Executive Summary

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

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

Goal 1: Prepare the future workforce for marine and fisheries sciences
Goal 2: Strengthen collaborations across universities to enhance academic programs in marine and fisheries sciences
Goal 3: Develop an exemplary capacity for scientific collaborations among partner institutions in the fields of marine and fisheries sciences

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

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

To accomplish Goal 2, the Center used the Virtual Campus including the use of videoconferencing, Adobe Connect, Go-To-Meeting and Blackboard, for curriculum development and seminars and to offer courses to LMRCSC students, including a NOAA NEFSC contractor located in Woods Hole, MA enrolled in the Professional Science Master's (PSM) degree program at UMES. More than thirty-three (33) NOAA scientific and administrative personnel were engaged in LMRCSC education and outreach, scientific research and administrative functions, including the planning and execution of the NOAA EPP Education and Science Forum that was held at UMES in October 2014. The LMRCSC has continued to strengthen its capability to train students and conduct research in marine and fisheries sciences and resource economics by hiring new faculty. For example, Dr. Aurea Rodrigues with expertise in molecular genetics of ichthyoplankton was hired as a Research Assistant Professor at HU. Dr. Yeong Chi, a resource economist, joined the faculty of UMES.

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

resources and communities, and (4) Sustainable fisheries and safe seafood for healthy populations and vibrant communities. They also address some of the goals, objectives and priorities listed in NMFS 2007 Strategic Plan for Fisheries Research. Examples of managed or protected species studied by LMRCSC scientists, students and their NOAA collaborators are salmon, red deepsea crab, loggerhead turtles, black sea bass, striped bass, oysters, and blue crabs.

In the area of Quantitative Fisheries, Miller et al. (OSU) completed a study on the relationship between climate, plankton communities, and forage fish diets and growth on the Oregon coast. They found that summer upwelling was associated with specific plankton communities dominated by either diatoms or flagellates, and that copepods feeding on diatoms had higher levels of 16:1w7 fatty acids, which produced significantly better growth of anchovies, which are an important prey of salmon. Stevens (UMES), Chung (UMCES) et al. began sampling for the red deepsea crab *Chaceon quinquedens* on commercial vessels, and have determined that it has a two-year reproductive cycle. They have also sequenced the cDNA coding for two crustacean metabolites that will allow them to determine for the first time the reproductive cycle and stages of the crab, and successfully produced the first age estimates for red crabs, which could lead to major changes in crustacean management. In the area of Essential Habitat, Heppell et al. (OSU) used stable isotopes to determine that loggerhead turtles exhibited ontogenetic transitions in their diets and their habitats (from oceanic to neritic) at specific times in their life-history, following maximal growth spurts. Working with the NOAA Chesapeake Bay Laboratory, L. Almodovar (UMES) developed a habitat suitability model for juvenile black sea bass in Chesapeake Bay using Ecosim with Ecopath (EwE), and matched it to existing habitat maps in the Bay. Wiley and Walker (HU) also used EwE to develop a model of striped bass recruitment in Chesapeake Bay and found that it was highly dependent on sea surface temperature. In the area of Aquaculture, Horodysky et al. (HU) determined that the NOAA Montlake fish diet produced better growth rates for aquacultured pompano than frozen mysids or two other commercial diets. In cooperation with the Milford NOAA Lab, Schott et al. (UMCES-IMET) sequenced the genome of two *Vibrio* strains (OY15 and B183), and determined that OY15 was probably *Vibrio alginolyticus* which provides probiotic inhibition against pathogenic strain B183 in cultivated oysters. In the area of Fishery Socioeconomics, Gong et al. (UMES) determined that changes in price and alternative fishing opportunities were the most important factors affecting the decision of Chesapeake Bay blue crab fishermen to enter or stay in the fishery. Therefore, LMRCSC research is contributing information necessary for management of exploited species, and conservation of protected species in the Pacific and northwest Atlantic Oceans, and Chesapeake Bay, as well as for enhancement of aquaculture.

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

A total of ~$1.9 million was collectively awarded in grants to the LMRCSC institutions during this reporting period, which has directly impacted and will continue to have positive impacts on Center activities. These funds enhanced LMRCSC research through support of its faculty and students and by development/enhancement of infrastructure. The foregoing indicate that the LMRCSC educational, research and outreach activities are addressing three of the five essential activities NOAA has identified as being important for the success of its mission: (i) "*developing, valuing, and sustaining a world-class workforce*", (ii) "*ensuring sound, state-of-the-art research*", and (iii) "*promoting environmental literacy*". Thus, the Center is making significant contributions to the training of a diverse body of students in NOAA related STEM disciplines that will help increase U.S. competitiveness in the global economy.

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

- Number of students from underrepresented communities who were trained **(# = 111; 22 Ph.D., 19 M.S., 70 B.S.)** and graduated **(# = 8; 2 Ph.D., 3 M.S., 3 B.S.)** in NOAA-mission sciences in the past six months
- Number of students who were trained **(# =143; 23 Ph.D., 36 M.S., 84B.S)** and graduated **(# =9; 2 Ph.D., 4 M.S/PSM, 3 B.S.)** in NOAA-mission sciences in the past six months;
- Number of students who completed experiential opportunities at NOAA facilities **(# =6);**
- Number of EPP funded students who were hired by NOAA **(# = 2)**, NOAA contractors **(# = 0)** and other environmental, natural resource, and science agencies at the Federal **(# = 0)**, State**,** local and tribal levels, in academia **(# = 2)** and the private sector;
- Number of NOAA science and administrative personnel engaged in CSC Education and Outreach, Scientific Research, and Administrative functions **(# = 33)**

- Number of collaborative research projects undertaken between NOAA and MSI partners in support of NOAA operations **(# = 12);**
- Number of students **(# = 2)** and faculty **(# = 0)** who participated in and completed postdoctoral level research programs in support of the NOAA mission;
- Number of peer reviewed papers published in NOAA-mission sciences by scientists (faculty, postdoctoral fellows, and students) sponsored by NOAA EPP **(# = 30);**
- Funds leveraged with NOAA EPP funds (including student support) **(# = ~$1.9 million);** and,
- Number of outreach participants engaged in NOAA mission relevant learning opportunities **(2000-3000).**

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

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

URMs = Underrepresented minorities

Summary of LMRCSC Performance Measures of Success (Research Programs)

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

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