or contextualized within the IERT Panel Final Report.

NERTO Report

In fall 2019, the students conducting NERTO projects during this academic year were surveyed to collect formal response data to allow the evaluation team to consider the impacts of the NERTOs overall. In addition to these surveys, the evaluation team has been conducting site visits at the LMRCSC partner institutions to also conduct interviews with graduate students, NOAA scientists, and university mentor faculty members associated with the project and to conduct field observations of the contexts in which these students are working. These data are also contributing to an understanding of the impacts of the NERTO efforts. The summary sections as follows will consider first the survey responses from eight graduate students who participated in the NERTO and completed the survey in fall 2019, and then briefly summarize select interview narrative that relates to these NERTO projects.

Items one through four of the survey focused on the content of the NERTO projects. Respondents described their projects (item one) which addressed ecosystem modeling in Maryland, and a variety of commercially important species (Dungeness crabs, shellfish) or other forage fishes related to resource uses. When asked to align their projects with the NOAA mission science research priorities, the responses distributed in 25% equal units with Seafood safety/Aquaculture, Ecosystem Science, Stock Assessment, Living Resource Management. Item three responses note that five of the eight responding students were required to “manage, analyze or manipulate large datasets” while working on their projects. And (item four) three of the respondents indicated that they considered the social science implications of their projects during the NERTO. Particularly with item four (social implications), over a third of the respondents did not associate social science with their project. The responses suggest there may be a gap in the students’ conceptions of social impacts of science research. It is noted that in the interviews with the graduate students, this gap did not appear when they were prompted to think through potential social science implications, as the interview methodology allowed for probing questions as the evaluators met with the individual graduate students.

Items five through ten addressed the relationships and roles of the mentors on the projects and students. Five of the eight respondents had worked with their mentor more than a year, with the other respondents less than this. Four of the respondents were working more than eleven hours weekly (two, more than twenty hours weekly). Item seven suggested, counter-intuitively, that direct, in person conversation with the primary method of communications between the students and mentors. Most had significant support from their academic mentors, although there is one person in the response pool who is disgruntled in some way. In item eight, five of the eight respondents indicated that the mentor has supported their academic work either significantly or quite a bit. In item nine, six of the eight respondents indicated that the mentor has supported their professional careers either significantly or quite a bit.

Item ten followed up the previous questions to ask respondents to describe the ways in which their mentors had provided this support. Except for one student, the respondents indicated networking in the field as a primary mechanism for career support. One select quote that illustrates well the overall essence of these responses is, "By treating me as part of the team, I was expected to fully participate in lab meetings…I was also given an opportunity to present my work in front of other scientists."

From the narrative responses, the participants viewed the primary benefit of NERTO was insight into the NOAA community from working in a NOAA research facility. Other benefits mentioned by students included professional relationships with NOAA scientists, and other collaborations and networking opportunities. Numerous students also mentioned the benefit of a professional association with NOAA several times.

It does seem clear from select response items and narrative descriptions that the NERTO participants perceive the NERTO influenced their career decisions, with seven of the eight students strongly agreeing or agreeing. The narrative responses are helpful in clarifying these perceptions:

- *Interning at a NOAA Lab this summer allowed me to experience what it would be like to work at NOAA and has inspired me to possibly work at NOAA when I graduate;*
- *I learned more in depth how NOAA operates as an organization and the role of science in the government; and,*
- *I got a chance to see what NOAA does in person and be a part of that work. I am more energized about NOAA's mission and seeing what they do first hand, solidified my wanting to work for NOAA one day.* Continuing this workforce theme of questioning, item sixteen reveals that seven of the eight respondents gained "good insight into the NOAA organizational culture through their NERTO." Item seventeen further revealed that seven of the eight perceived that NERTO "helped create a network for future success in the workforce." And finally, item nineteen reflects that seven of the eight had a mentor who "introduced them to other colleagues in the field during the NERTO experience." This was reinforced with responses in item twenty-three where six of the eight completed their NERTO with a "sense of belonging to NOAA mission science fields."

TAB Report

Annually, the Technical Advisory Board (TAB) for the project receives proposals for original research from graduate students, and following a technical review, awards funds for these projects, conducted by the students under the supervision of a university mentor.

In fall 2019, students in the TAB projects were provided an electronic survey to complete to provide responses aligned to the NOAA EPP guiding questions for the Cooperative Science Centers. Seven students provided responses to the survey, with their responses summarized below. Items one through five solicited descriptions of the student projects. Item one reflects that three respondents were Ph.D. students, and four were masters level students. In item two, respondents described, briefly, the extent of their projects:

- The objective of my research is to test if Atlantic Sea Scallops are contaminated with microplastics and determine the polymer composition of the plastics found in them.
- The funded project used geostatistical modeling to understand the spatio-temporal distribution of larval King Mackerel in the northern Gulf of Mexico and how it impacts the trends and uncertainty in the index of spawning biomass abundance, used for the stock assessment.
- Exploring underrepresentation in marine and fisheries science professions
- Investigating the reproductive biology of the Jonah crab. Using hormone expression as an indicator of male sexual maturity and determining the size at which these males are becoming mature.
- Develop an improved stage structured population model for Kemp's ridley sea turtles to evaluate the contribution of Atlantic turtles to population growth.
- Validating ageing methods for Goosefish (*Lophius Americanus*) using microconstituent analysis.
- Determining the reach of spring blooms of HAB species *Dinophysis acuminata* and overwintering strategy. Item three asked respondents to align their projects with one of the NOAA science content emphasis areas. Students selected aquaculture and seafood safety, stock assessment, living resource management, or social science and economics in their responses. Five of the seven respondents (item four) were required to use, analyze, or manipulate a large data set to complete the requirements of their projects, and four of the students (item five) were required to consider the social science implications of their research as a part of their project work. Items six through eleven were related to the students work with the academic mentor who oversaw the TAB project. Item six notes that all of the students had worked with the supervising mentor for at least a full academic year, with most having worked multiple years with that mentor. Five of the students (item seven) worked five hours per week on the project, with one student working up to ten hours weekly, and one other student working more than ten hours weekly. Item eight describes the communications process used between students and mentors, with five of the seven meeting face to face, and two additional students using email as the primary mode of communications. All of the respondents (item nine) perceived the mentor as being supportive of their academic work, with four of the students expressing that this support was more than minimal to substantial. A larger proportion of respondents (five of the seven on item ten) perceived stronger support for their career aspirations from these mentors. When asked to describe the nature of this support (item eleven), the respondents listed being introduced to potential professional colleagues and a network of scientists, being provided opportunities to apply for grants, and being invited to professional meetings and science conferences as primary mechanisms.

Item twelve asked respondents to describe the primary benefit(s) they perceive from participating in a TAB project. Their responses were unique and seemed to cover a wide but expected range of professional and academic issues:

- The primary benefits obtained from this TAB project are the experience of writing a research proposal and working directly with a NOAA affiliate.
- Networking and geostatistical modeling skills.
- It is contributing to the rest of my dissertation.
- A much better understanding of how fisheries are managed and the data that is needed to produce policies.
- Funding for the last year of my program and establishment of new collaborations.
- Funding for the last year of my program and establishment of new collaborations.
- Funding to continue my project and have samples run.

Items thirteen through sixteen solicited responses regarding career development opportunities which were embedded in the TAB projects and related work. Four of the seven respondents perceived that the TAB project influenced their ultimate career selection. And among the seven responses to this item, the primary skills developed through the TAB projects were communication related skills, grant writing, data modeling, and science process skills. Finally, the respondents indicated that the TAB process increased their awareness of working for a government agency as a scientist.

Items seventeen and eighteen asked respondents about their perception specifically of the NOAA workforce and networks for career advancement. Six of the seven respondents indicated that they agreed or strongly agreed that their experience conducting their TAB project gave them good insight into the NOAA work culture. Four of the seven further concluded that the TAB project had helped them develop a network of contacts that would be important for their careers.

Item nineteen asked the respondents to describe their new or changed perceptions about the workforce based on the TAB experience. The responses were richly descriptive and included:
- I have the experience of managing a budget, writing proposals, abstracts and reports, in addition, to working closely with government affiliates.
- It is a very small community and people hire those that they know even if they are not as competent as the employer may think.
- Who you know or who you are connected to definitely gets you in the door in quantitative fisheries jobs especially on the west coast.
- I gained an in depth understanding of the proposal process and budgeting, which are both transferable skills that can be used in many other jobs or careers in the sciences.
- I have a more thorough understanding of the NOAA organizational structure which is useful to any future job with NOAA.
- This project has revealed a whole new avenue of potential careers I was not even aware of prior. Most of which pertain to NOAA.
- I will look at NOAA jobs as potential opportunities. Item twenty reflected that all of the respondents were introduced to other colleagues in the field during the TAB project experience. This created an opportunity for networking that could be important for careers down the road.

Items twenty-one through twenty-seven asked respondents to comment on the administrative and process elements of the TAB experience and a selection of potentially informative issues regarding program management and student experiences, to allow the evaluators to consider this programming element in light of the NOAA EPP questions regarding CSC administrative culture and process. Sample size limited the range of responses to these items and preclude the observation of clusters of responses. One exception to this was item twenty-three which asked respondents what they had learned about the Social Implications of their research. These expressions from the students constitute evidence of an enhanced knowledge for the social science integration of their research as per the NOAA EPP guiding questions 1.5:

- I have learned this project has a large societal impact, because plastics are commonly involved in everyday life.
- During my TAB project, I was able to sit in on the groundfish planning team meetings. This meeting included all kinds of people who had a stake in the fishery. It was interesting to learn and witness first had the conflict between what fisherman and scientists want versus what management and funding will allow. There are a great deal of social science decisions that play into the management of a valuable commercial fish stock and they must all be taken into account when trying to set quotas.
- The importance of fisheries management, to keep this resource sustained to continue to keep fisherman employed, I have not learned anything new regarding social implications specific to my project however I was exposed to this topic in the Cohort Experience.
- In the future I plan to explicitly include social science aspects in my research proposals.
- I have seen that Fishery's management is more about managing people and their expectations rather that managing the species in question. Also how my work could greatly impact the lives of those who rely on work with goosefish.
- The importance of being able to communicate your science to people not within science fields and even other scientists outside of your field is one of the most important skills to develop.

It is important to highlight these various descriptions of students' perceptions of the social implications of their research, particularly in light of NOAA EPP question 1.5. This question emphasizes "evidence of enhanced knowledge" of social science integration, not a full or complete understanding of a clearly defined criterion of knowledge. Clearly, there is evidence that LMRCSC students are learning and obtaining enhanced knowledge in this area.

Data Management for Scientists Course Report

Late in the fall semester, the evaluators were contacted by the Project Director and asked to create and implement an evaluation of the Data Management for Scientists online course, which had been developed and implemented as a program element of the LMRCSC. While this specific element had not been sequenced for evaluation during this program year by the evaluators, nevertheless, a survey was quickly formulated and approved by the leadership, and then distributed to course participants.

The following summaries by item are based on responses from six graduate students who took the course, and are clearly bimodal in their positive to negative reactions to the course. The specificity of critique offered by the respondents read as if they are, in two groups, describing in separate ratings and narratives a course, its instructor, and its requirements and outcomes that are wildly differing. Items two through six, as follows, were essentially demographic or related to the pacing and credit of the course experience and are presented with little explanation:

Item two: five of six respondents rated themselves as average (two) or below average (three) in their understanding of data management prior to taking the course.

Item three: after the course five of the six rated their knowledge as average (four) or above (one) in their understanding.

Item four: four of the respondents had taken more than four credit hours of statistics prior to taking this course, but two had fewer than three hours.

Item five: only one respondent of six indicated that he/she had used the content or skills from the course in a NERTO or TAB project.

Item six: three respondents thought the course was paced too slowly; two thought it was paced well and one thought it was paced too quickly.

Item seven: respondents were asked to rate the amount of work required for the two credit hour course. The responses were equally distributed, two each, in exceeded, met or beneath expectations of work quantity.

Given the small number, relatively, of respondents possible for this survey, there were a few anecdotes observed in the data that seem important to bring to the attention of the LMRCSC leadership. There was a concerning statement in the item seven responses: *We never received a syllabus with weekly homework and due dates. Every week, the course varied between 1-3 hours of class time with 0-2 hours of homework. It was extremely frustrating to go into a class not knowing how much time I needed to budget for the course. In addition, the professor did not make the course accessible for Mac users. The code we needed was somewhat different and it took additional time outside of class to find and incorporate that code into projects.*

Item eight asked respondents if they "considered this course, as they experienced it, was helpful for their future careers." The responses were substantially negative, with five of six respondents indicating a negative response. Descriptive comments included: the course was insufficient to teach database management. Other detailed responses included: every single, three hour class could have been condensed to thirty minutes with no information lost; YouTube was more helpful for learning SQL than this course; I didn't learn anything…that is not an exaggeration; the course was unnecessary for the career-path I'm on; and I'm a first year graduate student without any data to work on so it was unhelpful right now. Item 9 further records that only one of the six respondents perceived that the course was helpful for meeting other LMRCSC students with whom they might eventually work.

Item ten asked respondents to provide an overall quality rating of the course. Two of the responses were positive (one very high, one high quality) and four of the responses were low (two responses) or very low (the final two responses). These evaluations are generally skewed positive by typical respondents in these types of survey contexts, and so this pattern, even for a small sample size, is likely concerning. Nevertheless, in item eleven, as a follow-up, the respondents did identify one consistent benefit to the course: some elemental or basic level instruction in SQL programming.

Item twelve asked the respondents to provide narrative descriptions of some ways that the course could have been improved. Given the negative values expressed by approximately half of the six respondents across the survey, it seemed prudent to provide the responses to this item in their entirety for the program leadership to review. These included:

- Pre-class prep: rarely did we receive data more than a few hours before the class. 2) Schedule: Every day we went in not knowing what we are covering and if homework would be assigned. 3) Homework Due Dates: Making homework due the day it was assigned was difficult, as we would have to rearrange our schedules to accommodate homework on subjects we had just covered. 4) SQL Program Installation: Spending a 3-hr lecture on something that a piece of paper could accomplish was frustrating.
- Allowed student microphone usage.
- Ask students with Macs to bring a PC in advance. The program doesn't seem to work properly on a MAC, thus much time was spent on the instructor troubleshooting their issues or explaining how to code on their computers.
- Shorter classes meeting multiple times a week instead of one long class. Syllabus more tailored to students and going at a slower pace
- Would have been nice for the professor to have a plan for the lecture prior to the beginning of the lecture. We would have benefited from powerpoints, illustrations, or other learning tools for complex database topics. It would have also been nice for the professor to explain how concepts were linked in this course. Every lecture, and, indeed, the entire structure of the class, felt very disjointed and ill-prepared.

Item fourteen solicited the primary challenge in taking the course from respondents. Two of the respondents provided substantive and negative criticisms of the course quality, organization, and effectiveness. The program leadership are encouraged to review these extensive narratives in the raw data for this item which are provided to the leadership separately. These are not included here as they essentially restate prior negative responses that are already included. Other responses to this item didn’t seem essentially out of alignment with typical course struggles when content is new or difficult.
All respondents in item fifteen perceived that the analysis software incorporated in the course was appropriate. Item sixteen indicates that four of the six respondents perceived the course was offered at the most appropriate time to be helpful in their academic courses of study. Two of the respondents perceived it would likely be more helpful later.

Items seventeen and eighteen focused on the quality of instruction and the online format of the course. Again as observed in earlier items, the responses were bimodal: half the respondents were negative in evaluating the instructional quality, and four of the six were negative with respect to the online format, although the narrative explanations for the online format item seemed more pointedly concerns about the instructors capability, for example, pointing to the instructors inability to effectively use the instructional learning system for the course.
Items nineteen and twenty, again dividing into a set of positive and a set of negative responses, suggested half the students had improved their ability to develop a data

management plan, and half had improved their ability to manipulate and analyze data, with half responding negative in each item.

