Division of Academic Affairs

New Degree Program Approval

Routing and Signature Form

Proposed Program Title: Marine Science and Oceanography **CIP:** 30.3201

Degree Level: Master of Science

Department: _____ _____ _____

Chair/Director's Signature Date

College: Charles E. Schmidt College of Science _____ _____

Dean's Signature Date

Academic Affairs: _____ _____

Associate Provost for Programs and Assessment's Signature Date

_____ _____

Associate Provost for Planning and Budget's Signature Date

Team for Assurance of Student Learning (TASL): _____ _____

Committee Chair's Signature Date

Undergraduate Studies: _____ _____

Dean's Signature (For Undergraduate Degree) Date

Graduate College: _____ _____

Dean's Signature (For Graduate Degree) Date

UFS – GPC or UPC [circle one]: _____ _____

Chair's Signature Date

UFS – Academic Planning and Budget: _____ _____

Chair's Signature Date

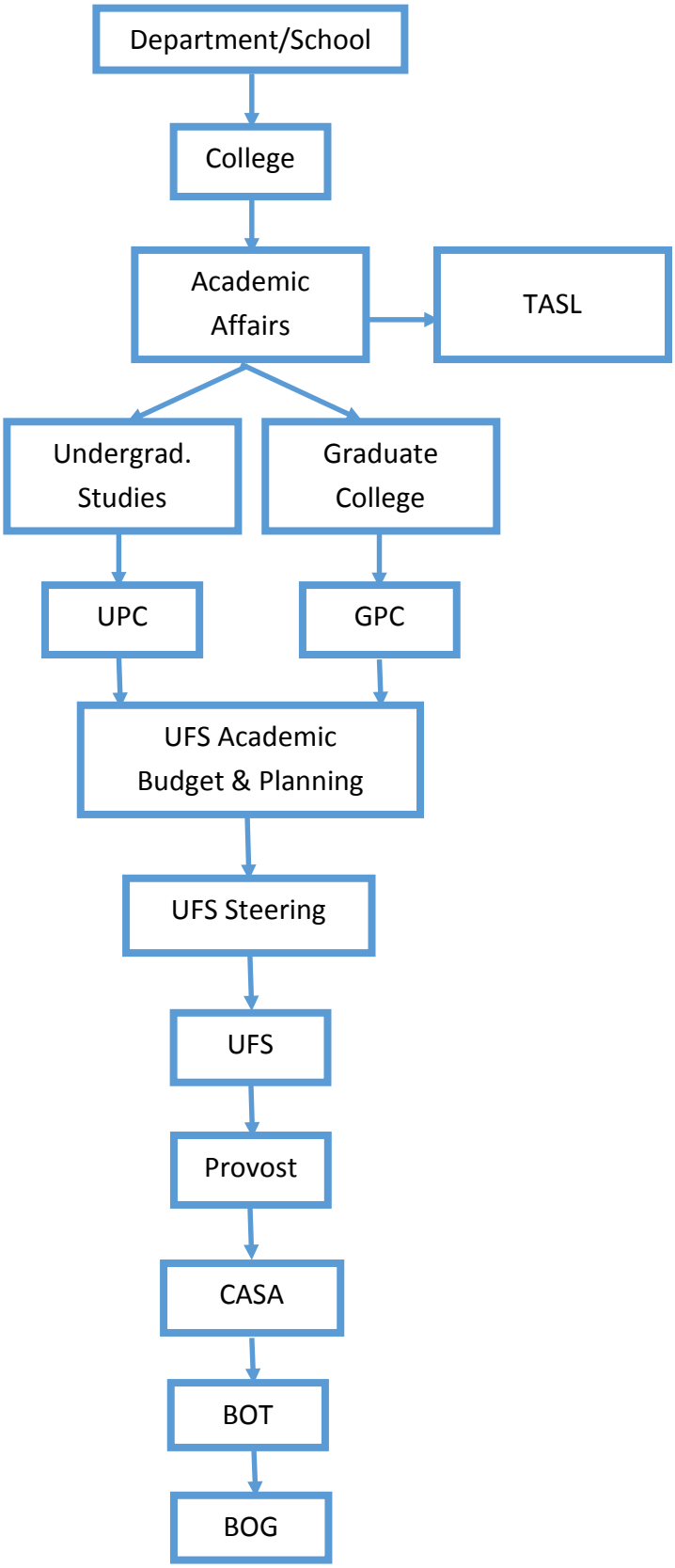
University Faculty Senate: _____ _____

UFS President's Signature Date

Provost: _____ _____

Provost's Signature Date

Routing Chart



Memorandum

To: University Program Committee

From: Sarah Milton and Peter McCarthy, Co-Directors, M.S. Program in Marine Science and Oceanography

Subject: Proposal to add new M.S. Program in Marine Science and Oceanography

Date: January 6, 2017

This memo requests approval for the creation of a new Master's Degree program in Marine Science and Oceanography (MS-MSO).

This is an interdisciplinary program designed to provide students with specialized training in Marine Science and Oceanography jointly administered by the Charles E. Schmidt College of Science and Harbor Branch Oceanographic Institute. Completion of the MS-MSO degree will provide Master's level graduate students with a broad understanding of coastal and oceanographic science, along with the research and inquiry skills necessary to independently conduct research and answer questions within their area of specialization. They should be well situated to enter the workforce ready to apply their skills to research, management and administrative questions related to coastal and oceanographic issues in research, education, government, private sector consulting and non-profit organizations. MS-MSO graduates will also be well positioned to enter the Integrative Biology-MSO track that is being put forward simultaneously with this request. The incorporation of HBOI faculty into the program will grant students an unprecedented opportunity to work directly with world class researchers in their labs and in the field. There has not been a science degree program that focused specifically on coastal and marine issues in the past, nor has there been a large selection of graduate courses offered on these topics. This track will also foster collaboration between HBOI and existing strengths at FAU in marine biology and geoscience. MS-MSO faculty are active in research and community engagement, as the expanding human population both in South Florida and worldwide is generating a need for a better understanding of coupled natural-human systems. Areas of expertise include but are not limited to: water quality issues, hydrology, marine ecology, biogeochemical cycling, both endangered and invasive species, harmful algal blooms, and urbanization. FAU marine scientists have expertise in coastal ecosystems that are of economic importance including coral reefs, estuaries, coastal marshes and mangroves, lagoonal systems, beaches, and shallow banks, as well as ecosystems of the open oceans. Primary research locations include Florida, the Bahamas, and the Caribbean.

The FAU Departments of Biological Sciences and Geoscience have individual strengths in marine and coastal sciences, with coursework in biology ranging from Marine Invertebrate Zoology to Introduction to Marine Biotechnology, and in Geosciences from GIS to Shore Erosion and Protection to Environmental Geophysics. However, the addition of coursework

taught by HBOI faculty, including courses in Physical & Geological Oceanography and Biological and Chemical Oceanography, and specialized courses in such areas as Underwater Optical Imaging and Ocean Monitoring Systems will greatly increase the course offerings in Marine Science and most importantly, promote cross-disciplinary training that will enable students to face the complex challenges of 21st century science. These areas fit directly into the new FAU Strategic Plan with clear links to the pillars of Ocean Science and Engineering/Environmental Science, Community Engagement and Economic Development, and Sensing and Smart Systems.