Finally, item twenty-two included an opportunity for respondents to provide an open-ended, narrative response to the evaluators about the course. The item specifically informed the respondents that their personal identity would be protected. As with the earlier survey items, the respondents were distributed with fifty percent positive and fifty percent negative in their responses, and again the leadership is encouraged to read the de-identified narrative in entirety to consider the reasoning and narrative on its own merits. The evaluators' view of these responses is that they are conceptually so far apart as to seemingly be describing two entirely different courses and instructors. In this case, it seems prudent to leave any requisite decision about this course moving forward to the judgment of the larger leadership team.

The evaluators strongly recommend that the results from this course evaluation be provided to the course instructor, with a requirement that revisions to the course be considered in response to these student evaluations. This process will be useful to document the use of evaluation reports for continuous quality improvement of the LMRCSC and its related programming elements.

Additional Evaluation Efforts for Year 4

Site Visit—Savannah State University

In addition to the surveys and data analysis and presentation work summarized above, the evaluation team continued to support the external evaluation of the project in two additional ways during year four. First, as described in the initial evaluation plan and as implemented in prior years, the team selected one institutional site partner location to conduct a site visit. This year in January 2020, the evaluation team visited Savannah State University. On location, the evaluators interviewed undergraduate students who obtain LMRCSC funding; SSU faculty members, a NOAA researcher housed at SSU, and a post-doctoral researcher, as well as extensive conversations with the LMRCSC Education Director, who is housed for the project at SSU. This site visit, as with those undertaken in earlier years, is funded from the evaluation budget to The College of Exploration (the external evaluators) and has been added to allow the evaluators to obtain direct observational evidence of the reach of the LMRSC at the institutional partner campuses, and with the students, faculty, and staff at those locations. This context facilitates the richer understanding of the Center by the external evaluators in terms of analyzing the collected data elsewhere in this report, and advising, on a month to month basis, the project leadership team when the need arises. The evaluators typed field notes from interviews and observations from the site visit, which are summarized as follows:

The External Evaluators traveled to Savannah, GA, to conduct a site visit at Savannah State University on January 17-18, 2020. During the visit, evaluators visited classrooms and laboratory facilities used by graduate and undergraduate students. In addition, evaluators conducted structured and semi-structured interviews with a nearly encompassing set of individuals associated with the LMRCSC: the institutional Co-PI, faculty members from the academic department, undergraduate and graduate students, the department chair, the LMRCSC Post-Doctoral Researcher who is housed at SSU, and the LMRCSC Education Director (who is also housed at SSU). A conference room was reserved for uses by the evaluators to meet with the different individuals or groups of individuals delineated above.

Field notes from the evaluator interviews, as well as embedded observations by the evaluators, suggest a strong program at the campus level. All of the individuals had an operational awareness of the LMRCSC, although the undergraduate students were less aware of the breadth of the program.

The faculty had been engaged for multiple years, although they expressed concerns with the relative difficulty of using LMRCSC funds due to restrictions on the use of the funds. These restrictions had curtailed the interest of the faculty in applying for funding, with one expressing that she was required to write the proposal and manage the funds, but was unable to use funds for her own contract time. These funding restrictions as issues within the LMRCSC have emerged before at other partner institutions and from Co-PIs themselves in conversation with the evaluators.

The three graduate students who were interviewed were excited about LMRCSC, and expressed the benefits of the network opportunities, the scholarships, the research experiences, and the social community. Nevertheless, collectively, there was a similar concern which has emerged from other graduate students at other institutions: a lack of communications about the broader NOAA effort and jobs in that agency; a perception of a lack of jobs in higher education as faculty, and living within very tight financial means during their research work experiences.

Student Recruitment Survey Development and Summary Report

An additional evaluation effort emerged in late spring and summer of year four as a result of the IERT panel review of the LMRCSC. The panel concluded that there was a deficiency in the development of a formal recruitment plan for the Center, which necessitated the collection of input data from the stakeholder community on the issues surrounding student recruitment. The evaluation team was tasked to develop, circulate, and revise a survey instrument, and to summarize the respondent data obtained from this survey to support the Center administrative efforts and in compliance with the IERT panel. The survey was kept brief and focused, including thirteen items that focused on several dimensions of the recruitment process and these students' experiences. The following brief narrative summarizes this initial survey effort.

Twenty-eight students from all partner institutions completed the survey. The survey was completed by six undergraduate students, ten master's students, and twelve doctoral students. Six of these respondents had prior LMRCSC awards; but for twenty-two respondents, this was their first award.

Items four and five explored reasons for applying to or participating in the LMRCSC. The primary reasons for participation in LMRCSC fell into several main areas. For many of the respondents, the main motivator was funding. Several students mentioned the connection or mentorship with NOAA and building a connection with a scientific or marine community, while other respondents listed the motivation of a potential career field or employer. Several students expressed interest in marine sciences and the opportunity to gain research and lab experience and networking connections. In this vein, one student highlighted the diversity of LMRCSC, stating ”I wanted to be surrounded by a community that looked like me.”

The respondents were asked how they first learned about LMRCSC. Their responses included:
- internships at partner institutions;
- from one of the PIs, a counselor or advisors, or a faculty member;
- from an REU;
- from a campus communication or source;
- on a job board at campus;
- upon university application/acceptance; or
- from a TAB RFP.

In addition to these communications channels, several students listed, by name, specific individuals from whom they were informed about LMRCSC. These names are not included here in the interest of privacy, but are included in the raw data provided to the LMRCSC leadership.

Prior to starting LMRCSC, 92% of respondents were already interested in fisheries or ocean sciences. The responses mentioned experiences in early life, through recent research. The impetus for their interest in fisheries or ocean sciences included:
- Early life on an island; experiencing the beach or lake; love of the ocean as a child; reading about fishing and documentaries;
- Sea World, or going to an aquarium as a child;
- Shark week on television, documentaries;
- Through high school classes, high school summer program;
- Interactions on campus, undergraduate research experiences, scholars’ programs, coursework in ecology-based biology, or undergraduate degrees in Marine Biology; or
- Previous research experiences, environmental work with MPAs.

When asked (Question 9) about other information they wished they had concerning the LMRCSC and its opportunities, several main themes emerged. Many expressed the desire to have a clear list of requirements, with consistent and solid updates about the requirements, including timelines and the NERTO requirements (the creation of this resource is the subject of a separate IERT Panel Recommendation). Also mentioned was a desire to know about “heavily encouraged events,” such as conferences or training. Several respondents mentioned project, research, internship, or mentorship opportunities, as well as opportunities after graduation. One respondent mentioned “It was difficult, as a freshman, to seek out research opportunities.” One suggestion for enhanced communication was “a quick overview about finding a good mentor, and how to be a reliable student in a mentor-mentee relationship.”

Other respondent suggestions included:
- Realistic assessment of the number of years for funding,
- More university information about graduate life,
- Awareness of availability for undergraduates, and

 Support for science content development.

When asked (Question 10) about ideas for recruiting students into LMRCSC, the respondents offered several compelling suggestions, to showcase the LMRCSC to other students:
 Several mentioned having students or alumni speak with incoming students. Direct connection was important. Experience fairs were suggested. *“Current students and alumni are a great tool. If they are happy with the program, they can help bring many new students.”*
 Have mentors available to incoming students (better definition of mentorship is an additional IERT Panel Recommendation).
 Target students doing internships and other marine science research opportunities at other minority institutions.
 Emphasize the potential of LMRCSC to provide good connections for students (to others and to NOAA), “promote the network,” highlight post-graduation options, make the full portfolio of the LMRCSC program visible to students (again, an additional IERT Panel Recommendation addresses this communication need).
 Highlight that a strong background in statistics is helpful.
 Advertise in as many places as possible for deeper community outreach.
 Visit other HBCUs to recruit students, and consider visiting high schools.
 Provide clear timelines and expectations regarding programs at each partnering university.

When asked about recommending LMRCSC to other students, the respondents were nearly all very positive and enthusiastic, offering a resounding “yes,” using words like *grateful*, *valuable*, *special*, *supportive*, and *opportunities*. One enthusiastic response was “absolutely, best experience ever!” And one respondent exclaimed, “The metaphorical door has opened up so many research opportunities.” “It is a fantastic pathway to connections in marine science, internships and scholarships. It is incredibly applicable to young scientists at HCBUs and other minority-serving institutions” was an additional, positive affirmation about the CSC.

Aside from the primarily positive comments, there were several negative comments which should be considered. One respondent felt that better recognition was needed by NOAA of LMRCSC. One respondent would not recommend LMRCSC to second year masters students due to the difficulty of accomplishing the requirements. A final respondent would not recommend the program due to the requirements and the “toxic environment.” There was no further explanation from the student of what this comment might point towards.

When queried about other advertisements or announcements about the LMRCSC which respondents recalled seeing, most could not remember seeing any. Some respondents said they saw pamphlets or notices posted on a jobs board on their campuses, or the TAB RFP announcement. Two respondents mentioned direct communications with faculty or one of the co-PIs.

A final question addressed retaining students and asked the respondents to identify the greatest challenges in moving forward through their institution's degree programs while participating in LMRCSC. Specific challenges which were provided included:

- Distance between the other partner institutions,
- UMES lack of broad choice of classes,
- Professors having to handle several students for research projects,
- Disconnect between LMRCSC, the School of Graduate Studies, the department of Natural Sciences and the Office of the Registrar (UMES),
- Meeting deadlines, "Handling business within a reasonable timeframe was difficult,"
- "Requirements to remain a part of LMRCSC are confusing,"
- Keeping up with LMRCSC activities while doing classes, and
- COVID challenges.

Suggestions related to program or experience improvements provided by respondents included:

- Do things to engage students across the partner institutions. Helpful to meet other LMRCSC students at conferences,
- Boost morale of students and faculty (UMES),
- Acknowledge individual differences and challenges for each student, and
- Hold additional seminars on professional development skills.

One student remarked "It was challenging to continue meeting my research requirements, but having a supportive mentor makes that much easier."

And finally, one negative comment related to LMRCSC administration. This respondent indicated (without any explicit or actionable description) "the director does not listen to student concerns: student struggles are dismissed" with a parallel concern about the lack of a way to register complaints. While this comment is isolated and doesn't provide sufficient context to even allow investigation, it may point to a need to define mechanisms generally for participants to register concerns, issues or complaints in a neutral manner during their program experiences.

External Evaluation Support for IERT Panel Review and Response

An additional, substantial effort for the external evaluation team in year four (from a time commitment) was support for the LMRCSC Panel Review, conducted in March 2020, followed by substantive efforts to address recommendations and suggestions from that panel report which interfaced with the external evaluation. Efforts to support the review included development of Center responses for select sections of the preliminary briefing document in the center report narrative; creation of a custom Power Point presentation and delivering this to the Review Panel during the review; creation of a hard copy notebook which included all external evaluation written reports, survey instruments, and guiding documents for the Center Director and the IERT Panel members; and meeting privately with the Review Panel for additional questioning by the panel.

After the final report was received from the IERT Panel, the external evaluators developed the following responses to each of the recommendations and suggestions included in the report, as well as supplemental draft surveys as indicated in the responses. These supplemental documents, i.e. a stakeholder survey for post-assessment of the TAB projects, the recruitment planning survey summarized in the above narrative, and a draft conceptual rubric and instrumentation to monitor Student Core Competency attainment have also been attached to this annual report, as these will be the beginning efforts in year five of the external evaluation support for LMRCSC.

Evaluation Team Responses to IERT Recommendations and Suggestions

The IERT Panel Report provided a group of three Recommendations and three additional Suggestions for the CSC External Evaluators to refine or extend their activities with respect to the LMRCSC. Those have been excerpted from the Final Report of the IERT Panel and copied below. Under each of these, the External Evaluators have provided narrative explaining how their efforts are or have already been revised to accommodate this report from the Panel. In select cases, additional documents are attached where noted to new data collection instruments, or previously development and implemented instruments, to document these efforts.

Recommendation 1: Develop a clearer and more transparent strategy for the evaluation of LMRCSC students in both the attainment of core competencies and the evolution of professional development skills.

The evaluation team coordinated with the LMRCSC leadership in identifying the core competencies that have been embraced in the project for students, as well as professional development skills. The evaluators have developed an Assessment Rubric as a scale of measurement for attainment of these competencies and skills which will be used by the LMRCSC leadership, distributed to select Co-PIs, faculty mentors, and instructional faculty who interact with the students, to directly measure and obtain evidence for attainment and evolution of these competencies and skills. The current draft Assessment Rubric is attached and will be piloted in fall 2020; revised in late fall/early winter 2020-2021, and then fully implemented in spring 2021. In addition, an overview sheet for the Assessment Rubric and a Master Scoring Sheet to be used for each student has been included in the attachments.

Recommendation 2: Develop a Center standardized process for monitoring results when Center incorporates the recommendations from external evaluation process to track – with data – impacts for continuous improvement.

Recommendation 2, while included in the IERT Panel Report for the External Evaluation, points appropriately to the use of the evaluation results, through a standardized process, by the Center to track continuous improvement. The response to this Recommendation will come from the Center Leadership, as the work effort required for this Recommendation cannot be undertaken by the evaluators, but only by center leadership.

Recommendation 3: Develop evaluation criteria for the TAB mini grant projects to evaluate the impact of the TAB on student research interests, and to capture the quality of the project, dissemination of results, and student professional development through performance in the TAB project.

Working with the LMRCSC leadership, the evaluation team has created a new assessment tool to measure and collect evidence for the quality of the TAB projects, the dissemination of results, student professional development, and (emerging from Suggestion 1 below) the integration of social science in the TAB projects. This assessment tool will be used by LMRCSC leadership to collect evidence from TAB project faculty and student principal investigators, and from the project science director who chairs the TAB processes. The draft survey is attached to this report, and will be piloted this fall semester for the 2019-2020 TAB awards.

Suggestion 1: Assess how well the TAB projects incorporate social science integration.

This current Annual Report (see above) already includes student descriptive data of the incorporation of social science integration into both TAB and NERTO projects. The evaluators have included these response items in annual surveys of both students and faculty/scientists since the project's inception. These raw data, blank surveys, and evaluation written reports were provided to the IERT Panel and previously to the LMRCSC Director and Co-PIs. As noted under Recommendation 3 above, the new assessment tool for the TAB post-project assessment includes two items explicitly related to social science integration (items 8 and 13). Item 8 is an open-ended narrative response item to obtain a rich description of the integration of social sciences. Item 13 is a numeric rating scale to metric the final work of each project for comparison to a comparable rating scale used in initial review and award decisions at the front-end of the TAB project. These qualitative and quantitative data will be provided to both the TAB review panel, the LMRCSC Director and Science Director, and reported to the full leadership team by the Evaluators at a monthly team phone meeting. The assessment tool is included in the attachments.

Suggestion 2: Assess how LMRCSC students and their research fit within the thematic areas.

Each year, students, faculty, and science mentors are surveyed to identify the match between student research and academic experiences fit within NOAA's four, science areas incorporated in the CSCs. The response data are analyzed for patterns and reported to the leadership team, and included in a written annual report. The student completed survey data for both TAB and NERTO projects as summarized earlier in this report demonstrates that the external evaluation has been collecting these data since the project inception.

Suggestion 3: Assess the LMRCSC recruitment strategies for fellows – at all postsecondary levels and alumni including Center post-doctoral fellows – along with how the fellow's research advance the award objectives within the Center and the solicitation requirements.

Working with the LMRCSC leadership team, the Evaluators have created an additional assessment tool to identify, summarize, and assess the recruitment strategies used for undergraduate, graduate, and post-graduate participants in the CSC. This survey has been piloted already (in July 2020) and a summary report has been provided to the LMRCSC leadership, and attached to this document along with a copy of the survey itself.

Conclusions and Recommendations for the Annual Report

The conclusions and recommendations for the LMRCSC emerging from the annual report of the external evaluation team are of necessity couched within the year four report of the IERT Panel. The Panel provided substantive and significant input to the leadership of the LMRCSC through numerous recommendations and suggestions. The LMRCSC, by the time of submission of this annual evaluation report, will have most certainly submitted its responses to the IERT recommendations and suggestions. The External Evaluation team has not yet analyzed this response document submitted to NOAA EPP by LMRCSC Leadership with a view toward year five evaluation efforts, but will address its (the external evaluation team) efforts in year five to evidence collection in support of these project revisions, as well as the new TAB, Student Core Competency, and Student Recruitment evidence collection.

LMRCSC Mid Year Report (Year 5)

March 10, 2021

The Living Marine Resources Cooperative Science Center (LMRCSC) was "established in October 2001 as a cooperative agreement between NOAA's Educational Partnership Program (EPP), and a collective of universities to address environmental, natural resources management and STEM workforce challenges…." The mission of the Center "is to prepare a diverse student body for careers in marine and fisheries science through exemplary academic and research collaborations" (all quotes from the Project Narrative). The LMRCSC received an additional five years of funding, which began in Fall 2016. The project leadership contracted with The College of Exploration's (TCOE) Dr. Tina Bishop, Peter Tuddenham, and Dr. Howard Walters to develop and implement an external evaluation of the project. This evaluation plan was reviewed and approved by internal project leadership, and also was submitted with the project proposal for review and approval by NOAA EPP. This current mid-year report for program year five has been written by Drs. Bishop and Walters and submitted to the LMRCSC Project Director. It should be noted that year five has been substantially impacted due to the SARS-COVID Emergency Response conditions which have been implemented across the nation, implicating each of the institutions where LMRCSC is implemented. These responses have included significant shifting of face to face activities to online communications methods, and creating programming planning and implementation complications. Due to these responses, NOAA EPP has issued a one year no-cost extension to the LMRCSC to continue and finalize planned activities for the project period. The external evaluators included select response items on the student survey reported below to attempt to ascertain some of the impact of these COVID responses on the LMRCSC students themselves. The evaluators have continued to participate in monthly leadership committee calls and recurring education committee calls during the COVID response period in year five, and have provided evaluation updates at these committee meetings.

Among the significant programs implemented under LMRCSC is the *Data Management for Scientists* graduate course taught online as a requirement for all students in the program.

This current mid-year report provides summaries of a survey which was implemented for a second year on this graduate course, with some cross-comparisons from the findings and observations from the first implementation of this same survey.

Additionally, on a rotating basis across the project period, the evaluators have collected response data directly from the graduate students (and undergraduates, although after the undergraduate evaluation report was distributed in fall 2020, no undergraduate students completed the survey). This current mid-year report includes summaries of these graduate student responses for this current programming year, as well as the responses to the COVID related items as noted above.

Data Management Course Survey Report 2020

There were thirteen graduate students sequenced to take the data management course this cycle. Of this number, ten completed the course, one only audited the course, one deferred until next year, and one did not pass. Five of the students completed a twenty-two question survey about the Fall 2020 data management course, after three invitations to complete the survey which were sent out by the LMRCSC administration staff.

Students' Data Management Foundation and Background

The respondents conveyed mixed ratings of their ability in data management prior to taking this course, with only one person stating, "above average." Each of the five respondents listed either one-three credit hours or four-six credit hours as hours of statistics or data management that they had previously taken. After taking the course, all five respondents rated their ability as "average." This was interesting in that one person's self-rating dropped to average from above average and two people's understanding increased to "average." The respondents learned about the class from several sources, including an advisor, cohort members and mentors as well as noting that it was recommended or mandatory for their program.

Overall Ratings

The overall course rating (Question ten) given by four of the respondents was: "low quality." (three people) And Neither "high" nor "low" (one person). The overall rating of instruction (Question seventeen) was rated "average" by four of the five respondents and one person rated it "Below Average." One person said, "it has been easier to understand this course watching videos on YouTube." It should be noted that LMRCSC administrative team and the external evaluators have begun a conversation in concern over these ratings (even though the survey response is low) and are planning structured interviews with the graduate students on the specific topic of this data management course to pursue solutions to possible concerns.

The Structure of the Course

The perception of the pace of the course was mixed, with three people saying it was too fast, one student too slow, and one suggesting it was paced perfectly. The amount of work required was also viewed in different ways by the different respondents. For two respondents the work exceeded their expectations. For two people their expectations were met, with one person saying it was below expectations for amount of work. Quotes reveal the difficulties with the amount of work required:

“The class was very slow and the communication with the instructor was not the best.”
“The material was very difficult to grasp so I ended up spending a lot more time doing assignments.”

When asked about the appropriateness of the course software, two of the five respondents felt it was appropriate. However, the other three respondents said it was not appropriate with one person explaining about their inability to get the software running and the ensuing damage to their computer. Two people clearly felt that this software was not helpful for their research and the data they collect. One person felt R programming or even SAS would have been more beneficial than MySQL. A quote illustrated this frustration,” Most assignments were to take our own data and use the software to analyze it but I felt like that did not make sense. Using this software for my own research would not make my data analysis easier or more organized.” One person expressed a positive view of the course structure, saying that it was positive: “He taught us the format of the computing language before we even started coding.”

When asked about the effectiveness of the online course format, the reaction was mixed, with two students saying it was effective and three respondents saying it was not effective. Comments about the online format included:

- “To be effective more than just talking live in a computer is needed.”
- “Give the assignments written because it is hard to get all the instructions by hearing them one time with a connection that is cutting off.”
- “The Professor could not physically see the error codes and messages being displayed to the students so his response to us was to just look it up on google.”
- “While the lessons were being recorded, very often the screen cut off so what the professor was showing could not even be seen, making the recordings unhelpful.”
- One person said, “This course does not need to be taught online.”

The Usefulness and Timing of this Course

All five respondents indicated that the course content was not used by them in either a NERTO or a TAB. When asked (item eight) if the course was helpful for their career, two answered “yes” and three answered “no.” When asked about the helpfulness of this course for meeting other LMRCSC students, two students said “yes” and three people said “no.” Even with the low response rate (about fifty percent) to the survey, this proportion of negative reactions is a concern and part of the current conversation about the course that was noted above.

When asked if this course was offered at a helpful time in their academic course of study, the responses were mixed. Although two people indicated that it was at an appropriate academic time, three disagreed. One person said it would have been better at the beginning semester and one person said it conflicted with another course, therefore creating difficulty. One person explained with a strong statement about the inappropriateness of this course: “I answered no because I really didn’t find this course helpful or relevant for my research, so it really doesn’t matter when it is offered.” An additional quote took the same, negative approach: “I did not find this course helpful for my future career as majority of my data has to do with numbers; Nothing that could help me in the case of organizing colony counts, sample sizes, etc." And a third concerning response: "Course gave me insight on some data management tools but background information on how to utilize it was not clear." Two respondents felt it was helpful to learn the concepts, but one said, "I don't think that will be useful in my future work or career. We did not delve deeply into the topic for me to feel like I can use this programming language in the future."

Student Learning Outcomes and Benefits

When asked about their improvement of ability to develop a data management plan, responses indicated various perspectives: two said "yes", two said "no," and one person was "not sure." This mixed reaction was also reflected in their responses to the ability to manipulate and analyze data, with one student stating this skill improved because of the class, two students saying "no," and two students being "Not Sure." A similar pattern of mixed reactions was also articulated when asked about the effectiveness of the hands-on activities supporting their learning. The students did indicate that there were some beneficial skills developed in the course:

- Getting a general overview of how databases are made and managed
- Learning how to create a database
- Creating parent and child databases
- Creating a data management plan using DMP tool

Question thirteen of the survey asked respondents the primary benefits of taking this course. While two respondents listed skills such as using data management tools and increasing knowledge of computational tools, other respondents reflected less positive reactions. One person said the main benefit was fulfilling the LMRCSC requirement and meeting other LMRCSC students. Three quotes illustrate lack of benefits associated with this course:

"No benefits, this class gave me so much stress that it is affecting me in other classes."

"I couldn't complete the course because the program need for this course damaged my computer…."

"I honestly do not know what the primary benefit of this course was. I felt as though I had a much harder time organizing my data on the MySQL software than using excel."

Challenges and Criticisms

Question fourteen asked specifically about course challenges, and the difficulties mentioned elsewhere were reiterated and expanded in responses to this question. This question evoked strong responses. Some respondents indicated great difficulty following the course and understanding the content that was being presented. Two of the students said they did not have a clear understanding of assignments or what the course expectations were. Furthermore, Wi-Fi difficulties and challenges with using Mac software, learning how to correctly use MySQL Workbench, setting up problems correctly, and correcting script errors created challenges. One person mentioned lack of interaction with the other students to be a challenge. There was an issue with incompatibility with the professor using a Windows computer and student having a MacBook, forcing the student to use YouTube for information to complete assignments. Again, students' narrative responses highlight their perceptions related to challenges with this class:

- "Downloading a program affected my computer and my studies in other classes as this computer is only tool for everything we do."
- "Couldn't download a data management program into my computer."
- "Often the professor gave us homework assignments but completed them in class."
- "I did not feel as though the information was being thoroughly shared and explained…"
- "I learned more in a couple you tube videos than in this class, which was very slow and unclear. It was hard to know what I was being asked." Additionally, this person stated that "the recordings of this class are very bad."
- "He kept switching between languages, so it was hard to tell what the right syntax was for a given language. Sometimes materials provided were only compatible with one syntax or software, so those students who were using the other version either could not use the file or had to significantly edit the file in order for it to work, which required a lot of additional work."

One quote highlights a substantive difficulty: "It was also challenging because people were using different computers (Mac vs PC) and coding languages (My SQL vs SQL server) and we kept jumping back and forth between all of those, so it was hard to get a grasp on the syntax that would work best for my computer."

Suggestions and Ideas for Improvement

The overall sense from the student responses was this course needs to be improved. This follows on from and reiterates the 2019 survey results, which also indicated that there were definite improvements needed. In comparing the student responses from the 2019 administration of the course and the follow-on survey, it is difficult to see that the course has improved, with many examples of student concerns continuing into this second year survey.

However, in fairness to the instructor and the LMRCSC team, only five of the ten students who completed the course took the time to complete the survey, and so sampling bias toward negative responses is an authentic concern in interpreting these course evaluation data. This is in part the motivation for an ongoing conversation among LMRCSC administration staff and external evaluators to design and conduct further data collection from a larger set of course student participants to seek concrete and actionable interventions to revise this data management course moving forward. This process will be part of the external evaluation annual report this coming summer.

Based on the student surveys for both 2019 and 2020, looking for replicated concerns from students, the following ideas seem to warrant consideration for course revision moving forward:

- Delineate clearer expectations in the master syllabus and distribute this to students;

- Provide written material to support the classes (this was requested by the student but not received);
- Provide a syllabus or hub where all class materials could be stored. These suggestions were mentioned in both program years. It is imperative that a syllabus be presented to the students and this should be remedied. It is unclear how a university could allow a credit course to be offered without distributing a syllabus to students; The syllabus should state the software and hardware requirements and where these are to be obtained;
- Effort should be invested to enhance the interactivity of the course, between and among students and the faculty;
- Consider the match between student learning outcomes and objectives and the assignments and assessments incorporated in the class;
- Explore screen-sharing capability to enhance learning;
- Consider the use of prerecorded instructions for software and hardware use and common or typical problems which may be encountered; and
- Seek handouts from the software publisher with common terminology, syntax error codes, and guidance—these are commonly available upon software adoption and seem not to have been distributed to students.

Final Observations

A final question asked for any other comments the respondents wished to share with the evaluators. One person reiterated the stress that this course generated and the frustration that the course caused in damaging the laptops used for the course. This person exclaimed "I need to find the way to pass this course…. Required work on a program I don't have, and I need it to graduate from my program." Another person mentioned the difficulty to get properly enrolled in the course at their university, saying that "the course number and name should be in the online course catalog." And once more the respondent mentioned the absolute need for a syllabus and online hub to keep track of all course materials and when assignments were due. The concerns and frustrations which are apparent in these survey responses need to be considered, and with suggestions for improvement being carefully reviewed, addressed, and remedied.
Given the recurrence of some of these negative responses from multiple students in multiple years, it is not clear to the external evaluators that the course survey data was used for continuous quality improvement of this data management course.

LMRCSC Graduate Student Survey Fall 2020

Of the eleven graduate students enrolled in this cohort, seven responded to this thirty-one-question survey. Given the funding provided to graduate and undergraduate students by LMRCSC, it is recommended that consideration be given to requiring participation in the external evaluation of the project by select and periodic survey responses be required of students. The survey questions ranged from student academic information, to background questions on their interest in science. Queries were made about extracurricular activities, course work and meaningful career preparation. Benefits and challenges were explored. These categories further serve as the framing categories of the structured student interviews which are conducted annually by the external evaluators to enhance the credibility and reliability of the overall evaluation process and to aid data interpretations. The responding students were from each LMRCSC participating university except Savannah State and the University of Miami. Six of the seven students were pursing an MS degree and one respondent was a PhD student.

The degrees students are seeking are in Biology and Environmental Science (two students). Fisheries (two students), Marine Estuarine Environmental Science (two students) and Natural Resources (one student). None of the seven respondents had changed their major as a result of their participation in LMRCSC. When asked about their undergraduate degree, five students said their undergraduate degree was in Biology and two had degrees in Marine Science.

The survey then considered a set of career related questions. When asked about their ideal job, several respondents specifically indicated that they would prefer to work for NOAA. Several others desired a job in their field or in laboratory research; other goals mentioned included to work on an aquaculture farm, serve as a policy advisor, or to become a professor. When asked how and when they began considering a career in science, it was interesting to note that childhood experience played a key role. They used phrases to represent this early interest "I've always been interested in science since I was a child…as early as I can remember." Two students mentioned that high school was the starting point of their interest and two others mentioned this occurred at the undergraduate level. When asked about the reason why they wanted to pursue a career related to science, a strong sentiment emerged on the part of the responding students that this was interesting and fulfilling. The altruistic motivation was illustrated by comments such as "help make the world a better place", "contributing to a cause greater than myself and desire to add diversity to the field." One student wanted to bridge science and policy.

When describing the research or field experiences they had participated in because of LMRCSC, respondents mentioned virtual NERTO and TAB projects with description of specific research about oysters and leopard seals. Two new students had not conducted research yet. The research projects mentioned were:

- New technology for oyster post-harvest treatment (aquaculture)
- Impact of oyster conditioned water on oyster setting efficiency
- Qualifying microplastics in coastal bay fish
- Impact of climate change on Nassau grouper
- Effects of climate change on leopard seals
- Proteomics

In addition to the specific research topic, the respondents mentioned that the value was also in learning how to implement a research project, create mentorships, acquire statistical and analytical skills, present findings, and build a network. One person stated, "It provides me the opportunity to fully develop, run, analyze, and report on a scientific project of my own…." One comment eloquently stated that the LMRCSC funding allowed "me to grow as a scientist and a scholar."

An additional set of questions probed awareness of LMRCSC, source of that awareness, and mentoring background. Six out of seven students had received an orientation or information about the LMRCSC from someone at their home institution.

The students described professional mentors who have guided them academically, helping students navigate the science field, providing guidance on a number of issues and helping students in the lab.
Likewise, supportive faculty were identified and glowing positive comments about specific individuals were made. The specifically named mentors and faculty with these appreciative comments can be found in the attached raw data. An example comment illustrates the appreciation “The advice she gives comes from a place of caring and wanting the best for me as a student.”

Students mentioned a number of organized, school-based science programs, including conferences and meetings, courses, and publications from which they had benefited. Two of the respondents were EPP/MSI scholars. For extracurricular science-related activities, four out of seven respondents indicated involvement in extracurricular and community service activities, including citizen science projects, Governor School, AFS, and a Diversity Collaborative, and volunteering at a museum. All seven students said they remain in communication with a key high school or undergraduate faculty member. When asked about immediate family in a science career, only two indicated they had a family member engaged in science. Key adults in their lives were important in encouraging these students’ interest in a science career. They mentioned their parents, and an uncle as specifically supportive of their interest. When asked about employment prospects in science, the respondents perceived their employment prospects within their chosen career as very employable (three students) and Moderately employable (four students).

Students were asked about positive or beneficial LMRCSC activities from the prior year.