The attached document provides a catalog description of the proposed MS degree in Marine Science and Oceanography which is being submitted for approval simultaneously with this memo. The MS MSO track will use existing courses currently approved and no new courses need to be developed or approved to create all the required courses and learning experiences for this track. All faculty teaching are already members of the Graduate Faculty at Florida Atlantic University and are already teaching approved courses and mentoring both MS and Ph.D. students.

We are also requesting that this track appears on student transcripts as the Major under Curriculum Information. See the below example.

Curriculum Information	
Current Program	
Master of Science	
Program:	Master of Science in Marine Science and Oceanography
College:	C.E. Schmidt College of Science
Major:	Marine Science and Oceanography

Master of Science with Major in Marine Science and Oceanography

This is an interdisciplinary program designed to provide students with specialized training in Marine Science and Oceanography jointly administered by the Charles E. Schmidt College of Science and Harbor Branch Oceanographic Institute. Participating faculty have appointments at HBOI and the College of Science.

Students are required to take most of the coursework spread across the core subject areas listed below. The exact courses taken are to be determined by students and their advisory committees. The application deadline is March 15 for the fall semester.

Admissions Requirements

In addition to meeting all of the University and College admission requirements for graduate study, each applicant for the M.S. MSO program must:

1. Have a minimum of 3.0 GPA (B or better average) on the last 60 hours of undergraduate credits, or established graduate level proficiency.
2. Provide two letters of recommendation,
3. Have minimum GRE scores of 151 Verbal and 151 Quantitative for GREs taken during or after August 2011 (or a cumulative score of 1000 on the Verbal and Quantitative portions of the GRE prior to Oct 2011). GRE scores older than 5 years prior to admission will not be accepted.
4. Obtain a "sponsor" from within the faculty of the M.S. MSO program, who will then act as the student's advisor until a thesis topic has been chosen.

For sponsor selection suggestions, go to the departmental web pages to examine the fields and interests of individual faculty. When you find a faculty member in your field of interest, contact them directly. Your application package must contain a signed sponsor form from the faculty member.

Thesis Option

A student curriculum consists of a minimum of 37 credits taken in the following three categories:

Required Courses: Three courses (7 credits) are required of all M.S. MSO students. They should be taken at the beginning of the graduate program.

MSO Required Courses		
Physical & Geological Oceanography	OCE 6097	3
Biological and Chemical Oceanography	OCE 6057	3
Geosciences Colloquium Series	GEO 6920	1
Total Research Core		7

Core Subject Areas and Electives: 24 credits from the core subject areas and electives, with at least one course from each of four different core subject areas. Up to 6 credits designated as "Special Topics" courses may be taken with the approval of the Thesis Advisor.

No more than 6 credits of electives taken outside the core areas will be counted toward the degree. No courses under the 5000 level may be taken. No more than 3 credits of Directed Independent Study may be counted toward this degree.

Thesis: 3 to 6 credits.

Non-Thesis Option

A student curriculum consists of a minimum of 37 credits taken in the following three categories:

Required Courses: Three courses (7 credits) are required of all M.S. MSO students. They should be taken at the beginning of the graduate program.

MSO Required Courses		
Physical & Geological Oceanography	OCE 6097	3
Biological and Chemical Oceanography	OCE 6057	3
Colloquium	GEO 6920	1
Total Research Core		7

Core Subject Areas: A minimum of 24 credits from the core subject areas, with at least one course from each of four different core subject areas. Up to 6 credits designated as "Special Topics" courses may be taken with the approval of the student's Advisor.

Electives and Directed Independent Study: No more than 6 credits of electives taken outside the core areas will be counted toward the degree. No courses under the 5000 level may be taken. No more than 3 credits of Directed Independent Study may be counted toward this degree.

Core Subject Areas	
Marine Biology	
Marine Invertebrate Zoology	ZOO 6256
Marine Invertebrate Zoology Lab	ZOO 6256L
Biology of Sea Turtles	ZOO 6406
Biology of Sharks and Their Relatives	ZOO 6409
Natural History of Fishes	ZOO 6456
Natural History of Fishes Lab	ZOO 6456L
Seminar in Ichthyology	ZOO 6459
Histology of Fishes & Aquatic Invertebrates	ZOO 6757
Aquatic Animal Health	PCB 6772
Physiology of Marine Animals	PCB 6775
Advances in Finfish Aquaculture	BSC 6342
Marine Molecular Biology	PCB 6465
Sensory Biology & Behavior of Fishes	PCB 6871
Introduction to Marine Biotechnology	BSC 6346
Coastal and Geological Science	
Marine Global Change	OCE 6019
Shore Erosion and Protection	GLY 5575C
Marine Geology	GLY 5736C
Comparative Carbonate Sedimentology	GLY 6352
Coastal Environments	GLY 6737
Global Environmental Change	GLY 6746
Methods in Hydrogeology	GLY 6838
Coastal Hazards	GLY 6888
Advanced Topics in Applied, Coastal, and Hydrogeology	GLY 6934
Conservation and Ecology	
Natural History of the Indian River Lagoon	OCB 6810
Coastal Plant Ecology	BOT 6606
Coastal Plant Ecology Lab	BOT 6606L
Coral Reef Ecosystems	OCB 6266
Coral Reef Ecosystems/Lab	OCB 6266L
Conservation Biology	PCB 6045
Advanced Ecology	PCB 6046
Marine & Estuarine Community Dynamics	PCB 6316
Marine Ecology	PCB 6317

Marine Conservation	BSC 6936
Marine Ecology Lab and Field Studies	PCB 6317L
Biogeography	GEO5305
Restoration Implementation and Management	EVR 6358
Ecological Theory	PCB 6406
Remote Sensing and GIS	
Digital Image Analysis	GIS 5033C
Remote Sensing of the Environment	GIS 5038C
Principles of Geographic Information Systems	GIS 5051C
Applications in Geographic Information Systems	GIS 5100C
Programming in Geographic Information Systems	GIS 5103C
Advanced Remote Sensing	GIS 6039
Topics in Geoinformation Science	GIS 6120
Hyperspectral Remote Sensing	GIS 6127
Underwater Optical Imaging for Marine Scientists	OCE 6267
Marine Optics	OCE 6269
Data Processing for studies & Modeling of Marine Systems	OCB 6673
Image & Video Processing & Vision in Marine Environment	EVS 5385
Ocean Monitoring Systems & Implementation Strategies	OCE 6680
Chemistry	
Chemistry for Environmental Scientists	CHS 6611
Environmental Geochemistry	GLY 5243
Dynamics of Marine Biogeochemical Processes	OCE 6350
Statistics and Communication	
Experimental Design and Biometry	PCB 6456
Advanced Multivariate Biometry	PCB 6457
Scientific Communication	BSC 6846

** NB: Courses hi-lited in yellow are special topics courses that will be going through for course approval simultaneously with this proposal. Should they not be approved at this time they will remain as available special topics courses.