The responses included:

- ASLO;
- Graduate seminar series;
- OSU virtual monthly meetings; and
- TAB proposal process “This was the first grant that I’ve ever applied for, so it was a very informative and valuable experience.”

The students said that these activities were the most significant because in many cases the listed activity was the only activity due to the emergency responses tied to COVID. The most beneficial courses were listed as Marine Population Dynamics, Conservation Biology, Fisheries Management and Life History of fishes, Biostatistics and Statistics. One student listed next generation sequence analysis using Unix based tools as a good introduction to computing languages.

Of key interest in this program is how LMRCSC has enhanced the students’ knowledge of NOAA. Students mentioned that the program has made them aware of more job opportunities across NOAA. One person stressed the increased realization of the importance of diversity to NOAA. One person highlighted increased knowledge of international treaties, and agreement to protect Antarctic marine Living resources, which NOAA leads.

The respondents acknowledged limited interaction with other students or professors in the LMRCSC. Five people said this interaction was “low.” When asked about their knowledge of NOAA EPP, the responses were mixed. Two people said they had high knowledge while two said medium knowledge and three people said they only had low knowledge. When asked about continuing interaction LMRCSC through an Alumni Association, all seven students were interested or very interested in a potential alumni association. This seems to be an opportunity for a sustainability element for the LMRCSC moving forward, to leverage the involvement of these alumni.

When asked to reflect on their perceived greatest challenge moving forward in completing their career-related education, the responses were varied and offered some insight for potential remedies. The COVID-19 pandemic responses and challenges to the national economy and workforce were near the top of the list for a couple students. Other challenges included:

- Funding;
- Expenses for a cross-country move for potential job;
- Lack of help by professors when courses are on other campuses; and
- Public speaking and science communication weaknesses.

These comments point to possible solutions to be considered by the LMRCSC team. One suggestion would be to offer short courses or webinars on public speaking and science communication, taught by experts in these fields. The concern about professorial help when courses are offered at other campuses could be remedied through a structured online support or centralized advisement process. Perhaps there could be a team-teaching approach to involve a professor at the student's own institution.

A final question was asked about students' university responses to COVID and the impact on the students' education. Responses included:

- Curtailed travel
- Decreased time in laboratories and decreased learning of lab techniques;
- Limited meetings with advisors or committee members;
- Some impact on course work with some professors, though it was mentioned that some university courses were already set up for virtual teaching;
- Difficulty in adapting to online work; and
- Feeling disconnected from LMRCSC and the other students.

When asked to offer ideas for additional support that would be helpful, the students provided some insights, which included:

- Career pathway meetings or discussions;
- Networking on a virtual platform;
- Fellowships or internships; and
- One person commented, "I feel that more information and resources from the LMRCSC would be helpful, especially in regards to making sure we are aware of all the requirements we need to fulfill for the LMRCSC."

Additional Activity by the External Evaluators and Final Summary Discussion at the Mid-Year

While this current mid-year report is a snapshot of some student responses to two ongoing LMRCSC activities during the program year, there are additional activities which the evaluators have conducted or participated in which have involved significant effort. First, in response to the year four IERT panel recommendations, the external evaluators invested significant effort to create a TAB post-project summative assessment which was built on the review criteria used to award these grant projects to students. This post-assessment instrument was revised several times and then provided to the LMRCSC administration for dissemination to the TAB students as they finish their projects—including any current or continuing students who have already completed a TAB project. As of this mid-year report date, this post-assessment has not been distributed to students, or else the students have simply not responded to the survey. The evaluators are maintaining this survey as an "open" instrument in data collection software and would like guidance from the LMRCSC director for this ongoing cost—if the survey is not going to be administered, it should be closed out.

In addition to this TAB post-assessment, again, recommended by the IERT panel report, an additional set of instruments and rubric were prepared in view of an assessment of the Core Professional Skills and Competencies which students develop across their LMRCSC participation. This process has not moved forward, and it is likely that the various institutional responses to COVID have certainly impacted the discussions and timetable for implementing this assessment item. It is recommended that this process and activity by further discussed at a monthly leadership team conference call in view of continuing this effort.

Third, there was an undergraduate student survey which was developed during year four based on the rotation plan for assessing student perceptions and activities in the LMRCSC. This survey was distributed electronically to the undergraduate students by LMRCSC leadership. Unfortunately, no useful sample of students responded to the survey this year. It is likely that the fall semester was hectic and somewhat chaotic for these young adults due to the COVID responses at their respective universities, nevertheless, it is critical that students participate in these evaluation efforts as a part of their support commitments for LMRCSC. This
issue should be discussed by the project leadership team. There were reminders emailed out to prompt students, but these failed to yield additional responses.

Finally, significant effort was invested in developing, implementing, and reporting on the Data Management Course post-assessment in 2019 (with a final written report) and again in 2020 (reported above). The strong similar concerns of students over two consecutive years of the course have warranted an ongoing conversation among the LMRCSC administration and external evaluators which should continue. To effectively demonstrate continuous quality improvement through the use of performance assessment data, the LMRCSC team should demonstrate some response to the persistent student negative assessments of the course in a tangible manner. Surely, the low sample size may in fact indicate that the larger proportion of student completers have no concerns to warrant their attention to completing the post- assessment survey—this would be a fairly typical sample bias here—but this should be ascertained through follow-up communication with a larger set of these students to ensure a quality experience of this critical program element.

LMRCSC Year Five Annual Report

July 14, 2021

The Living Marine Resources Cooperative Science Center (LMRCSC) was "established in October 2001 as a cooperative agreement between NOAA's Educational Partnership Program (EPP), and a collective of universities to address environmental, natural resources management and STEM workforce challenges…." The mission of the Center "is to prepare a diverse student body for careers in marine and fisheries science through exemplary academic and research collaborations" (all quotes from the Project Narrative). The LMRCSC received an additional five years of funding, which began in Fall 2016. The project leadership contracted with The College of Exploration's (TCOE) Dr. Tina Bishop, Peter Tuddenham, and Dr. Howard Walters to develop and implement an external evaluation of the project. This evaluation plan was reviewed and approved by internal project leadership, and also was submitted with the project proposal for review and approval by NOAA EPP. This annual report for program year five has been developed by Drs. Bishop and Walters and submitted to the LMRCSC Project Director. It should be noted that year five has been substantially impacted due to the SARS-COVID Emergency Response conditions which have been implemented across the nation, implicating each of the institutions where LMRCSC is implemented. These responses have included significant shifting of face-to-face activities to online communications methods, and creating programming planning and implementation complications. Due to these responses, NOAA EPP has issued a one year no-cost extension to the LMRCSC to continue and finalize planned activities for the project period. The external evaluators included select response items on the student survey reported below to attempt to ascertain some of the impact of these COVID responses on the LMRCSC students themselves. The evaluators have continued to participate in monthly leadership committee calls and recurring education committee calls during the COVID response period in year five and have provided evaluation updates at these committee meetings.

Among the significant programs implemented under LMRCSC is the *Data Management for Scientists* graduate course taught online as a requirement for all students in the program. This annual report provides summaries of a survey which was implemented for a second year on this graduate course, with some cross-comparisons from the findings and observations from the first implementation of this same survey.

Additionally, on a rotating basis across the project period, the evaluators have collected response data directly from the graduate students (and undergraduates, although after the undergraduate evaluation report was distributed in fall 2020, no undergraduate students completed the survey). This report includes summaries of these graduate student responses for this current programming year, as well as the responses to the COVID related items as noted above.

Finally, the annual Cohort Experience, an annual meeting of the new cohort of students for intensive professional and science training, was redesigned and implemented as a virtual experience this year due to the Covid pandemic response in place across the nation. These participants were also surveyed, with responses included in this annual report.

Data Management Course Survey Report 2020

There were thirteen graduate students sequenced to take the data management course this cycle. Of this number, ten completed the course, one only audited the course, one deferred until next year, and one did not pass. Five of the students completed a twenty-two question survey about the Fall 2020 data management course, after three invitations to complete the survey which were sent out by the LMRCSC administration staff.

Students' Data Management Foundation and Background

The respondents conveyed mixed ratings of their ability in data management prior to taking this course, with only one person stating, "above average." Each of the five respondents listed either one-three credit hours or four-six credit hours as hours of statistics or data management that they had previously taken. After taking the course, all five respondents rated their ability as "average." This was interesting in that one person's self-rating dropped to average from above average and two people's understanding increased to "average." The respondents learned about the class from several sources, including an advisor, cohort members and mentors as well as noting that it was recommended or mandatory for their program.

Overall Ratings

The overall course rating (Question ten) given by four of the respondents was: "low quality." (three people) And Neither "high" nor "low" (one person). The overall rating of instruction (Question seventeen) was rated "average" by four of the five respondents and one person rated it "Below Average." One person said, "it has been easier to understand this course watching videos on YouTube." It should be noted that LMRCSC administrative team and the external evaluators have begun a conversation in concern over these ratings (even though the survey response is low) and are planning structured interviews with the graduate students on the specific topic of this data management course to pursue solutions to possible concerns.

The Structure of the Course

The perception of the pace of the course was mixed, with three people saying it was too fast, one student too slow, and one suggesting it was paced perfectly. The amount of work required was also viewed in different ways by the different respondents. For two respondents the work exceeded their expectations. For two people their expectations were met, with one person saying it was below expectations for amount of work. Quotes reveal the difficulties with the amount of work required:

"The class was very slow and the communication with the instructor was not the best.""
"The material was very difficult to grasp so I ended up spending a lot more time doing assignments."

When asked about the appropriateness of the course software, two of the five respondents felt it was appropriate. However, the other three respondents said it was not appropriate with one person explaining about their inability to get the software running and the ensuing damage to their computer. Two people clearly felt that this software was not helpful for their research and the data they collect. One person felt R programming or even SAS would have been more beneficial than MySQL. A quote illustrated this frustration, " Most assignments were to take our own data and use the software to analyze it but I felt like that did not make sense. Using this software for my own research would not make my data analysis easier or more organized." One person expressed a positive view of the course structure, saying that it was positive: "He taught us the format of the computing language before we even started coding."

When asked about the effectiveness of the online course format, the reaction was mixed, with two students saying it was effective and three respondents saying it was not effective. Comments about the online format included:

- "To be effective more than just talking live in a computer is needed."
- "Give the assignments written because it is hard to get all the instructions by hearing them one time with a connection that is cutting off."
- "The Professor could not physically see the error codes and messages being displayed to the students so his response to us was to just look it up on google."
- "While the lessons were being recorded, very often the screen cut off so what the professor was showing could not even be seen, making the recordings unhelpful."
- One person said, "This course does not need to be taught online."

The Usefulness and Timing of this Course

All five respondents indicated that the course content was not used by them in either a NERTO or a TAB. When asked (item eight) if the course was helpful for their career, two answered "yes" and three answered "no." When asked about the helpfulness of this course for meeting other LMRCSC students, two students said "yes" and three people said "no." Even with the low response rate (about fifty percent) to the survey, this proportion of negative reactions is a concern and part of the current conversation about the course that was noted above.

When asked if this course was offered at a helpful time in their academic course of study, the responses were mixed. Although two people indicated that it was at an appropriate academic time, three disagreed. One person said it would have been better at the beginning semester and one person said it conflicted with another course, therefore creating difficulty. One person explained with a strong statement about the inappropriateness of this course: "I answered no because I really didn't find this course helpful or relevant for my research, so it really doesn't matter when it is offered." An additional quote took the same, negative approach: "I did not find this course helpful for my future career as majority of my data has to do with numbers; Nothing that could help me in the case of organizing colony counts, sample sizes, etc." And a third concerning response: "Course gave me insight on some data management tools but background information on how to utilize it was not clear." Two respondents felt it was helpful to learn the concepts, but one said, "I don't think that will be useful in my future work or career. We did not delve deeply into the topic for me to feel like I can use this programming language in the future."

Student Learning Outcomes and Benefits

When asked about their improvement of ability to develop a data management plan, responses indicated various perspectives: two said "yes", two said "no," and one person was "not sure." This mixed reaction was also reflected in their responses to the ability to manipulate and analyze data, with one student stating this skill improved because of the class, two students saying "no," and two students being "Not Sure." A similar pattern of mixed reactions was also articulated when asked about the effectiveness of the hands-on activities supporting their learning. The students did indicate that there were some beneficial skills developed in the course:

- Getting a general overview of how databases are made and managed
- Learning how to create a database
- Creating parent and child databases
- Creating a data management plan using DMP tool

Question thirteen of the survey asked respondents the primary benefits of taking this course. While two respondents listed skills such as using data management tools and increasing knowledge of computational tools, other respondents reflected less positive reactions. One person said the main benefit was fulfilling the LMRCSC requirement and meeting other LMRCSC students. Three quotes illustrate lack of benefits associated with this course:

"No benefits, this class gave me so much stress that it is affecting me in other classes."

"I couldn't complete the course because the program need for this course damaged my computer…."

"I honestly do not know what the primary benefit of this course was. I felt as though I had a much harder time organizing my data on the MySQL software than using excel."

Challenges and Criticisms

Question fourteen asked specifically about course challenges, and the difficulties mentioned elsewhere were reiterated and expanded in responses to this question. This question evoked strong responses. Some respondents indicated great difficulty following the course and understanding the content that was being presented. Two of the students said they did not have a clear understanding of assignments or what the course expectations were. Furthermore, Wi-Fi difficulties and challenges with using Mac software, learning how to correctly use MySQL Workbench, setting up problems correctly, and correcting script errors created challenges. One person mentioned lack of interaction with the other students to be a challenge. There was an issue with incompatibility with the professor using a Windows computer and student having a MacBook, forcing the student to use YouTube for information to complete assignments. Again, students' narrative responses highlight their perceptions related to challenges with this class:

- "Downloading a program affected my computer and my studies in other classes as this computer is only tool for everything we do."
- "Couldn't download a data management program into my computer."
- "Often the professor gave us homework assignments but completed them in class."
- "I did not feel as though the information was being thoroughly shared and explained…"
- "I learned more in a couple you tube videos than in this class, which was very slow and unclear. It was hard to know what I was being asked." Additionally, this person stated that "the recordings of this class are very bad."
- "He kept switching between languages, so it was hard to tell what the right syntax was for a given language. Sometimes materials provided were only compatible with one syntax or software, so those students who were using the other version either could not use the file or had to significantly edit the file in order for it to work, which required a lot of additional work."

One quote highlights a substantive difficulty: "It was also challenging because people were using different computers (Mac vs PC) and coding languages (My SQL vs SQL server) and we kept jumping back and forth between all of those, so it was hard to get a grasp on the syntax that would work best for my computer."

Suggestions and Ideas for Improvement

The overall sense from the student responses was this course needs to be improved. This follows on from and reiterates the 2019 survey results, which also indicated that there were definite improvements needed. In comparing the student responses from the 2019 administration of the course and the follow-on survey, it is difficult to see that the course has improved, with many examples of student concerns continuing into this second-year survey. However, in fairness to the instructor and the LMRCSC team, only five of the ten students who completed the course took the time to complete the survey, and so sampling bias toward negative responses is an authentic concern in interpreting these course evaluation data. This is in part the motivation for an ongoing conversation among LMRCSC administration staff and external evaluators to design and conduct further data collection from a larger set of course student participants to seek concrete and actionable interventions to revise this data management course moving forward. This process will be part of the external evaluation annual report this coming summer.

Based on the student surveys for both 2019 and 2020, looking for replicated concerns from students, the following ideas seem to warrant consideration for course revision moving forward:

- Delineate clearer expectations in the master syllabus and distribute this to students;

- Provide written material to support the classes (this was requested by the student but not received);
- Provide a syllabus or hub where all class materials could be stored. These suggestions were mentioned in both program years. It is imperative that a syllabus be presented to the students and this should be remedied. It is unclear how a university could allow a credit course to be offered without distributing a syllabus to students;
- The syllabus should state the software and hardware requirements and where these are to be obtained;
- Effort should be invested to enhance the interactivity of the course, between and among students and the faculty;
- Consider the match between student learning outcomes and objectives and the assignments and assessments incorporated in the class;
- Explore screen-sharing capability to enhance learning;
- Consider the use of prerecorded instructions for software and hardware use and common or typical problems which may be encountered; and
- Seek handouts from the software publisher with common terminology, syntax error codes, and guidance—these are commonly available upon software adoption and seem not to have been distributed to students.

Final Observations

A final question asked for any other comments the respondents wished to share with the evaluators. One person reiterated the stress that this course generated and the frustration that the course caused in damaging the laptops used for the course. This person exclaimed "I need to find the way to pass this course…. Required work on a program I don't have, and I need it to graduate from my program." Another person mentioned the difficulty to get properly enrolled in the course at their university, saying that "the course number and name should be in the online course catalog." And once more the respondent mentioned the absolute need for a syllabus and online hub to keep track of all course materials and when assignments were due. The concerns and frustrations which are apparent in these survey responses need to be considered, and with suggestions for improvement being carefully reviewed, addressed, and remedied. Given the recurrence of some of these negative responses from multiple students in multiple years, it is not clear to the external evaluators that the course survey data was used for continuous quality improvement of this data management course.

LMRCSC Graduate Student Survey Fall 2020

Of the eleven graduate students enrolled in this cohort, seven responded to this thirty-one-question survey. Given the funding provided to graduate and undergraduate students by LMRCSC, it is recommended that consideration be given to requiring participation in the external evaluation of the project by select and periodic survey responses be required of students. The survey questions ranged from student academic information to background questions on their interest in science. Queries were made about extracurricular activities, course work and meaningful career preparation. Benefits and challenges were explored. These categories further serve as the framing categories of the structured student interviews which are conducted annually by the external evaluators to enhance the credibility and reliability of the overall evaluation process and to aid data interpretations. The responding students were from each LMRCSC participating university except Savannah State and the University of Miami. Six of the seven students were pursing an MS degree and one respondent was a PhD student.

The degrees students are seeking are in Biology and Environmental Science (two students). Fisheries (two students), Marine Estuarine Environmental Science (two students) and Natural Resources (one student). None of the seven respondents had changed their major because of their participation in LMRCSC. When asked about their undergraduate degree, five students said their undergraduate degree was in Biology and two had degrees in Marine Science.

The survey then considered a set of career related questions. When asked about their ideal job, several respondents specifically indicated that they would prefer to work for NOAA. Several others desired a job in their field or in laboratory research; other goals mentioned included to work on an aquaculture farm, serve as a policy advisor, or to become a professor. When asked how and when they began considering a career in science, it was interesting to note that childhood experience played a key role. They used phrases to represent this early interest "I've always been interested in science since I was a child…as early as I can remember." Two students mentioned that high school was the starting point of their interest and two others mentioned this occurred at the undergraduate level. When asked about the reason why they wanted to pursue a career related to science, a strong sentiment emerged on the part of the responding students that this was interesting and fulfilling. The altruistic motivation was illustrated by comments such as "help make the world a better place", "contributing to a cause greater than myself and desire to add diversity to the field." One student wanted to bridge science and policy.

When describing the research or field experiences they had participated in because of LMRCSC, respondents mentioned virtual NERTO and TAB projects with description of specific research about oysters and leopard seals. Two new students had not conducted research yet. The research projects mentioned were:

- New technology for oyster post-harvest treatment (aquaculture)
- Impact of oyster conditioned water on oyster setting efficiency
- Qualifying microplastics in coastal bay fish
- Impact of climate change on Nassau grouper
- Effects of climate change on leopard seals
- Proteomics

In addition to the specific research topic, the respondents mentioned that the value was also in learning how to implement a research project, create mentorships, acquire statistical and analytical skills, present findings, and build a network. One person stated, “It provides me the opportunity to fully develop, run, analyze, and report on a scientific project of my own….” One comment eloquently stated that the LMRCSC funding allowed” me to grow as a scientist and a scholar.”

An additional set of questions probed awareness of LMRCSC, source of that awareness, and mentoring background. Six out of seven students had received an orientation or information about the LMRCSC from someone at their home institution. The students described professional mentors who have guided them academically, helping students navigate the science field, providing guidance on several issues and helping students in the lab. Likewise, supportive faculty were identified and glowing positive comments about specific individuals were made. The specifically named mentors and faculty with these appreciative comments can be found in the attached raw data. An example comment illustrates the appreciation “The advice she gives comes from a place of caring and wanting the best for me as a student.”

Students mentioned several organized, school-based science programs, including conferences and meetings, courses, and publications from which they had benefited. Two of the respondents were EPP/MSI scholars. For extracurricular science-related activities, four out of seven respondents indicated involvement in extracurricular and community service activities, including citizen science projects, Governor School, AFS, and a Diversity Collaborative, and volunteering at a museum. All seven students said they remain in communication with a key high school or undergraduate faculty member. When asked about immediate family in a science career, only two indicated they had a family member engaged in science. Key adults in their lives were important in encouraging these students’ interest in a science career. They mentioned their parents, and an uncle as specifically supportive of their interest. When asked about employment prospects in science, the respondents perceived their employment prospects within their chosen career as very employable (three students) and moderately employable (four students).

Students were asked about positive or beneficial LMRCSC activities from the prior year. The responses included:

- ASLO.
- Graduate seminar series.
- OSU virtual monthly meetings; and
- TAB proposal process “This was the first grant that I’ve ever applied for, so it was a very informative and valuable experience.”

The students said that these activities were the most significant because in many cases the listed activity was the only activity due to the emergency responses tied to COVID. The most beneficial courses were listed as Marine Population Dynamics, Conservation Biology, Fisheries Management and Life History of fishes, Biostatistics and Statistics. One student listed next generation sequence analysis using Unix based tools as a good introduction to computing languages.

Of key interest in this program is how LMRCSC has enhanced the students' knowledge of NOAA. Students mentioned that the program has made them aware of more job opportunities across NOAA. One person stressed the increased realization of the importance of diversity to NOAA. One person highlighted increased knowledge of international treaties, and agreement to protect Antarctic marine Living resources, which NOAA leads.

The respondents acknowledged limited interaction with other students or professors in the LMRCSC. Five people said this interaction was "low." When asked about their knowledge of NOAA EPP, the responses were mixed. Two people said they had high knowledge while two said medium knowledge and three people said they only had low knowledge. When asked about continuing interaction LMRCSC through an Alumni Association, all seven students were interested or very interested in a potential alumni association. This seems to be an opportunity for a sustainability element for the LMRCSC moving forward, to leverage the involvement of these alumni.

When asked to reflect on their perceived greatest challenge moving forward in completing their career-related education, the responses were varied and offered some insight for potential remedies. The COVID-19 pandemic responses and challenges to the national economy and workforce were near the top of the list for a couple students. Other challenges included:

- Funding.
- Expenses for a cross-country move for potential job.
- Lack of help by professors when courses are on other campuses; and
- Public speaking and science communication weaknesses.

These comments point to possible solutions to be considered by the LMRCSC team. One suggestion would be to offer short courses or webinars on public speaking and science communication, taught by experts in these fields. The concern about professorial help when courses are offered at other campuses could be remedied through a structured online support or centralized advisement process. Perhaps there could be a team-teaching approach to involve a professor at the student's own institution.

A final question was asked about students' university responses to COVID and the impact on the students' education. Responses included:

- Curtailed travel
- Decreased time in laboratories and decreased learning of lab techniques.
- Limited meetings with advisors or committee members.
- Some impact on course work with some professors, though it was mentioned that some university courses were already set up for virtual teaching.
- Difficulty in adapting to online work; and
- Feeling disconnected from LMRCSC and the other students.

When asked to offer ideas for additional support that would be helpful, the students provided some insights, which included:

- Career pathway meetings or discussions;
- Networking on a virtual platform;
- Fellowships or internships; and
- One person commented, “I feel that more information and resources from the LMRCSC would be helpful, especially in regards to making sure we are aware of all the requirements we need to fulfill for the LMRCSC.”

Additional Activity by the External Evaluators and Final Summary Discussion at the Mid-Year

While this current mid-year report is a snapshot of some student responses to two ongoing LMRCSC activities during the program year, there are additional activities which the evaluators have conducted or participated in which have involved significant effort.

First, in response to the year four IERT panel recommendations, the external evaluators invested significant effort to create a TAB post-project summative assessment which was built on the review criteria used to award these grant projects to students. This post-assessment instrument was revised several times and then provided to the LMRCSC administration for dissemination to the TAB students as they finish their projects—including any current or continuing students who have already completed a TAB project. As of this mid-year report date, this post-assessment has not been distributed to students, or else the students have simply not responded to the survey. The evaluators are maintaining this survey as an “open” instrument in data collection software and would like guidance from the LMRCSC director for this ongoing cost—if the survey is not going to be administered, it should be closed out.

In addition to this TAB post-assessment, again, recommended by the IERT panel report, an additional set of instruments and rubric were prepared in view of an assessment of the Core Professional Skills and Competencies which students develop across their LMRCSC participation. This process has not moved forward, and it is likely that the various institutional responses to COVID have certainly impacted the discussions and timetable for implementing this assessment item. It is recommended that this process and activity by further discussed at a monthly leadership team conference call in view of continuing this effort.

Third, there was an undergraduate student survey which was developed during year four based on the rotation plan for assessing student perceptions and activities in the LMRCSC. This survey was distributed electronically to the undergraduate students by LMRCSC leadership. Unfortunately, no useful sample of students responded to the survey this year. It is likely that the fall semester was hectic and somewhat chaotic for these young adults due to the COVID responses at their respective universities, nevertheless, it is critical that students participate in these evaluation efforts as a part of their support commitments for LMRCSC. This issue should be discussed by the project leadership team. There were reminders emailed out to prompt students, but these failed to yield additional responses.

Finally, significant effort was invested in developing, implementing, and reporting on the Data Management Course post-assessment in 2019 (with a final written report) and again in 2020 (reported above). The strong similar concerns of students over two consecutive years of the course have warranted an ongoing conversation among the LMRCSC administration and external evaluators which should continue. To effectively demonstrate continuous quality improvement through the use of performance assessment data, the LMRCSC team should demonstrate some response to the persistent student negative assessments of the course in a tangible manner. Surely, the low sample size may in fact indicate that the larger proportion of student completers have no concerns to warrant their attention to completing the post-assessment survey—this would be a typical sample bias here—but this should be ascertained through follow-up communication with a larger set of these students to ensure a quality experience of this critical program element.

LMRCSC Virtual Cohort Experience

An extensive, virtual workshop was designed for the LMRCSC cohort experience during year five due to continued meeting restrictions related to the COVID pandemic. Working with the LMRCSC leadership and education director, the evaluators created a survey for participants in the virtual cohort experience and distributed this immediately following the last session (included with this report). Ten of the participants completed the survey.

Respondents included students from all LMRCSC affiliated institutions except for Delaware State University. Fifty percent of these respondents (n=5) had been part of the LMRCSC for two years, three respondents less than two years and one person five years.

One important element of LMRCSC is establishing and supporting network relationships between cohort students and NOAA scientists. Item two of the survey asked respondents to identify or list these scientists, who included:

- Kimberly Roberson
- Dr. Larry Alade
- Dr. Ashok Deshpande
- Dr. Paulinus Chigbu
- Laurie Weitkamp
- Jason Spires
- Shawn McLaughlin
- Bruce Vogt
- Mandy Bromilow
- Douglas Krause
- Steve Gittings

When asked (Item four) if the cohort experience fully met their expectations, half of them stated they were *Neutral*, while four respondents *Agreed* that it met their expectations.

Only one respondent *Disagreed*. Their narrative responses tell the reasons for their choice of response. The biggest negative that was expressed by several of the respondents was the timing, which was a problem for them. Comments such as “timing was horrible,” “labor intensive in the middle of the semester,” “way too much for this time of year”, “would have been less stressful during the summer.” Positive comments related to liking the recorded lectures, valuing interesting and important content, and enjoying getting to know other LMRCSC students.

One person did not find value the discussion board posts, saying they failed to help with learning. Two people used the term “busy work” to describe some of the tasks. Although there seemed to be a preference by one responder for in person interactions, one person highlighted that “it was a solid experience overall.”

Item six asked respondents to identify benefits of having the cohort experience online instead of face to face. These types of inputs will be valuable in the future as organizations or programs consider lessons learned and technologies used during the Covid period. Benefits which were mentioned included:

- Flexibility; working at own pace and at one’s preferred timetable
- Interaction with more people; meeting with science center people
- Not having to travel; making it easier to do other academic tasks

Items seven and twenty asked about challenges encountered during the cohort experience. The challenge of time requirements seemed to be emphasized in responses. Balancing classes and thesis writing at the same time as the cohort experience was challenging. One person suggested that a time earlier in the semester would have been preferred. Time to meet with groups was seen to be difficult. Having the program run on eastern time was mentioned as a problem for a west coast participant. And finally, the extended length of the experience was seen as a problem for several respondents. One person reiterated dislike of the discussion posts, saying that they “were more work than necessary and created additional stress.”

Communication issues presented challenges. Expectations of when tasks were due or late posting were also mentioned as problems. Select quotes related to this included: “It would have been great if all the material was posted at the start of the cohort experience.” “It was unclear when things were due.” “The notifications only worked during the discussion comments.” Another person failed to receive important announcements due to an email problem.

Item eight solicited rating responses for the components of the Cohort Experience areas. Rating was onea scale of 1 to 5, with 5 being of highest importance. These responses are included on the table as follows:

Content Area and Rating (N=10)

	1 (lowest)	*2*	*3*	*4*	*5 (highest)*
Social science and human dimensions	0	0	2	5	3
Stock assessment and fishery management	1	1	1	3	4
Healthy habitats	1	0	0	5	4
Safe seafood/aquaculture	0	1	1	7	1
Grant writing	2	2	0	1	5

Grant writing was given the highest rating by half of the respondents, but on the other hand, 40% of respondents gave it low ratings. One person thought that grant writing would be more useful to undergraduates. This dichotomy of response pattern to grant writing should be considered moving forward should this element remain in the program. Healthy habitats, social science, and safe seafood/aquaculture were rated four or five by 80-90% of the respondents. Stock assessment had mixed ratings, but one person indicated that "stock assessment gave me insight on modeling."

Item nine included an extensive rating matrix to obtain responses on the various potential personal and professional benefits of participation in the workshop. These responses are included on the table as follows:

Personal and Professional Benefits Rating (N=10)

	1 (lowest)	*2*	*3*	*4*	*5 (highest)*
Developing relationships with other students	0	1	1	4	4
Developing relationships with faculty from my institution	1	0	6	2	1
Developing relationships with faculty from other institutions	2	1	2	4	1
Developing relationships with other LMRCSC personnel	1	1	2	3	3
Developing relationships with NOAA scientists	1	0	0	4	5
Obtaining career opportunities and pathways	1	0	0	1	8
Developing time management skills	2	1	2	4	1
Fostering cooperation and collaboration in research	0	1	1	5	3
Enhancing communication skills	0	0	1	5	4

Obtaining career opportunities and pathways was highly rated (scores of four or five) by 90% of the respondents, with 80% of the respondents giving it the highest rating of five.

Developing relationships with NOAA scientists was rated four or five by 90% of the respondents as well. Mixed ratings with some low ratings were given for developing relationships with faculty from other institutions. These low and mixed ratings were also given to fostering time management skills.

Unanimously, the respondents said that the cohort experience helped them better understand LMRCSC's goals and better understand NOAA's mission science (items ten and eleven). These are important findings and a good accomplishment and outcome of the LMRCSC cohort experience.

The most frequently mentioned helpful information (items twelve and thirteen) received during the cohort experience was grant writing (which was interesting, as in the ratings matrix this focus did not emerge), and budgeting was cited. Other information that was listed included stock assessment, social science, and the NOAA Scientist meeting. One person negatively expressed "I didn't receive a lot of information that was extremely helpful."

The Cohort experience was seen to help advance or refine academic goals (again from item thirteen) in that it provided students with ideas and approaches that were:

- Holistic
- Interdisciplinary
- Connected to SNAP
- Wider in scope
- Supportive group work

One respondent wrote, "The video with the ten philosophies helped with academic goals by providing more knowledge on my topic as well as others."