Board of Governors, State University System of Florida

Request to Offer a New Degree Program

(Please do not revise this proposal format without prior approval from Board staff)

Florida Atlantic University	**Fall 2017**
University Submitting Proposal	**Proposed Implementation Term**
CES College of Science	**HBOI/Biological Sciences/Geoscience**
Name of College(s) or School(s)	**Name of Department(s)/ Division(s)**
	MS in Marine Science and Oceanography
Academic Specialty or Field	**Complete Name of Degree**
30.3201	
Proposed CIP Code	

The submission of this proposal constitutes a commitment by the university that, if the proposal is approved, the necessary financial resources and the criteria for establishing new programs have been met prior to the initiation of the program.

Date Approved by the University Board of Trustees	**President**	**Date**
Signature of Chair, Board of Trustees	**Date**	**Vice President for Academic Affairs**	**Date**

Provide headcount (HC) and full-time equivalent (FTE) student estimates of majors for Years 1 through 5. HC and FTE estimates should be identical to those in Table 1 in Appendix A. Indicate the program costs for the first and the fifth years of implementation as shown in the appropriate columns in Table 2 in Appendix A. Calculate an Educational and General (E&G) cost per FTE for Years 1 and 5 (Total E&G divided by FTE).

Implementation Timeframe	Projected Enrollment (From Table 1)		Projected Program Costs (From Table 2)				
	HC	FTE	E&G Cost per FTE	E&G Funds	Contract & Grants Funds	Auxiliary Funds	Total Cost
Year 1	15	13.0	$20,706	$269,175	$100,000		$369,175
Year 2	37	32.0					
Year 3	51	44.3					
Year 4	61	53.2					
Year 5	73	64.1	$5,769	$369,765	$300,000		$669,765

Note: This outline and the questions pertaining to each section must be reproduced within the body of the proposal to ensure that all sections have been satisfactorily addressed. Tables 1 through 4 are to be included as Appendix A and not reproduced within the body of the proposals because this often causes errors in the automatic calculations.

INTRODUCTION

I. Program Description and Relationship to System-Level Goals

A. Briefly describe within a few paragraphs the degree program under consideration, including (a) level; (b) emphases, including majors, concentrations, tracks, or specializations; (c) total number of credit hours; and (d) overall purpose, including examples of employment or education opportunities that may be available to program graduates.

The proposed degree is a Masters of Science in Marine Science and Oceanography. The primary educational objective is to provide graduate students with a broad understanding of coastal, nearshore and oceanographic science, along with the research and inquiry skills necessary to independently conduct research and answer questions within their area of specialization. They should be well situated to enter the workforce ready to apply their skills to research, management and administrative questions related to coastal and oceanographic issues in higher education, government, private sector consulting positions and non-profit organizations. Florida is the third ranked state in the number of job postings in this category, behind California and Louisiana. Last year, the number of job postings matching this degree in the nation was 448.

This is an interdisciplinary program designed to provide students with specialized training in Marine Science and Oceanography jointly administered by the Charles E. Schmidt College of Science and Harbor Branch Oceanographic Institute. Participating faculty have appointments at HBOI and the College of Science. Students are required to take 37 total credits: 3 core courses (7 cr.) and electives totaling 24 credits with at least one course from each of four different concentrations. Areas of concentration include Marine Biology, Coastal and Geological Science, Conservation and Ecology, Remote Sensing and GIS, Chemistry, and Statistics and Communication. The Thesis option will include 3-6 credits of thesis research. The exact courses taken are to be determined by students and their advisory committees.

B. Please provide the date when the pre-proposal was presented to CAVP (Council of Academic Vice Presidents) Academic Program Coordination review group. Identify any concerns that the CAVP review group raised with the pre-proposed program and provide a brief narrative explaining how each of these concerns has been or is being addressed.

The proposal was presented on February 16, 2016. There were no formal concerns against the degree proposal. The comments that need to be addressed in the proposal are:

1) While UF was supportive of the proposal, they indicate that your description of what UF offers in this area was misrepresented/underrepresented in your pre-proposal.
2) Ditto for FSU.

The section describing the programs at UF and FSU in this document have been expanded beyond what was presented in the preproposal.

C. If this is a doctoral level program please include the external consultant's report at the end of the proposal as Appendix D. Please provide a few highlights from the report and describe ways in which the report affected the approval process at the university.

N/A

D. Describe how the proposed program is consistent with the current State University System (SUS) Strategic Planning Goals. Identify which specific goals the program will directly support and which goals the program will indirectly support (see link to the SUS Strategic Plan on the resource page for new program proposal).

How this program supports specific university and SUS missions.
The three critical points of emphasis for the 2025 goals are Excellence, Productivity and Strategic Priorities for a Knowledge Economy.

Excellence
By incorporating the HBOI research faculty into this new degree program, we will be providing an academic program of the highest quality. HBOI has already demonstrated its ability to deliver world-class research, and they have engaged with Florida's communities and businesses in meaningful and measurable ways. The HBOI faculty will now turn their attention to delivering graduate curriculum to students who will have an unprecedented opportunity to work directly with world-class researchers in their labs and in the field. The abundance of research assistants that will be available to HBOI faculty should increase the research, scholarship and commercial endeavors of the HBOI faculty. This program will also foster collaboration between HBOI and existing strengths at FAU in coastal geology and marine biology and ecology.

Productivity
This program will engage students in STEM related research projects. As coastal and marine issues become more pressing and critical for the communities across the nation and the world, FAU will produce more students who are competitive in research and management positions related to the dynamics of coastal change and marine ecology. While FAU's other science programs have faculty that engage students in these topics, there has not been a science degree program that focused on coastal and marine issues in the past, nor is there a large selection of graduate courses offered on these topics. The addition of the HBOI research faculty to this degree program provides an unprecedented opportunity to develop a degree that targets the workforce demands of the future while providing for student demands for curriculum in the marine science area. Since much of this degree program will eventually be delivered as online or distance learning curriculum, access to students will be easier than with traditional degrees that require on site attendance for all activities related to degree completion.

Strategic Priorities for a Knowledge Economy
One of the priorities of the BOG Strategic Plan is to increase the number of degrees in STEM and other areas of strategic emphasis. As communities in south Florida experience a growing awareness of the long-term impacts of sea level rise, there will be a corresponding increase in critical needs related to coastal and marine issues. Graduate students will find that the wide range of courses and diverse research opportunities will facilitate the transition from the MS degree into the existing Ph.D. degrees in Integrated Biology and Geoscience. It is expected that the level of knowledge and expertise in applied areas related to coastal and marine science will grow and that the reputation of FAU graduates will become widely known, due to the diverse research opportunities afforded students through both the University and also through Harbor Branch.