With respect to advancing or career goals (Question fourteen) only seven people responded. Three respondents said it di not help with career goals. A couple respondents said the experience showed them the large scope of career opportunities and one person said it gave insight on networking. One respondent noted a NOAA related outcome: the workshop "further confirmed that I want to work for NOAA."

When asked about the ways the cohort experience fostered collaboration with students or faculty from other institutions the respondents acknowledged the grant writing project as a key collaborative experience. They expressed the importance of meeting with students from other institutions.

To item sixteen, ways in which the cohort experience provided support from NOAA scientists, there seemed to be quite a difference of opinion. Four out of the seven respondents to this item said the NOAA scientists were supportive; offering ideas of how and where to look for jobs. One person perceived that the experience "further proved that they are all approachable and willing to help." However, three people indicated that the experience did not offer support from NOAA scientists, with one person saying "I feel there was no support given." These contrasting opinions warrant further investigation into why these different opinions occurred. It may be that some students already have placements or institutions where they have a greater interaction with NOAA personnel than the workshop afforded, and thus have skewed perceptions. In the next funding/programming cycle, it may be that greater use of interviews and focus groups and fewer anonymous surveys could provide a different view of the experiences.

Seven people responded to the query about the single greatest benefit they derived from the cohort experience (item seventeen). The top responses were meeting students from other institutions, those with the same goals and grant writing. Learning NOAA's goals was also mentioned.

When asked to provide suggestions about additional activities to strengthen their cohort experience (item eighteen), several students recommended more live sessions, more interactivity and socializing. This was deemed more desirable than the discussion board. One person suggested replacing grant writing with manuscript writing.

Other ideas for follow-up information arose from responses to item nineteen. Several respondents indicated "none" to wanting follow-up information, but pro-positive suggestions included:

- Grant writing
- Career preparation
- Stock assessment
- Social science
- Ecosystems
- Climate change

The amount of time for the experience was viewed by seven out of ten respondents to be "too much." The other two respondents said it was "just right."

Item twenty-two inquired how the experience fostered enhanced relationships among key groups and the respondents offered uplifting remarks about networking with other students and with the NOAA scientists. One respondent indicated that the workshop "broke down barriers and encouraged us to reach out." Another responded that the workshop "had individuals from varying backgrounds and research interests come and work together towards a common goal." One negative comment suggested that the cohort experience would develop relationships in person but "online it was mostly awkward, and no key relationships were formed."

Comments about a journal assignment evoked different responses, with most people indicating they did not keep one, though one person said it "showed me how each included core workshop component related in some way to my project."

The combined cohort experience, Northeast Fisheries Science Meeting, and the NOAA EPP Forum (addressed in item twenty-four) offered a unique opportunity for the LMRCSC cohort participants. They were seen to enhance knowledge, connect with students and other researchers, and support future academic and career path. “They all fit well together, but it was a lot jammed into a little bit of time.” “The NOAA EPP Forum was great.”

In summary, the post-cohort experience workshop survey seemed compellingly positive given the significant social impediments and emotionally fraught cultural moment of the Covid pandemic response. It is likely that the overwhelming shift to online communications and professional work, training and education over the past year influenced the participation and perceptions of these students. Understanding this will require wider venues of research than this evaluation study. Nevertheless, it seems warranted to conclude that the online cohort experience met its intended goals.

Report Conclusions

This final year of the LMRCSC brought challenges which would have been nearly insurmountable for a less cohesive leadership team with a less well-organized communications structure. The evaluation team, as through the first four years, participated monthly in overall administrative leadership team phone meetings, as well as monthly education committee meetings. In addition to these formal meetings, consistent email communications across the year reflected, taken together, a shared commitment to managing the COVID-required pandemic response in a way that best allowed the LMRCSC core functions to continue unabated. The positive feedback across the various interviews, meetings, and stakeholder surveys suggests that these core functions succeeded in moving the graduate and undergraduate students toward their eventual personal and professional goals.

It is also noted that in preparation for the IERT panel review at the end of Year 4, a comprehensive archive (three-ring binder) of each mid-year and annual report and each survey instrument created across the first four years was provided to the LMRCSC Director for the IERT Panel, along with a comprehensive PowerPoint slide presentation of the full assessment history.

In response to the concerns of the IERT, the evaluation team created an additional evaluation instrument and procedure for reviewing and assessing the quality of completed TAB projects. The instrument as created, and then revised, by the project leadership, and then provided to the LMRCSC Director and the Chief Research Scientist. The scientific expertise required to review the project-specific assessment data necessitated that these data be initially interpreted by science staff. Unfortunately, the project leadership has not followed through to date with ensuring this survey was administered. While some data have been collected on the TAB projects in the ongoing evaluation surveys administered regularly by the evaluation team to students, this gap in TAB assessment should be considered for subsequent years.

In addition to this TAB assessment issue, and also in response to the IERT panel recommendations, the evaluation team created an assessment rubric and draft instrument to assess and monitor the acquisition of core competencies and work skills among LMRCSC students. The concern with core competencies continues to be refined and addressed by LMRCSC leadership, and so the issue of assessment relative to these is also fluid and ongoing. As this effort continues, nevertheless, as with the TAB assessment, the evaluation team has collected feedback on core competencies from students in an ongoing basis across the past five years and will continue to evolve this strategy. Evaluation team members, moving forward, will continue their practice of fully participating in leadership and education committee monthly meetings to monitor internal plans and discussions and to be responsive.

LMRCSC Year Six (No cost extension year) Mid-Year Report March 15, 2022

The Living Marine Resources Cooperative Science Center (LMRCSC) was "established in October 2001 as a cooperative agreement between NOAA's Educational Partnership Program (EPP), and a collective of universities to address environmental, natural resources management and STEM workforce challenges…." The mission of the Center "is to prepare a diverse student body for careers in marine and fisheries science through exemplary academic and research collaborations" (all quotes from the Project Narrative). The LMRCSC received an additional five years of funding, which began in Fall 2016. The project leadership contracted with The College of Exploration's (TCOE) Dr. Tina Bishop, Peter Tuddenham, and Dr. Howard Walters to develop and implement an external evaluation of the project.

This evaluation plan was reviewed and approved by internal project leadership, and was submitted with the project proposal for review and approval by NOAA EPP. During year five, there were substantial impacts to the LMRCSC due to the SARS-COVID Emergency Response conditions which have been implemented across the nation. These were described in the annual report for year five submitted in early fall 2021. These responses included shifting of face-to-face activities to online communications methods, and numerous program planning and implementation complications which affected student research, access to laboratories and other research settings, and program participation and travel. Due to these responses, NOAA EPP issued a one year, no-cost extension to the LMRCSC to continue and finalize planned activities for the project period.

This current report is the mid-year, abbreviated summary of continued evaluation efforts in this sixth year. As in previous years, the first half of the year included collection of impact assessments from undergraduate and graduate students. In addition, a revised workshop focused on student data skills, i.e., the Data Carpentry workshop, was implemented in fall 2021, to include both internal and external impact survey data collection from participants. These data are summarized for this mid-term report below.

Undergraduate Student Impact Survey

A group of six undergraduate students representing Hampton University, Savannah State University, and the University of Maryland-Eastern Shore, completed a mid-year survey to identify perceptions of the program and potential impacts on their educational and career trajectories. Five indicated they are pursuing degrees in Marine and Environmental Sciences or (one) Environmental Sciences. Each has remained confirmed in their selection of college major—which is atypical as the normal pathway for undergraduates is to exhibit regular changes of major.

Item five on the survey asked students for their career goals. Two indicated research, two indicated work as environmental lawyers, one each in environmental consulting and resource management. The students' motivation for careers in science (item six) seemed highly related to environmental and global stewardship issues. Respondents perceive a value-laden focus to science careers. Interestingly, even though they are undergraduates, four of the six describe research or field experiences (item eight) in which they have participated under the funding or auspices of the LMRCSC. This is a stronger response from undergraduates and suggests a growing refinement and expertise in the education programs for LMRCSC and particularly in the communications efforts to link, in the minds of students, their college experiences with LMRCSC as an umbrella entity.

Items nine and ten solicited descriptions of any professional mentors which the students/respondents had. Three of the five respondents to this item noted undergraduate professors as fulfilling this professional role for them. This is a valuable observation from a programmatic standpoint.
LMRCSC leadership may wish to consider whether there is sufficient outreach to the undergraduate faculty members at the respective institutions about the need for student mentoring, with orientation on the LMRCSC and opportunities connected to it, as well as further professional opportunities through LMRCSC for the faculty members themselves.

Finally, in this pool of questions, item eleven revealed that four of the six respondents had received LMRCSC orientation and information from faculty members or program representatives at their home institutions. This observation addresses the question of administrative effectiveness of the LMRCSC and suggests that communications and program orientation, recruitment, and onboarding of students is occurring and embedded down into the institutional faculty level.

Items twelve through seventeen sought to identify pre- or co-collegiate/co-curricular activities related to science among the responding pool. These have been found in related research in science career pipeline issues to have some relationship with students choosing or persisting in the STEM employment pipeline. While this response pool was small, interesting observations in response data include little family background for STEM careers for these students, but some evidence of involvement in other STEM related activities beyond the LMRCSC project. There was evidence of family encouragement for STEM careers from parents and grandparents. One individual participated in an REU program.

Item eighteen reflects that these respondents believe there are strong employment possibilities for STEM careers which they are pursuing.
Item twenty asked respondents to identify other potential activities of interest which could be offered by the LMRCSC. Among the activities suggested were visits to other LMRCSC institutions, additional workshops for statistics, policy or justice issues, and scuba diving or other research opportunities. The respondents perceived (item twenty-one) that these additional activities would supplement their knowledge and also have important social affects by linking students with other LMRCSC participants and institutions.

Item twenty-three asked respondents how their knowledge of NOAA had changed over the recent year. This item is related to one of the mission objectives of the LMRCSC for communication of NOAA mission and research objectives to students in the LMRCSC. Three of the respondents answered this item and provided detailed information. One had served as a NOAA/EPP fellow over the previous year. One specified that a workshop offered by LMRCSC provided NOAA information. A final respondent simply noted affirmatively that his/her knowledge of NOAA had increased without specifying a source of this knowledge.

Items twenty-four through twenty-six solicited additional information specific to the LMRCSC more broadly. Four of the six respondents reported little interaction with other LMRCSC institutions. All six of the respondents reported high to medium knowledge of LMRCSC as a NOAA EPP network—a strong response and further evidence of effective administrative/communications efforts in the LMRCSC. And finally, all six reported high levels of interest in continuing involvement with LMRCSC through a potential alumni organization in the future.

The remaining items, twenty-seven through thirty-two, suggest that these respondents continue to have some concerns about support structures for transitioning to graduate school, even though all six report a high level of interest in doing so. Some of their concerns relate to preparing for the GRE and identifying and transitioning to graduate schools and programs. There is evidence in these questions that many of these respondents are already interacting with graduate students and obtaining some input from program leadership and faculty at their institutions.

Graduate Student Impact Survey

A larger response pool—eighteen individuals—was obtained from the graduate students for the mid-term cycle of survey collection. It may be that this far into the program, the graduate students have grown more accustomed to receiving these information requests from the evaluation team, or simply may be more mature in viewing this as a professional responsibility and reality in the workplace. There was wide distribution of the respondents across the LMRCSC, with each of the institutions having representation in the response pool (there may have been some misinterpretation of the "home school" question, so some individuals may have pointed back to an undergraduate home school as alumni.
Thirteen of the respondents are seeking MS degrees, and five are seeking Ph.D. degrees. The primary content disciplines for all of these students are marine related, suggesting strong success in the recruitment processes for LMRCSC, and a strong NOAA-aligned

academic and research focus. None of the respondents have changed their focus while working within the LMRCSC. All reported undergraduate preparation in related disciplines including marine science, biology, environmental science or oceanography. One outlier is an individual respondent out of nutritional sciences tied to an agricultural orientation. Each of the respondents (item six) identified future career orientations pertaining to the professoriate or research positions, either for a university or a government agency. Three respondents specifically named NOAA as a future opportunity for employment, although most of the other responses align with NOAA mission science.

Item seven asked respondents to describe how and when they began considering a career in science. Again, this type of background information can be useful in formulating an effective recruitment plan. The largest cluster of responses (n=6) pointed back to childhood, followed by high school (3) or middle school (2) as the time when perceptions of science careers or desires for science careers began to form. This is a critical observation, as there remains some institutional perception, particularly in the federal science agencies, that targeting career recruitment education and outreach below the undergraduate level is not a valuable use of funds. For this group of graduate students pursuing STEM careers, those decisions formed in childhood and adolescence were crystalizing and powerful.

Item eight asked respondents *why* they wanted to pursue a career in science, seeking to ascertain motivation. The most interesting and powerful cluster to emerge from these response data using content analysis were the ideas of *meaning and passion*. Although the specific vocabulary differed—terms such as love, passion, joy, happiness, fun and related terms—the emergent motivation was very similar.
Students perceived an affective, positive response when thinking about a STEM career. Several used the terms meaningful or fulfilling. These ideas are thoroughly consistent with adult learning principles, where adult and young adult students pursue life goals through an attachment of personal fulfillment and meaning to the pursuit. Again, this observation may be useful in planning education programs for these young adults and as an additional theoretical framework (adult learning theory) to describe the important work of the LMRSC.

Items nine through thirteen prompted very rich and lengthy narrative responses from these graduate students which described a wide range of research and/or field experiences in which they had participated as a result of LMRCSC. Clearly, this reflects that LMRCSC is aligned with and supporting NOAA Mission Science concerns in the opportunities that it is providing to its graduate students. The respondents also described powerful mentorship experiences which they had had, many of which came through LMRCSC personnel or undergraduate or graduate course faculty. Several respondents mentioned their NERTO mentors. And LMRCSC personnel, Dr. Chigbu, Dr. Dionne Hoskins-Brown, Dr. Rose Jagus, Dr. Liz Babcock and Dr. Victoria Young were mentioned specifically as valued and valuable career mentors. As a final note, it seems clear from the responses that these graduate students indeed view the NERTO assignment as an authentic and valuable research experience which has supported them professionally. Finally, thirteen of seventeen responses had received orientation to LMRCSC formally from someone at their home institution, with four additional respondents stating that they were unsure whether they had received orientation or not. Again, a positive reflection for the administrative functions of communication.

Items fourteen and fifteen sought to identify whether these graduate students had a “track record” of participation in STEM related activities from high school forward through college. The responses were rich and inspiring. The data reflect a veritable “who’s who” of the national or regional, federally funded opportunities. Responses listed the EPP MSI scholarship, NOSB, the McNair Scholar program, NSF STEM Fellow programs, and REU programs. There is support for concluding that this holistic community of scaffolded STEM experiences are functioning as somewhat of an incubation system for emerging young science scholars. This complex-systems view of the formal and informal connections among these background supports for LMRCSC students certainly has contributed to these students current “moment” and should likely be researched or evaluated as contributory factors in the LMRCSC program.

Items sixteen and seventeen reveal an interesting divergent observation. While most respondents (15/18) remain in communication with key high school teachers or undergraduate faculty members, the inverse (3/18) describes these student’s family members employment in STEM fields. As observed in other research, teachers at the secondary and post-secondary level can be valuable vectors for career pipeline development of young adults, even in the absence of parental support for these STEM disciplines.

Given this previous observation, item eighteen does demonstrate that parents who are not employed in STEM areas do value STEM careers for their children. Many of these graduate student respondents describe how parents encouraged their passion and interest in science. This encouragement was viewed as very important and memorable by these respondents.

Item nineteen asked respondents to gauge their employability in their chosen career aspirations. Fifteen of eighteen rated this as Very or Moderately employable over the next ten years. Previous concerns expressed by earlier students were absent in these ratings.