The research expertise of the faculty includes numerous subject-areas of economic importance, including:

- Expertise in several coastal ecosystems that are important fisheries habitats including coral reefs, estuaries, coastal marshes and mangroves, lagoonal systems, beaches, shallow banks, as well as ecosystems of the open oceans and seas. These include the Gulf Stream, the Sargasso Sea, deep-sea island shelves, deep reefs, and the polar seas. Primary research areas include Florida, Bahamas, the Caribbean, and Alaska.
- Research on important economic and ecological animal, plant and microbial groups. This includes sea turtles, wading birds, manatees, whales, dolphin, sharks, bill fish, pelagic fish, reef fish, estuarine fish, corals, sponges, conch, crabs, and other invertebrates, along with seagrass, macroalgae, phytoplankton, mangroves, and marshes.
- Nutrient cycling and harmful algal blooms related to anthropogenic pollution, sediment biogeochemistry, invasive aquatic species, impacts of point and non-point source pollution, pollution remediation, diseases of marine organisms, and human pathogens in the marine environment.
- Cutting edge technology in research in the deep sea and coastal zones, including the deployment of oceanographic vessels, autonomous underwater vehicles (AUVs), deep-sea submersibles, submersible cameras, and networked and single-unit data logging equipment for remote analysis of water quality information.
- Biotechnological advances in the areas of drug discovery and aquaculture.
- Data processing utilizing state-of-the-art mathematical modeling and statistical techniques, and the application of mapping visualization tools, such as Geographic Information Systems, to analyze and convey the complex nature of marine ecosystems and processes.
- The application of current molecular techniques to understand physiological mechanisms and population dynamics of important keystone animal and plant species within marine ecosystems.
- The deployment of satellite-linked telemetry to study the movement and behavior of wading birds, fish, sea turtles, and mammals.

FAU's 2012-2017 Strategic Plan and signature themes

The FAU's 2015-2025 strategic plan for Race to Excellence identifies signature pillars and platforms some of which will be addressed through this new degree program. In fact, this new degree proposal is a cornerstone for one of these signature pillars: Ocean Science and Engineering/Environmental Science. The platforms such as Community Engagement and Economic Development; Leadership, Innovation and Entrepreneurship; and Big Data Analytics are addressed through college departments working with external partners. The pillar on Sensing and Smart Systems with the College of Engineering and Computer Sciences is enhanced by interactions with HBOI's Ocean Engineering and Technology group and FAU's Department of Geoscience GIS labs.

Charles E. Schmidt College of Science Tactical Plan in support of the University Strategic Plan
One of the goals of the College's tactical plan is to enrich the educational experience of students. Strategy 5 involves increasing the number of online course offerings. Some Harbor Branch courses will be developed into synchronous online courses. Objective B is also met by strengthening and expanding graduate programs, including Strategy 3, which requires increasing the number of affiliate faculty involved in the graduate programs (14 faculty from Harbor Branch). Strategy 4, which aims to increase funding for stipends from nontraditional sources is met by the Indian River State College arrangement where the State College hires FAU students as instructors, and FAU provides tuition waivers within the confines of the tuition waiver budget at Harbor Branch. In addition, HBOI scientists have strong ties to industry, in particular in the fields of engineering and remote sensing, drug discovery, and aquaculture, which may provide opportunities for both research support and internships. Increased collaboration between different departments will also encourage applications to new funding agencies, many of which favor cross-disciplinary research.

E. If the program is to be included in a category within the Programs of Strategic Emphasis as described in the SUS Strategic Plan, please indicate the category and the justification for inclusion.

The Programs of Strategic Emphasis Categories:

1. Critical Workforce:
   - Education
   - Health
   - Gap Analysis
2. Economic Development:
   - Global Competitiveness
3. Science, Technology, Engineering, and Math (STEM)

Please see the Programs of Strategic Emphasis (PSE) methodology for additional explanations on program inclusion criteria at the resource page for new program proposal.

1. Critical Workforce:

Education: The broad education received by the students will make them capable teachers filling the critical workforce need that has been identified in education, particularly in the STEM areas.

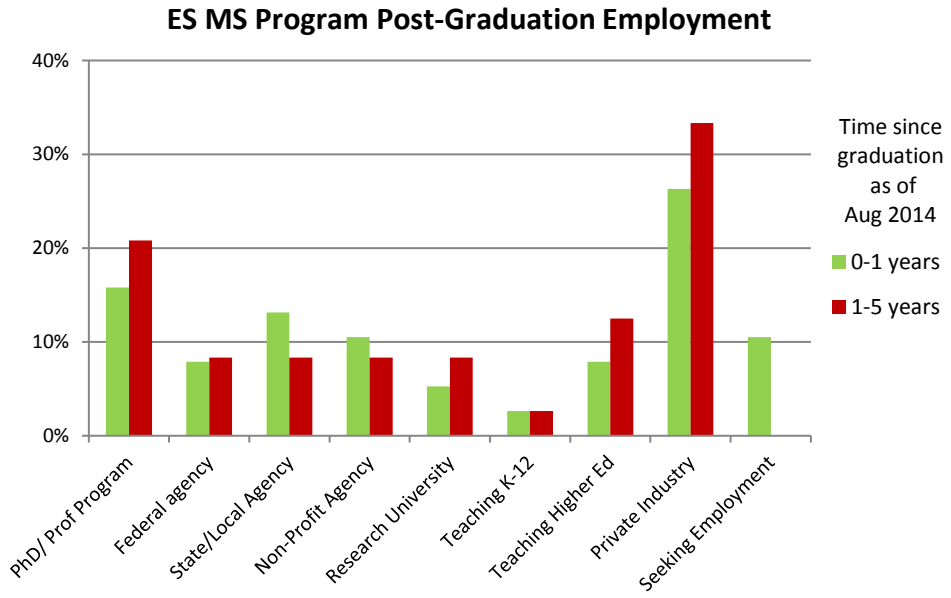
2. Economic Development:

Global Competitiveness: HBOI is a world leader in such fields as aquaculture, the development of underwater sensors, and the development of new therapeutic agents from marine organisms. Each of these areas has been driven by a combination of academic research and collaboration with for-profit partners with the goal of developing products which are competitive in global markets. In addition, South Florida in general is a highly populated, highly developed area surrounded by fragile environments, and thus is at the forefront for studies of coupled human-natural systems, including such problems as climate change and the impacts of sea level rise and increased storm activity on e.g. shoreline stabilization, agriculture, and freshwater resources. Thus research performed at FAU will be globally significant.

3. Science, Technology, Engineering, and Math (STEM)

The MS in Marine Science and Oceanography offers coursework, field, and laboratory training at the graduate level in a wide array of science, technology and engineering disciplines. These early career scientists and engineers will be entering Florida's workforce with the capabilities to fill emerging needs. This addresses STEM development in "Natural Sciences and Technology" as identified in the Programs of Strategic Emphasis.

In a recent (2014) study performed by the Environmental Sciences program at FAU (the current program most related to the proposed degree), 25-35% of recent graduates were involved in industry, 10-15% were involved in education, and approximately 25% were working in government or private agencies (Figure below).



The new program will provide graduates into the workforce with expertise pertaining to a number of areas identified in Appendix B of the Resource page for New Program Proposals as important to industry, including: STEM and STEM teachers, Life Sciences, Optics and Photoptics, Environmental Consulting, Biotechnology, Pharmaceuticals, Clean/Green Energy, Future supply and quality of water, and Modelling/Statistics.

F. Identify any established or planned educational sites at which the program is expected to be offered and indicate whether it will be offered only at sites other than the main campus.

The program will be offered via courses at both HBOI and other FAU campuses. The first semester for incoming graduate students will consist of core course with field and lab components offered only at HBOI. Following semester coursework may be taken at HBOI, the Boca campus, or the Davie campus depending on interests of the individual student. Many courses will include a distance learning component so that they may be attended from any campus.

INSTITUTIONAL AND STATE LEVEL ACCOUNTABILITY

II. Need and Demand

A. Need: Describe national, state, and/or local data that support the need for more people to be prepared in this program at this level. Reference national, state, and/or local plans or reports that support the need for this program and requests for the proposed program which have emanated from a perceived need by agencies or industries in your service area. Cite any specific need for research and service that the program would fulfill.

The survey conducted by Market Research Associates of Graduates in coastal and marine sciences within the State of Florida (completed in September 2014) showed that they are generally employed in Higher Education (59%) and Government (39%; Federal, State, and Local) positions. Smaller numbers find employment with non-profit organizations and in consulting positions. In 2014 the nationwide numbers of job postings requiring a graduate degree in the field of marine science has increased by 4.2% from 430 to 448.

Research universities drive employer demand for marine and coastal science graduate degree-holders in Florida; all of the 11 metropolitan areas with the most job postings for marine and coastal science graduate degree-holders host at least one large research university.

While other marine and coastal science programs establish partnerships with local marine laboratories and agencies, FAU has its own internal but independent research institute, Harbor Branch, which makes the program unique. Students will be taking core curriculum with HBOI research faculty, and will have many opportunities to take additional courses and work in many lab environments with researchers that have external funding and existing partnerships outside of FAU, on both basic and applied research projects. This is in addition to the College of Science research faculty who have established and funded research programs in Biology and Geoscience. FAU has also established partnerships with such institutions as the Smithsonian Marine Station at Ft. Pierce and the USGS on the Davie campus, which offer additional training and research opportunities.

B. Demand: Describe data that support the assumption that students will enroll in the proposed program. Include descriptions of surveys or other communications with prospective students.

Demand for Graduates in Marine Science and Oceanography

A Google survey was conducted of the students in the IFP class Environment and Society in the Fall of 2015. There were 228 respondents. Of these, 59% indicated that they had an interest in pursuing a graduate degree in coastal and marine science, 57% said that they would apply to one if there was one at FAU, and 45% said they were looking elsewhere for such a degree. While we currently offer students MS degrees in Biology, Environmental Science and Geoscience that allow them to focus somewhat on coastal and marine science issues, we are losing students because they want degrees that allow them to concentrate on these topics and credential their expertise in these areas. Adding more than a dozen new Harbor Branch graduate courses taught by faculty who are primarily researchers with established research labs will greatly strengthen the exposure of our graduate students to marine research.

In the comments section of the Google survey, several indicated excitement at the concept of a joint FAU College of Science and FAU Harbor Branch degree, and several suggested that the strength would be the diversity of potential coastal and marine classes at FAU versus the limited focus on Marine Biology in other SUS graduate programs. A biology undergraduate advisor, Glenn Malone has stated that we will fill the program quickly as many biology majors are seeking a Marine Science Masters degree after their major at FAU in which they develop an interest in marine science but find the existing MS programs in Environmental Science, Biological Science and Geoscience are not sufficiently focused on marine and coastal issues. A degree that adds the research courses, faculty and labs at HBOI along with courses across the marine and coastal disciplines at FAU would suit these students well.

C. If substantially similar programs (generally at the four-digit CIP Code or 60 percent similar in core courses), either private or public exist in the state, identify the institution(s) and geographic location(s). Summarize the outcome(s) of communication with such programs with regard to the potential impact on their enrollment and opportunities for possible collaboration (instruction and research). In Appendix C, provide data that support the need for an additional program.

Within the State system three schools offer strong Masters Programs in Marine Science: the University of South Florida, the University of Florida and Florida State University.

USF offers MS programs through the College of Marine Science, which fall into four broad oceanographic categories – biological, chemical, geological and physical oceanography – and for each a concentration in Marine Resource Assessment is offered.

UF offers programs leading to an MS degree in Botany and Zoology through the College of Liberal Arts and Sciences and allows a concentration in marine studies by working with the faculty at the Whitney Laboratory for Marine Biosciences. Research specializations include ecology, evolution, behavior, development, comparative and environmental physiology, molecular biology, neurobiology, genetics, and phylogenetics. Their work ranges from problems at the genomic level to analyses of ecosystems. They have ongoing research in a variety of terrestrial and aquatic environments, across geographic regions (tropics through subpolar), and on a range of organisms. The program involves laboratory and field-based studies as well as theoretical work in their areas of expertise. In addition, the School of Forest Resources and Conservation; Fisheries and Aquatic Sciences department offers an MS in Fisheries and Aquatic Sciences which focuses on sustainable fisheries, aquaculture, aquatic animal health, and conservation and management of aquatic environments. The School also offers a GIS Master's degree program with a Geomatics graduate concentration. Geomatics is also offered as a non-thesis on-line MS program.

FSU offers MS degrees through the faculty in the Department of Biological Science and the affiliated faculty at their Coastal and Marine lab offers opportunities for graduate studies. Marine biological research in the Department of Biological Science has three main foci: (1) the use of marine organisms as effective models for investigating basic processes relating to neurobiology, cellular & subcellular mechanisms, behavior, and ecology; (2) the identification of morphological, physiological, behavioral, and evolutionary adaptations of living organisms to the unique milieu of the marine environment; (3) the assessment of mechanisms underlying the operation of marine populations and communities as they pertain to fisheries and other living marine resources. The Earth, Ocean and Atmospheric Department offers an MS program in one of three

areas of Oceanography: Biological (focusing on a variety of organisms from microbial communities to large marine mega-fauna at tropical to polar oceans and from the land-ocean interface to deep-ocean); Chemical Oceanography and Biogeochemistry (studying the mechanisms that control the distribution of elements and compounds in the atmosphere, ocean, coastal waterways, and sediments on the sea floor); or Physical (focusing on the interaction between oceans and atmosphere and how that interaction influences and shapes our world) and a non-thesis option in Aquatic Environmental Science designed to serve working professionals and undergraduate science majors.

Other schools offer MS programs in which Marine Biology can be an option. These include: the University of West Florida (MS Biology, MS Biology Coastal Zone Studies (non-thesis), and MS Biology, Environmental Biology (non-thesis)); and Florida Gulf Coast University where the MS in Environmental Sciences degree offered through the Department of Marine and Ecological Studies is an integrated study of ecosystems (from uplands to coastal systems), environmental education and public outreach.

Since this is the first proposed Marine Science CIP 30.3201 in the FL SUS, it was not possible to separate out the other university Marine Science students, as the CIP codes for their degrees include non-Marine Science foci, such as the MS in Biology. Using the CIP 40.0607 Oceanography, Chemical and Physical, we found 64 beginning graduate students in 2014 at FSU and USF through the Governors Interactive Data Source.

D. Use Table 1 in Appendix A (1-A for undergraduate and 1-B for graduate) to categorize projected student headcount (HC) and Full Time Equivalents (FTE) according to primary sources. Generally undergraduate FTE will be calculated as 30 credit hours per year and graduate FTE will be calculated as 24 credit hours per year. Describe the rationale underlying enrollment projections. If students within the institution are expected to change majors to enroll in the proposed program at its inception, describe the shifts from disciplines that will likely occur.