The next set of interesting data to emerge in the survey was in item twenty-one. Respondents identified the most engaging or significant LMRCSC activity from the past year. Several respondents listed the Data Carpentry Workshop, a significant and positive improvement in responses to data workshops or courses from previous years. Further, and again a notable positive observation, several respondents used the term “cohort” or “cohort experience.” In earlier years, it was difficult to ascertain whether the concept for cohort relationships was being adequately “pushed down” into the awareness of students, even though it was very much a goal of the LMRCSC leadership. Refinements to workshops and orientation (which these survey data demonstrate is happening) may have contributed, or likely contributed, to this emergence of the cohort language in the survey data. These experience responses demonstrate positive administrative oversight, growth and improvement in the program, and positive impact on the students.

Item twenty-two asked respondents to explain why the previously mentioned experience was perceived as valuable. This question elicited rich and detailed responses. Several explained how the cohort experience workshop enhanced valued work skills. This comment was made about the data workshop as well. Several described the social interactions with other students, and also the ability to meet potential mentors. Given the context of Covid response that drove this experience online last year, it was interesting to observe from several comments that the experience helped them navigate and manage the "covid era."

Item twenty-three asked respondents to name and describe the most beneficial university course which they had taken in the past year. The intent of this question was, again, to identify the integration of LMRCSC experiences and opportunities for students with NOAA Mission Science. The courses identified by the respondents indeed demonstrated this. Courses listed included Coastal Pollution, Environmental Law, Population Dynamics, Ocean Law, and Marine Ecotoxicology among others. Fourteen of the eighteen responses were from science or science policy areas which clearly matched NOAA concerns.
Interestingly, other courses mentioned—Technical Writing, Programming in R, and Skills for Team Science—overlapped the professional work skills that are also objectives for the LMRCSC and NOAA EPP.

Item twenty-four drilled explicitly into enhanced student understanding of NOAA Mission Science and Fisheries Science from this past year's experiences. Students described a number of examples of how they had grown professionally, and the full response data set it powerful. Example quotes include:

- *My knowledge NOAA mission science has been enhanced by attending conferences and seminar series that described what role different scientists played in the NOAA mission.*
- *I have been very lucky to meet NOAA scientists and to learn more about the various areas they work in at the Gulf of Maine Research Institute this summer.*
- *Becoming a NOAA EPP/MSI Graduate Fellow helped me understand how my role as a NOAA supported student contributes to NOAA's mission and also ways that I can enhance my contributions to NOAA's mission and fisheries science.*
- *I actually recently had a meeting with Dr. Sexton that increased my knowledge on the mission statement and NOAA as a whole. Making sure to include MSI after EPP, how to address myself properly, and other important things to know were discussed. This year that knowledge was greatly enhanced.*

Items twenty-five and twenty-six were rating questions which reflected, as in earlier years, a perception that there was low to medium interaction with students and professors at other LMRCSC institutions (other than their home school), but a medium to high level of knowledge about the LMRSC as a NOAA EPP overall. In the former case, that response pattern is not unusual and is a function of a "home school advantage" for connections and networking. In the latter case, this seems to reflect a positive growth in the LMRCSC administrative, and communications functions this past year.

As with the undergraduate students, item twenty-seven indicates a strong interest in participating in a future potential Alumni Association for the LMRCSC. Item twenty-eight continued last year's concern about Covid responses and revealed some concerns about a loss of work time on research, the loss of hands-on experience due to social distancing, and the compression of time for those students where they are attempting to maintain a completion calendar or schedule to finish schooling. Item twenty-nine solicited descriptions of changes at their home universities required by Covid. Again, these descriptions validate the responses to the prior item by revealing that the most likely mitigation efforts for Covid did indeed isolate students, eliminate interpersonal contact and limit use of labs and research capability. The final item, seeking ideas for additional supports and resources, did not reveal strong clusters of similar items that would inform practice, but the evaluators encourage the leadership at LMRCSC to review these raw data responses regardless. Two respondents did suggest a common idea of writing support for theses and dissertations which might be discussed at a leadership monthly meeting.

Data Carpentry Workshop Survey

As noted in the graduate student survey responses above, there was a very positive receptivity to the Data Carpentry Workshop in fall 2021 that carried over into the general survey for the fall semester. The evaluators did develop a short survey specifically for this workshop and include it at the end of the workshop for students to garner additional, program specific information about this LMRCSC opportunity.

Item one asked respondents how many credit hours in statistics or data management they had taken prior to this course. Four respondents indicated from 1-3 hours. Five respondents indicated from 4- 6 hours, and two respondents indicated over six hours. One respondent had not taken statistics or data management coursework at all prior to this workshop. This response pattern suggests a widely divergent preparation for the student group.

Item two asked how respondents perceived the course would support or had supported their NERTO or TAB projects. Each of the twelve respondents perceived a benefit and use for the content of this course—which is a significant, positive improvement from earlier iterations of the data course and reflects significant work by the LMRCSC team to create a course that accommodated the widely divergent background preparation noted above. This is a commendable accomplishment. Item three suggests that only three of the twelve perceived the course moved too quickly (these were the students with the least background preparation via credit hours in related studies). All twelve respondents (item four) asserted that the workshop would be useful for their future career and eight respondents added open comments to expand on this. Select responses included:

- *I did not know much about any statistical tests before this workshop, it was very interesting to learn about more complex functions;*
- *Being able to use R will help with data analysis and the ability to find career opportunities;*
- *I have been hearing about R and needed an introduction but didn't know where to start on my own, so this was very valuable.*

Interestingly, item five on the survey revealed that only four of the twelve respondents perceived that the course fostered their developing relationships with other students. It is likely that the instructional modality (online) and the intensity of the content and study was not orientated to social development as was the Cohort Experience course. This is not viewed as a deficiency by the students, however. The overall rating of the course (item six) did not reflect a single negative evaluation: nine respondents rated the course as excellent and three rated it at the mid-point of the scale or as okay.

The remaining items explored the various content elements of the course and student perceptions of the value and importance of these. Item seven suggested that the data visualization skills were a strong and valuable part of the course. Item eight revealed nine of the twelve respondents perceived the sequencing of materials was appropriate and came at an appropriate moment in their academic program. The negative responses were from students who had a stronger background in statistics, and likely perceived that they were already past the difficult stage of concept development in this area. And finally, item nine records that nine of the twelve perceived that the online instructional modality was extremely or somewhat effective, with only three perceiving that it was not. One respondent qualified his/her negative rating by suggesting that the negative only applied to the course section on R, and that the other materials were very effective online. The final item (ten) solicited areas for improving this experience, and the largest cluster related to the intensity of the schedule, with suggestions that perhaps it could be disseminated over a longer time frame. Nevertheless, the evaluators discount this suggestion as it is a typical response to an intense experience, and there is no other evidence that student performance was negatively affected by the pace of instruction.

There are select, additional response data from this Data Carpentry workshop which will be reviewed holistically and included as necessary in the summer 2022, final annual report of the LMRCSC sixth year activities for this extension year. Initial review of these does not reveal any differing responses than those contained above or in the previous graduate fall survey.

Additional Evaluator Efforts (visit to SSU, participation in meetings, discussions on new evaluation plan for new funding)

As final summary of evaluator efforts this first half of the extension year, the following work effort was undertaken to maintain momentum in holistic evaluation of the LMRCSC. First, Dr. Tina Bishop visited Savannah State University and had an update conversation with Dr. Victoria Young, the LMRCSC Education Coordinator, to continue monitoring of program implementation. Second, the evaluation team regularly participated in the monthly LMRCSC Executive Committee video conference call, and on select Education Committee meetings to report formative information to the team for immediate review, and to continue to monitor project implementation. And finally, this second Covid response year has continued to foster the use of threaded email discussions and information sharing, and the evaluation team monitors and participates in these communication efforts as part of the overall administrative and communications plan.

Report Conclusions

It was a given that, with a second year of Covid emergency responses ongoing at the LMRCSC partner institutions, there was a possibility of program disruption. Nevertheless, the evaluation efforts for the first half of this no-cost-extension year reveal that the team has substantively adapted its project to the use of distancing and technologically mediated communications and work methods. Students, faculty, and team members demonstrate success in key project elements relying on these communication technologies.

Further, there is evidence that the opportunities to strengthen the LMRCSC which were identified by the external panel review have been or are being addressed. A substantively revised data course was implemented to wide acclaim by the students. Students perceive they are part of a cohort of graduate and undergraduate learners that relates to the LMRCSC as an overarching Center of which they are a part, and in which they have professional peers and colleagues across the various institutions. This should only benefit and strengthen the recruitment of undergraduate to graduate students in years to come. And finally, these revisions and others suggest a highly functioning administrative culture for the LMRCSC. The leadership team is capable of affecting positive change and program enhancement and growth as data inform their work. This is a strong finding for this midpoint in this year's effort.

LMRCSC Year Final Evaluation Report
September 10, 2022

The Living Marine Resources Cooperative Science Center (LMRCSC) was "established in October 2001 as a cooperative agreement between NOAA's Educational Partnership Program (EPP), and a collective of universities to address environmental, natural resources management and STEM workforce challenges…." The mission of the Center "is to prepare a diverse student body for careers in marine and fisheries science through exemplary academic and research collaborations" (all quotes from the Project Narrative). The LMRCSC received an additional five years of funding, which began in Fall 2016. The project leadership contracted with The College of Exploration's (TCOE) Dr. Tina Bishop, Peter Tuddenham, and Dr. Howard Walters to develop and implement an external evaluation of the project. This evaluation plan was reviewed and approved by internal project leadership, and was submitted with the project proposal for review and approval by NOAA EPP. During year five, there were substantial impacts to the LMRCSC due to the SARS-COVID Emergency Response conditions which have been implemented across the nation. These were described in the annual report for year five submitted in early fall 2021. These responses included shifting of face-to-face activities to online communications methods, and numerous program planning and implementation complications which affected student research, access to laboratories and other research settings, and program participation and travel. Due to these responses, NOAA EPP issued a one year, no-cost extension to the LMRCSC to continue and finalize planned activities for the project period.

This current report is the final summary of continued evaluation efforts in this sixth year. As in previous years, the first half of the year included collection of impact assessments from undergraduate and graduate students. In addition, a revised workshop focused on student data skills, i.e., the Data Carpentry workshop, was implemented in fall 2021, to include both internal and external impact survey data collection from participants. These data are summarized for this report below. Finally, the NERTO projects are a significant programming element for the LMRCSC and in some ways, constitute a capstone science research project for participants. A NERTO completion survey was distributed in summer 2022 to students completing these NERTO projects to capture perceptions of these graduate students about the impact of these projects.

Undergraduate Student Impact Survey

A group of six undergraduate students representing Hampton University, Savannah State University, and the University of Maryland-Eastern Shore, completed a mid-year survey to identify perceptions of the program and potential impacts on their educational and career trajectories. Five indicated they are pursuing degrees in Marine and Environmental Sciences or (one) Environmental Sciences. Each has remained confirmed in their selection of college major—which is atypical as the normal pathway for undergraduates is to exhibit regular changes of major.

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Items twenty-four through twenty-six solicited additional information specific to the LMRCSC more broadly. Four of the six respondents reported little interaction with other LMRCSC institutions. All six of the respondents reported high to medium knowledge of LMRCSC as a NOAA EPP network—a strong response and further evidence of effective administrative/communications efforts in the LMRCSC. And finally, all six reported high levels of interest in continuing involvement with LMRCSC through a potential alumni organization in the future.

The remaining items, twenty-seven through thirty-two, suggest that these respondents continue to have some concerns about support structures for transitioning to graduate school, even though all six report a high level of interest in doing so. Some of their concerns relate to preparing for the GRE and identifying and transitioning to graduate schools and programs. There is evidence in these questions that many of these respondents are already interacting with graduate students and obtaining some input from program leadership and faculty at their institutions.

Graduate Student Impact Survey

A larger response pool—eighteen individuals—was obtained from the graduate students for the mid-term cycle of survey collection. It may be that this far into the program, the graduate students have grown more accustomed to receiving these information requests from the evaluation team, or simply may be more mature in viewing this as a professional responsibility and reality in the workplace. There was wide distribution of the respondents across the LMRCSC, with each of the institutions having representation in the response pool (there may have been some misinterpretation of the “home school” question, so some individuals may have pointed back to an undergraduate home school as alumni. Thirteen of the respondents are seeking MS degrees, and five are seeking Ph.D. degrees. The primary content disciplines for all of these students are marine related, suggesting strong success in the recruitment processes for LMRCSC, and a strong NOAA-aligned academic and research focus. None of the respondents have changed their focus while working within the LMRCSC. All reported undergraduate preparation in related disciplines including marine science, biology, environmental science or oceanography. One outlier is an individual respondent out of nutritional sciences tied to an agricultural orientation. Each of the respondents (item six) identified future career orientations pertaining to the professoriate or research positions, either for a university or a government agency. Three respondents specifically named NOAA as a future opportunity for employment, although most of the other responses align with NOAA mission science.

Item seven asked respondents to describe how and when they began considering a career in science. Again, this type of background information can be useful in formulating an effective recruitment plan. The largest cluster of responses (n=6) pointed back to childhood, followed by high school (3) or middle school (2) as the time when perceptions of science careers or desires for science careers began to form. This is a critical observation, as there remains some institutional perception, particularly in the federal science agencies, that targeting career recruitment education and outreach below the undergraduate level is not a valuable use of funds. For this group of graduate students pursuing STEM careers, those decisions formed in childhood and adolescence were crystalizing and powerful.

Item eight asked respondents *why* they wanted to pursue a career in science, seeking to ascertain motivation. The most interesting and powerful cluster to emerge from these response data using content analysis were the ideas of *meaning and passion*. Although the specific vocabulary differed—terms such as love, passion, joy, happiness, fun and related terms—the emergent motivation was very similar. Students perceived an affective, positive response when thinking about a STEM career. Several used the terms meaningful or fulfilling. These ideas are thoroughly consistent with adult learning principles, where adult and young adult students pursue life goals through an attachment of personal fulfillment and meaning to the pursuit. Again, this observation may be useful in planning education programs for these young adults and as an additional theoretical framework (adult learning theory) to describe the important work of the LMRSC.

Items nine through thirteen prompted very rich and lengthy narrative responses from these graduate students which described a wide range of research and/or field experiences in which they had participated as a result of LMRCSC. Clearly, this reflects that LMRCSC is aligned with and supporting NOAA Mission Science concerns in the opportunities that it is providing to its graduate students. The respondents also described powerful mentorship experiences which they had had, many of which came through LMRCSC personnel or undergraduate or graduate course faculty. Several respondents mentioned their NERTO mentors. And LMRCSC personnel, Dr. Chigbu, Dr. Dionne Hoskins-Brown, Dr. Rose Jagus, Dr. Liz Babcock and Dr. Victoria Young were mentioned specifically as valued and valuable career mentors. As a final note, it seems clear from the responses that these graduate students indeed view the NERTO assignment as an authentic and valuable research experience which has supported them professionally. Finally, thirteen of seventeen responses had received orientation to LMRCSC formally from someone at their home institution, with four additional respondents stating that they were unsure whether they had received orientation or not. Again, a positive reflection for the administrative functions of communication.

Items fourteen and fifteen sought to identify whether these graduate students had a “track record” of participation in STEM related activities from high school forward through college. The responses were rich and inspiring. The data reflect a veritable “who’s who” of the national or regional, federally funded opportunities. Responses listed the EPP MSI scholarship, NOSB, the McNair Scholar program, NSF STEM Fellow programs, and REU programs. There is support for concluding that this holistic community of scaffolded STEM experiences are functioning as somewhat of an incubation system for emerging young science scholars. This complex-systems view of the formal and informal connections among these background supports for LMRCSC students certainly has contributed to these students current “moment” and should likely be researched or evaluated as contributory factors in the LMRCSC program.

Items sixteen and seventeen reveal an interesting divergent observation. While most respondents (15/18) remain in communication with key high school teachers or undergraduate faculty members, the inverse (3/18) describes these student’s family members employment in STEM fields. As observed in other research, teachers at the secondary and post-secondary level can be valuable vectors for career pipeline development of young adults, even in the absence of parental support for these STEM disciplines.