Graduate students for the program will be drawn from in-state and out-of-state populations. We expect to draw on both populations in the first year based on the level of interest that has already been expressed in such a program. In Year 1 we anticipate that 15 students will enroll and will include 3 from out-of-state. The in-state students will be FAU graduates, many of whom are likely to have taken the CES College of Science/Harbor Branch Semester-by-the-Sea program that is held each spring at Harbor Branch, and also students from other Florida public and non-public universities. A full course load will be 19 credits in the first year of the program and 18 in the second. In order to account for students who take less than the full load the FTE has been calculated at 16.5 credits per student.

The second enrollment year will see an increase to 22 new students entering the program from sources similar to those described for Year 1. This will bring the cumulative headcount to 37 students enrolled in the program in year 2.

According to statistics obtained from the FAU Graduate College, MS students take an average of 2.66 years (2 years + 2 semesters) to graduate if taking the thesis option. Students graduate in 2 years if taking the non-thesis option. Based on these numbers it is expected that 75% of the

students will complete within 2 to 2.66 years and all students will finish within 4 years.

In Year 3 the student body will include newly enrolled students, those completing their second year and also students enrolled in Year 1 who are continuing their studies into a third year.

We will work to gain an international reputation for the program and by Year 3 we expect to enroll our first international student. These students will be attending FAU at either their own expense or on a grant from their home country, we expect that these students will be full-time and are accounted as such in the FTE calculation.

Our Year 3 cumulative headcount will be 51 students (44.3 FTE). This will increase to 61 students (53.17 FTE) in Year 4, and 73 students (64.1 FTE) in Year 5. By Year 5 our expected enrollment will be 63% in-State, 27.4% out-of-State, and 9.5% International students.

We anticipate that the dropout rate will be low for this program and in line with other programs at FAU. It is anticipated that 80-90% of the students enrolled in this degree program will complete the degree. It is also anticipated that some of the students will complete a Master's degree along the way as they pursue their Ph.D. degree.

Students working with the Marine Science faculty in other disciplines might change majors in the first year. Only coursework that is part of the existing degree program can be counted towards the degree, transference of credits from previous degree programs will not be allowed.

E. Indicate what steps will be taken to achieve a diverse student body in this program. If the proposed program substantially duplicates a program at FAMU or FIU, provide, (in consultation with the affected university), an analysis of how the program might have an impact upon that university's ability to attract students of races different from that which is predominant on their campus in the subject program. <u>The university's Equal Opportunity Officer shall review this section of the proposal and then sign and date Appendix B to indicate that the analysis required by this subsection has been completed</u>.

Graduate students are drawn from both local and out-of-state populations. There were 228 respondents to a Google survey of the students in the IFP class Environment and Society in the Fall of 2015. Of these, 59% indicated that they had an interest in pursuing a graduate degree in Coastal and Marine Science, 57% said that they would apply to one if there was one at FAU, and 45% said they were looking elsewhere for such a degree. Underrepresented minorities will be well represented as FAU is the most ethnically diverse institution in the State of Florida (27th nationwide). Minorities currently make up 35% of the FAU enrollment, and FAU is designated by the DOE Office of Postsecondary Education as a minority serving institution. At FAU, for example, undergraduate and graduate students with a Biological Sciences Major have the ethnic composition of 43% white, 19% black, and 24% Hispanic and 3% non-resident aliens. Indeed, of the 30,429 students enrolled at FAU (all colleges) in fall 2013 whose ethnicity was known, 16,810 were white and 13,619 were URM. Over the last five years, black and Hispanic enrollments have increased more than that of any other groups; FAU's student body will soon be a "majority minority" mirroring the predicted demographic composition of the USA in the near future. Thus there is already a large and diverse pool of students from which this program can recruit.

Approximately 17% of the graduate students in Biology belong to underrepresented minority groups. This number continues to grow each year and we assume that it will eventually reach numbers similar to the undergraduate distribution of 45% URM.

At the CAVP meeting where the pre-proposal was presented, no OCR review was requested.

This information has been reviewed and approved by Katrina Oliver, J.D., Executive Director Equity, Inclusion, and Compliance for Florida Atlantic University (signature below)

III. Budget

A. Use Table 2 in Appendix A to display projected costs and associated funding sources for Year 1 and Year 5 of program operation. Use Table 3 in Appendix A to show how existing Education & General funds will be shifted to support the new program in Year 1. In narrative form, summarize the contents of both tables, identifying the source of both current and new resources to be devoted to the proposed program. (Data for Year 1 and Year 5 reflect snapshots in time rather than cumulative costs.)

All except one of the faculty participating in the degree program are current faculty holding full time positions at FAU, the other faculty member participating is an OPS employee. The majority of the faculty at Boca Raton and at Davie campuses are already teaching courses that will be part of the new degree program. The impact on these FAU faculty will be minimal, with 15 students in the first year, and over 30 courses offered across the campuses, it is expected that the additional load for all FAU faculty combined will be the equivalent of 0.26 PY ($18,409 based on current salaries and benefits for the Faculty listed in Table 4, with one student from the new degree program participating in a class of seven or two in a class of 14). These salary and benefit costs were calculated from the actual salary and benefit costs for CES College of Science tenure and tenure track faculty teaching an existing 3 credit course which is offered as an elective in the new program. The cost is calculated as 0.035% effort (1 student in a class of 7). These faculty salary costs ($18,409) will be reallocated from existing E&G expenses; the base before reallocation ($128,860) is calculated as the E&G cost to provide the full teaching load for the 3 credit courses offered as electives in Year 1 of the program. College of Science faculty offering courses that are included as part of this degree program will not necessarily teach the courses every year, therefore, Table 4 shows effort in years 1 and 5 for some of the faculty and other faculty would have effort in years 2 and 4. The Biology and Geoscience graduate programs will benefit from the new degree program by increasing the number of students in small graduate classes. This increased enrollment may avoid courses with low enrollment being cancelled.

In addition, the Administrator salaries (P. McCarthy (0.3 FTE, $51,062, including fringe benefits) and S. Milton (0.25 FTE, $32,759, including fringe benefits)) will be reallocated from the Harbor Branch and CoS budgets, respectively. The administrative budget to cover three months of S. Milton's salary will be discussed with the Chair of Biological Sciences and the new Dean of CES College of Science. Administrative support (0.5 FTE A&P, $46,242 and 0.1 FTE USPS, $5,845) will be provided as a redistribution of duties from existing members of the Harbor Branch administrative staff in Year 1, however, over the course of the 5 years as this program expands this will need to be considered as a program expense.

The majority of the new costs are associated with the Harbor Branch Research Faculty who are currently hired on contracts and grants. The costs for the five new graduate courses offered each semester at Harbor Branch will be $110,875 in year 1 and increasing to $114,201 in year 5 due to faculty and staff salary increases (3%). OPS salary support plus fringe ($3,983) is included for one adjunct faculty member (W. Louda) who is co-teaching one of the Core degree courses each year.

In some cases, students will be supported by Assistantships and Fellowships associated with research grants and contracts. Faculty will seek such funding to support students, which is estimated to be $50,000 in Year 1 rising to $150,000 by Year 5. Students will also have the opportunity to apply for scholarships from Philanthropic awards such as those awarded by the Indian River Lagoon Graduate Student Fellowship and the FAU Harbor Branch ForEverglades Scholarship. This support is estimated to be $50,000 in Year 1 rising to $150,000 by Year 5. We are requesting that Teaching Assistantships be included for this program: by Year 5 we will have 73 students enrolled and are requesting 7 Teaching Assistantships at a total cost of $92,634, calculated at a rate of $4,818 for Fall and Spring semesters and $3,212 for Summer semester plus benefits.

It is anticipated that grants and scholarships will cover 40-50% of the student assistantships and also their tuition. Some students will be eligible to apply for tuition waivers and other students will cover their costs to attend graduate school including covering their own tuition. These other sources of revenue will help to ensure that this degree program has a sustainable budget to support its expenses and growth.

We do not anticipate other expenses or capital outlay such as the purchase of new equipment or supplies and material for the program. Students will be working in research labs where the acquisition of new equipment and supplies and materials are from research grants and contracts. Student use of such items will be a component of the overall operation of the degree program.

B. Please explain whether the university intends to operate the program through continuing education, seek approval for market tuition rate, or establish a differentiated graduate-level tuition. Provide a rationale for doing so and a timeline for seeking Board of Governors' approval, if appropriate. Please include the expected rate of tuition that the university plans to charge for this program and use this amount when calculating cost entries in Table 2.

N/A as the program will use the standard tuition rates.

C. If other programs will be impacted by a reallocation of resources for the proposed program, identify the impacted programs and provide a justification for reallocating resources. Specifically address the potential negative impacts that implementation of the proposed program will have on related undergraduate programs (i.e., shift in faculty effort, reallocation of instructional resources, reduced enrollment rates, greater use of adjunct faculty and teaching assistants). Explain what steps will be taken to mitigate any such impacts. Also, discuss the potential positive impacts that the proposed program might have on related undergraduate programs (i.e., increased undergraduate research opportunities, improved quality of instruction associated with cutting-edge research, improved labs and library resources).

No programs are impacted by a reallocation of resources. Undergraduate programs are not impacted, since the new graduate courses are being taught by research faculty who have not had teaching assignments in the past. The positive benefits are that undergraduates have long wanted FAU to have a stronger focus on marine and coastal science. Opportunities for undergraduate research can also be expected to increase as additional graduate students work with faculty in the marine sciences and oceanography; undergraduates often assist graduate student projects and are trained by them for independent research. Another positive impact is that low enrollment graduate classes offered in Geoscience and Biology will have a small amount of increase enrollment that will grow over the next five years. Since there are many options among existing graduate courses, this will probably be a small impact across the college, but courses that could not be offered regularly due to low enrollments will make enrollment targets, while courses that were traditionally run with small numbers of student will increase in size. This program is also likely to increase enrollment in the FAU Integrated Biology doctoral program as students complete the MS degree and move into doctoral programs. The IB Ph.D. program is in the process of adding a Marine Science and Oceanography concentration that is expected to be approved prior to or simultaneously with this degree proposal.

D. Describe other potential impacts on related programs or departments (e.g., increased need for general education or common prerequisite courses, or increased need for required or elective courses outside of the proposed major).

The program proposes to offer five graduate courses each Fall and Spring semester taught by Harbor Branch faculty. All the anticipated supporting graduate courses already exist within the college. It is conceivable that the growth of marine science graduate education will stimulate interest in developing an undergraduate curriculum.

E. Describe what steps have been taken to obtain information regarding resources (financial and in-kind) available outside the institution (businesses, industrial organizations, governmental entities, etc.). Describe the external resources that appear to be available to support the proposed program.

The program has access to research programs and resources that are sponsored by industrial and governmental collaborators. This includes groups whose focus is aquaculture, biotechnology, and engineering. The program also has close connection to research programs sponsored by the US Geological Survey, the National Park Service, the Army Corps of Engineers and the Navy.

IV. Projected Benefit of the Program to the University, Local Community, and State

Use information from Tables 1 and 2 in Appendix A, and the supporting narrative for "Need and Demand" to prepare a concise statement that describes the projected benefit to the university, local community, and the state if the program is implemented. The projected benefits can be both quantitative and qualitative in nature, but there needs to be a clear distinction made between the two in the narrative.

The expanding human population in South Florida is generating a need for more environmental professionals**.** This provides unique opportunities for the study of coupled natural-human systems, in diverse subtropical ecosystems, including developed and undeveloped coastlines, large estuaries, and coastal waters. These provide opportunities to study aspects of global change, including water quality, hydrology, coastal geology, biogeochemical cycling, both

endangered and invasive species, harmful algal blooms, and urbanization. These studies will have economic impacts as FAU marine scientists have expertise in several coastal ecosystems that are important fisheries habitats including coral reefs, estuaries, coastal marshes and mangroves, lagoonal systems, beaches, shallow banks, as well as ecosystems of the open oceans and seas. Primary research areas include Florida, Bahamas, and the Caribbean.

The research of FAU marine scientists also focuses on important economic and ecological animal, plant and microbial groups, including sea turtles, wading birds, manatees, whales, dolphin, sharks, bill fish, pelagic fish, reef fish, estuarine fish, corals, sponges, conch, crabs, and other invertebrates, along with seagrass, macroalgae, phytoplankton, mangroves, and marshes.

FAU marine scientists and engineers have expertise in nutrient cycling and harmful algal blooms related to pollution problems, sediment biogeochemistry, invasive aquatic species, impacts of point and non-point source pollution, pollution remediation, diseases of marine organisms, and human pathogens in the marine environment.

FAU coastal geologists have expertise in Geographic Information Systems, hydrogeology, coastal morphodynamics, and global environmental change.

The program will provide opportunities for students to train in a broad range of disciplines within Marine Science and Oceanography. Enrollment is expected to increase to provide an ongoing headcount of at least 70 students at an E&G cost per Student FTE of $5,769. The multi-disciplinary nature of the program and the demand for students trained in these fields will attract both in-state students (approx. 63% by year 5) and out-of-state and international students (approx. 36% combined by year 5).

V. Access and Articulation – Bachelor's Degrees Only

A. If the total number of credit hours to earn a degree exceeds 120, provide a justification for an exception to the policy of a 120 maximum and submit a separate request to the Board of Governors for an exception along with notification of the program's approval. (See criteria in Board of Governors Regulation 6C-8.014)

N/A

B. List program prerequisites and provide assurance that they are the same as the approved common prerequisites for other such degree programs within the SUS (see link to the Common Prerequisite Manual on the resource page for new program proposal). The courses in the Common Prerequisite Counseling Manual are intended to be those that are required of both native and transfer students prior to entrance to the major program, not simply lower-level courses that are required prior to graduation. The common prerequisites and substitute courses are mandatory for all institution programs listed, and must be approved by the Articulation Coordinating Committee (ACC). This requirement includes those programs designated as "limited access."