Given this previous observation, item eighteen does demonstrate that parents who are not employed in STEM areas do value STEM careers for their children. Many of these graduate student respondents describe how parents encouraged their passion and interest in science. This encouragement was viewed as very important and memorable by these respondents.

Item nineteen asked respondents to gauge their employability in their chosen career aspirations. Fifteen of eighteen rated this as Very or Moderately employable over the next ten years. Previous concerns expressed by earlier students were absent in these ratings.

The next set of interesting data to emerge in the survey was in item twenty-one. Respondents identified the most engaging or significant LMRCSC activity from the past year. Several respondents listed the Data Carpentry Workshop, a significant and positive improvement in responses to data workshops or courses from previous years. Further, and again a notable positive observation, several respondents used the term “cohort” or “cohort experience.” In earlier years, it was difficult to ascertain whether the concept for cohort relationships was being adequately “pushed down” into the awareness of students, even though it was very much a goal of the LMRCSC leadership. Refinements to workshops and orientation (which these survey data demonstrate is happening) may have contributed, or likely contributed, to this emergence of the cohort language in the survey data. These experience responses demonstrate positive administrative oversight, growth and improvement in the program, and positive impact on the students.

Item twenty-two asked respondents to explain why the previously mentioned experience was perceived as valuable. This question elicited rich and detailed responses. Several explained how the cohort experience workshop enhanced valued work skills. This comment was made about the data workshop as well. Several described the social interactions with other students, and also the ability to meet potential mentors. Given the context of Covid response that drove this experience online last year, it was interesting to observe from several comments that the experience helped them navigate and manage the “covid era.”

Item twenty-three asked respondents to name and describe the most beneficial university course which they had taken in the past year. The intent of this question was, again, to identify the integration of LMRCSC experiences and opportunities for students with NOAA Mission Science. The courses identified by the respondents indeed demonstrated this. Courses listed included Coastal Pollution, Environmental Law, Population Dynamics, Ocean Law, and Marine Ecotoxicology among others. Fourteen of the eighteen responses were from science or science policy areas which clearly matched NOAA concerns. Interestingly, other courses mentioned—Technical Writing, Programming in R, and Skills for Team Science—overlapped the professional work skills that are also objectives for the LMRCSC and NOAA EPP.

Item twenty-four drilled explicitly into enhanced student understanding of NOAA Mission Science and Fisheries Science from this past year’s experiences. Students described a number of examples of how they had grown professionally, and the full response data set it powerful. Example quotes include:

- *My knowledge NOAA mission science has been enhanced by attending conferences and seminar series that described what role different scientists played in the NOAA mission.*
- *I have been very lucky to meet NOAA scientists and to learn more about the various areas they work in at the Gulf of Maine Research Institute this summer.*
- *Becoming a NOAA EPP/MSI Graduate Fellow helped me understand how my role as a NOAA supported student contributes to NOAA's mission and also ways that I can enhance my contributions to NOAA's mission and fisheries science.*
- *I actually recently had a meeting with Dr. Sexton that increased my knowledge on the mission statement and NOAA as a whole. Making sure to include MSI after EPP, how to address myself properly, and other important things to know were discussed. This year that knowledge was greatly enhanced.*

Items twenty-five and twenty-six were rating questions which reflected, as in earlier years, a perception that there was low to medium interaction with students and professors at other LMRCSC institutions (other than their home school), but a medium to high level of knowledge about the LMRCSC as a NOAA EPP overall. In the former case, that response pattern is not unusual and is a function of a "home school advantage" for connections and networking. In the latter case, this seems to reflect a positive growth in the LMRCSC administrative, and communications functions this past year.

As with the undergraduate students, item twenty-seven indicates a strong interest in participating in a future potential Alumni Association for the LMRCSC. Item twenty-eight continued last year's concern about Covid responses and revealed some concerns about a loss of work time on research, the loss of hands-on experience due to social distancing, and the compression of time for those students where they are attempting to maintain a completion calendar or schedule to finish schooling. Item twenty-nine solicited descriptions of changes at their home universities required by Covid. Again, these descriptions validate the responses to the prior item by revealing that the most likely mitigation efforts for Covid did indeed isolate students, eliminate interpersonal contact and limit use of labs and research capability. The final item, seeking ideas for additional supports and resources, did not reveal strong clusters of similar items that would inform practice, but the evaluators encourage the leadership at LMRCSC to review these raw data responses regardless. Two respondents did suggest a common idea of writing support for theses and dissertations which might be discussed at a leadership monthly meeting.

Data Carpentry Workshop Survey

As noted in the graduate student survey responses above, there was a very positive receptivity to the Data Carpentry Workshop in fall 2021 that carried over into the general survey for the fall semester. The evaluators did develop a short survey specifically for this workshop and include it at the end of the workshop for students to garner additional, program specific information about this LMRCSC opportunity.

Item one asked respondents how many credit hours in statistics or data management they had taken prior to this course. Four respondents indicated from 1-3 hours. Five respondents indicated from 4-6 hours, and two respondents indicated over six hours. One respondent had not taken statistics or data management coursework at all prior to this workshop. This response pattern suggests a widely divergent preparation for the student group.

Item two asked how respondents perceived the course would support or had supported their NERTO or TAB projects. Each of the twelve respondents perceived a benefit and use for the content of this course—which is a significant, positive improvement from earlier iterations of the data course and reflects significant work by the LMRCSC team to create a course that accommodated the widely divergent background preparation noted above. This is a commendable accomplishment. Item three suggests that only three of the twelve perceived the course moved too quickly (these were the students with the least background preparation via credit hours in related studies). All twelve respondents (item four) asserted that the workshop would be useful for their future career and eight respondents added open comments to expand on this. Select responses included:

- *I did not know much about any statistical tests before this workshop, it was very interesting to learn about more complex functions;*
- *Being able to use R will help with data analysis and the ability to find career opportunities;*
- *I have been hearing about R and needed an introduction but didn't know where to start on my own, so this was very valuable.*

Interestingly, item five on the survey revealed that only four of the twelve respondents perceived that the course fostered their developing relationships with other students. It is likely that the instructional modality (online) and the intensity of the content and study was not orientated to social development as was the Cohort Experience course. This is not viewed as a deficiency by the students, however. The overall rating of the course (item six) did not reflect a single negative evaluation: nine respondents rated the course as excellent and three rated it at the mid-point of the scale or as okay.

The remaining items explored the various content elements of the course and student perceptions of the value and importance of these. Item seven suggested that the data visualization skills were a strong and valuable part of the course. Item eight revealed nine of the twelve respondents perceived the sequencing of materials was appropriate and came at an appropriate moment in their academic program. The negative responses were from students who had a stronger background in statistics, and likely perceived that they were already past the difficult stage of concept development in this area. And finally, item nine records that nine of the twelve perceived that the online instructional modality was extremely or somewhat effective, with only three perceiving that it was not. One respondent qualified his/her negative rating by suggesting that the negative only applied to the course section on R, and that the other materials were very effective online. The final item (ten) solicited areas for improving this experience, and the largest cluster related to the intensity of the schedule, with suggestions that perhaps it could be disseminated over a longer time frame. Nevertheless, the evaluators discount this suggestion as it is a typical response to an intense experience, and there is no other evidence that student performance was negatively affected by the pace of instruction.

There are select, additional response data from this Data Carpentry workshop which will be reviewed holistically and included as necessary in the summer 2022, final annual report of the LMRCSC sixth year activities for this extension year. Initial review of these does not reveal any differing responses than those contained above or in the previous graduate fall survey.

Additional Evaluator Efforts (visit to SSU, participation in meetings, discussions on new evaluation plan for new funding)

As final summary of evaluator efforts this first half of the extension year, the following work effort was undertaken to maintain momentum in holistic evaluation of the LMRCSC. First, Dr. Tina Bishop visited Savannah State University and had an update conversation with Dr. Victoria Young, the LMRCSC Education Coordinator, to continue monitoring of program implementation. Second, the evaluation team regularly participated in the monthly LMRCSC Executive Committee video conference call, and on select Education Committee meetings to report formative information to the team for immediate review, and to continue to monitor project implementation. And finally, this second Covid response year has continued to foster the use of threaded email discussions and information sharing, and the evaluation team monitors and participates in these communication efforts as part of the overall administrative and communications plan.

NERTO Student Survey

The evaluators prepared and distributed a survey to students completing there NERTO project during the 2022 calendar year. This research project is a culmination of student work in the LMRCSC and has been found by previous students to contribute substantively to their preparation for eventual career success.

Twelve students completed the twenty-five question survey this year. The responses included a nearly even distribution across the four content areas around which the NERTO projects are organized (the four key NOAA science concerns) with slightly more responses in stock assessment and living resources management. All but one person out of the twelve respondents reported that they had manipulated and analyzed large data sets. The responses concerning social science implications of research evoked responses for half of the respondents as neutral; five agreed and one strongly disagreed that their work had social impacts. From these responses it appears that social sciences impacts requires additional definitional work with students, as they seem to misunderstand or understate what seems to be clear alignment with social impacts. This suggests that discussion of what social science means as related to the STEM research somewhere in the LMRCSC program orientation might be beneficial. There needs to be a better definition of social science and what the variety of social science fields and topics should be—a conclusion that has emerged over the previous five years of the LMRCSC and verbalized by several key senior personnel.

Four of the twelve respondents worked only this summer on their NERTO; two worked a semester, and two worked a full year. Several others reported working over a period of two to four years. Three respondents worked with their mentor less than five hours a week while others had much more extensive weekly engagement. For communication they used Google Meet and Zoom (predominantly) and it was mostly virtual engagement with only two students able to work in person due to continued Covid restrictions. Two respondents said their mentor had not supported their academic work and one said only little—but these responses were a small proportion overall. Fifty percent (six students) indicated their mentor supported them *significantly* related to their academic work. This may indicate a need to better define mentor support for student projects moving forward. There was similar feedback regarding mentor support for the professional careers of students. Half (six) of the mentors were deemed to be *significantly* supportive by the students. The support included developing skills, especially data analysis such as R, and helping students identify career possibilities within NOAA. Other respondents described introductions and connections with other researchers that were facilitated by the mentors; other respondents described learning research processes and participating in field work that was "beneficial career lessons in building connections with scientists that could lead to collaborations." Overall, the mentoring provided through the NERTO was highly regarded by the student participants.

The next questions focused on benefits which accrued to the participants from NERTO or LMRCSC more broadly. Respondents described developing new skills such as statistical analyses and learning how to use NOAA datasets. Others described meeting new people and networking with NOAA personnel. Other new skills included how to write papers and to communicate in English and Spanish, and learning what it is like to work in NOAA. One respondent wrote that "it was very informative to be surrounded by projects and people thinking about how their current projects fit into the broader scheme of NOAA research generally."

Item twelve asked respondents to list specific skills they learned in their NERTO project which might be beneficial in their eventual careers. Students listed: data analysis, research design, techniques for scientific writing, various data analysis techniques and procedures, and the use of several pieces of laboratory equipment. Other students listed data coding, and several lab techniques including coral husbandry and cell sorting.

Item thirteen asked students how their NERTO project had influenced their career decision. Ten of the twelve respondents agreed or strongly agreed that the project had indeed influenced their career trajectory. One person strongly disagreed, although the evaluators are not sure what that means and would need to probe more into that response to understand, as the respondent failed to clarify.

Item fourteen asked if NERTO helped with other academic work. eight out of twelve respondents agreed or strongly agreed that it helped. Two were neutral and two disagreed with the prompt.

Item fifteen asked how the NERTO project might have inspired thinking or decisions on career choices. The responses confirmed interest in fisheries work generally, and particularly in NOAA. It was perceived that the NERTO project gave insight into career paths and supported interest in modeling work. In general, NERTO narrowed down interest and helped identify what respondents wanted or didn't want to do professionally. Two respondents said it increased their interest in government science and helped visualize the daily work of a NOAA employee. Respondents agreed that it helped them gain insight into NOAA and a desire to work for NOAA. One respondent said, "It exposed me to the ins and outs of fisheries management."

To the prompt in item sixteen, Eleven of twelve respondents indicated that it helped them gain insight into NOAA and its organizational culture. And in item seventeen, ten out of twelve respondents reported that NERTO "helped create a network for success in the workforce."

Item eighteen asked about perceptions about eventual careers as a result of the NERTO project—again trying to isolate detailed understandings about the impact of this project on students' professional growth. Respondents agreed that it increased interest in a government/STEM agency career and increased interest in NOAA fisheries specifically. It showed different career possibilities and showed the positives of working for the government. One respondent said, "it showed NOAA as an organization that supports diversity." Another respondent said, "it broadened my view of fisheries management to include the stakeholder community and fishermen."

Item nineteen asked the extent to which the NERTO project mentor introduced the participant to colleagues in the field. This surprisingly led to diverse responses: four said that the mentor *significantly* introduced them to colleagues; four said quite a lot; three said a little, while only one said there was no wider introduction to colleagues in the field. This set of respondents demonstrates the strong socialization into the research community that is associated to these LMRCSC projects—beyond the academic or science skills and knowledge.

Item 20 asked about challenges respondents might have faced in their NERTO project. Several people said that having to do the NERTO virtually was a challenge. This was complicated by time issues and time zone differences. It was hard for one student to find a time that worked for both the mentor and the student. COVID was another major challenge. One student reported he/she/they contracted COVID; one mentor got COVID and COVID led to only a few weeks of in-person work for one respondent. One respondent had to delay their in-person work and that was a challenge. Other challenges were equipment malfunctions, items on back order and a lab which was relocated or under construction. One person needed to work at the lab on weekends and this created a bit of a logistical concern. Another opportunity reported by one individual was that the completion and submittal of the application for NERTO should have a website and it should use clearer language to make it easier to fill out.

Item twenty-one (the last substantive response item) solicited respondents to describe any other support they might have needed to enhance their NERTO experience. Responses included a desire for in person work opportunities, a clearer NERTO information web page (several people noted this). Other potentially constructive comments to consider included a smoother application process, better communication with EPP and CSC, and a designated support person for NERTO in the LMRCSC office to enhance communications. It should be noted that several of these suggestions seem to be in place already—suggesting that the basic issue is awareness by students and not the process itself.

Report Conclusions

It was a given that, with a second year of Covid emergency responses ongoing at the LMRCSC partner institutions, there was a possibility of program disruption. Nevertheless, the evaluation efforts for this no-cost-extension year reveal that the team has substantively adapted its project to the use of distancing and technologically mediated communications and work methods. Students, faculty, and team members demonstrate success in key project elements relying on these communication technologies.

Further, there is evidence that the opportunities to strengthen the LMRCSC which were identified by the external panel review have been or are being addressed. A substantively revised data course was implemented to wide acclaim by the students. Students perceive they are part of a cohort of graduate and undergraduate learners that relates to the LMRCSC as an overarching Center of which they are a part, and in which they have professional peers and colleagues across the various institutions. This should only benefit and strengthen the recruitment of undergraduate to graduate students in years to come. And finally, these revisions and others suggest a highly functioning administrative culture for the LMRCSC. The leadership team is capable of affecting positive change and program enhancement and growth as data inform their work.

The NERTO survey collected from a robust group of graduate students at the very end of the extension year are highly positive and promising. Even in the significant interruptions that the Covid crisis engendered, these respondents perceived that they received strong mentoring, a career-related project that allowed them to gain skills, professional networking connections, and soft-skills (writing, problem solving and critical thinking, data analysis) which will be immediately applicable in the work setting after they graduate.

The LMRCSC leadership team worked through numerous challenges the last two years, but the students themselves—while recognizing the limitations of the virtual work setting—nevertheless perceived that they were supported and were receiving strong academic experiences to prepare them for their chosen professions.

Appendix 8: Number of Direct Funded Students By Degree and Race

Degree	Black or African American	White	Asian	American Indian or Alaska Native	Native Hawaiian or Pacific Islander	Hispanic	More than one	Total
B.S.	39	2		1		1	8	51
M.S.	18	10	1		1	6	1	37
Ph.D.	12	1			1	9	3	26
Non-Degree	25						4	29
Total	94	13	1	1	2	16	16	143