If the proposed prerequisites are not listed in the Manual, provide a rationale for a request for exception to the policy of common prerequisites. NOTE: Typically, all lower-division courses required for admission into the major will be considered prerequisites. The curriculum can require lower-division courses that are not prerequisites for admission into the major, as long as those courses are built into the curriculum for the upper-level 60 credit

hours. If there are already common prerequisites for other degree programs with the same proposed CIP, every effort must be made to utilize the previously approved prerequisites instead of recommending an additional "track" of prerequisites for that CIP. Additional tracks may not be approved by the ACC, thereby holding up the full approval of the degree program. Programs will not be entered into the State University System Inventory until any exceptions to the approved common prerequisites are approved by the ACC.

N/A

C. If the university intends to seek formal Limited Access status for the proposed program, provide a rationale that includes an analysis of diversity issues with respect to such a designation. Explain how the university will ensure that Florida College System transfer students are not disadvantaged by the Limited Access status. NOTE: The policy and criteria for Limited Access are identified in Board of Governors Regulation 6C-8.013. Submit the Limited Access Program Request form along with this document.

N/A

D. If the proposed program is an AS-to-BS capstone, ensure that it adheres to the guidelines approved by the Articulation Coordinating Committee for such programs, as set forth in Rule 6A-10.024 (see link to the Statewide Articulation Manual on the resource page for new program proposal). List the prerequisites, if any, including the specific AS degrees which may transfer into the program.

N/A

INSTITUTIONAL READINESS

VI. Related Institutional Mission and Strength

A. Describe how the goals of the proposed program relate to the institutional mission statement as contained in the SUS Strategic Plan and the University Strategic Plan (see link to the SUS Strategic Plan on the resource page for new program proposal).

The identified mission of the SUS is to "….provide undergraduate, graduate and professional education, research, and public service of the highest quality…". The goals of the proposed Masters of Science in Marine Science and Oceanography degree are to provide graduate students with a broad understanding of coastal, nearshore and oceanographic science, along with research and inquiry skills in their area of specialization. The new program will thus enhance both graduate education and public service in fields important not only to South Florida but globally by producing graduates well situated to enter the workforce ready to apply their skills to research, management and administrative questions related to coastal and oceanographic issues. Graduates are expected to enter into higher education, government, private sector consulting positions and non-profit organizations.

The areas of faculty expertise in the new program, from coastal engineering to aquaculture to endangered species biology, will support the state universities' mission to:

a. Support students' development of the knowledge, skills, and aptitudes needed for success in the global society and marketplace.

i. The MS MSO degree will provide cross-disciplinary training with a core curriculum in physical, chemical, physical, and biological oceanography, with additional coursework in areas of specialization in Conservation and Ecology, Marine Biology, Remote Sensing and GIS, Coastal and Geological Sciences, and Communication. Field and laboratory intensive courses, as well as seminar and thesis work, will prepare students for the workplace with practical experience and strong communication skills.

b. Transform and revitalize Florida's economy and society through research, creativity, discovery, and innovation.
   i. Participating faculty in the program are world-renowned in their fields, with strong records of publication, grantsmanship, and discovery.

c. Address the significant challenges and opportunities facing Florida's citizens, communities, regions, the state, and beyond.
   i. The MS MSO program will train students in a variety of areas relevant to citizens of Florida, the Southeastern United States, and worldwide. The aquaculture program at HBOI, for example, directly addresses the global need to increase sustainable food production, while the drug discovery program seeks to develop sources of novel pharmaceuticals from marine sources. Coastal geologists address issues related to erosion, beachfront development, and restoration, and there are strong FAU programs in endangered species (sea turtle) research and ocean acidification.

d. Deliver knowledge to advance the health, welfare, cultural enrichment, and economy through community and business engagement and service.
   i. Science at both FAU Colleges and HBOI include a strong culture of community and business engagement: FAU's main campus hosts bi-monthly "Frontiers in Science" public lectures, while at HBOI the Ocean Science Lecture Series provides a forum for the community at large to learn about Harbor Branch's most recent discoveries directly from the scientists who made them and from their colleagues at other institutions who work on topics relevant to Harbor Branch's research themes. HBOI has other outreach components associated with their Mission Ocean Discovery program. FAU students and faculty in marine biology also speak in the Gumbo Limbo Nature Center public lecture series (Eco-Watch) and in the Gallery program at the FAU laboratory on the Gumbo Limbo Nature Center campus.
   ii. The MS MSO Program will also seek to provide public service through student internships with federal, state and local agencies and organizations. The internships would offer opportunities for FAU students to collect data, participate in research and monitoring efforts, learn new skills, obtain experience, and provide various types of support to marine-related institutions and projects. Thus, the MS MSO Program, its faculty and students will become a resource for local communities, government agencies, and local businesses in their efforts to find innovative solutions to problems facing coastal Florida.

B. Describe how the proposed program specifically relates to existing institutional strengths, such as programs of emphasis, other academic programs, and/or institutes and centers.

Students in existing Master's programs in Biology, Geology, Geography, Environmental Science, and Urban Planning work in areas that could be enhanced by this new degree program. Environmental Science is organized around water themes, which means that students can focus on issues related to water from Lake Okeechobee, through the Everglades wetlands to the lagoon and nearshore environment on the Florida reef system. The Biology, Geology and Geography programs currently have students that also focus on the freshwater to nearshore reefs. It is anticipated that these degree programs will lose some students to the Marine Science degree. Approximately one third of the thesis topics in Environmental Science indicate that the students might have been in the Marine Science and Oceanography degree had it been available. There is some concern from Environmental Science and Ocean Engineering that their degree productivity will be impacted by this new degree program. To obtain Ocean Engineering's support, this program will not accept transfer credits, all credits will have to be earned after admission to this graduate program. OE courses are not listed at this time in the proposed new degree. It is likely that the OE courses would be too specialized and with too many prerequisites for the biological focus of the program at this time. The elective courses listed as part of the new program are specifically marine-oriented to reduce potential overlap with Environmental Science, and the required Marine Science and Oceanography core courses are new and will attract a different group of students than those who enroll in the ES Program.

FAU faculty have considerable academic and research experience with interests in diverse components of South Florida ecosystems ranging from the Everglades to estuarine and oceanic environments, as well as the human impacts on these ecosystems. The FAU Departments of Biological Sciences and Geoscience have individual strengths in marine and coastal sciences, with coursework in biology ranging from Marine Invertebrate Zoology to Introduction to Marine Biotechnology, and in Geosciences from GIS to Shore Erosion and Protection to Environmental Geophysics. However, the addition of coursework taught by HBOI faculty, including the core courses of Physical & Geological Oceanography and Biological and Chemical Oceanography, and specialization in such areas as Underwater Optical Imaging and Ocean Monitoring Systems will greatly increase the course offerings in Marine Science and most importantly, promote cross-disciplinary training that will enable students to face the complex challenges of 21st century science. These areas fit directly into the new FAU Strategic Plan with clear links to the pillars of Ocean Science and Engineering/Environmental Science, Sensing and Smart Systems and the platform Community Engagement and Economic Development.

C. Provide a narrative of the planning process leading up to submission of this proposal. Include a chronology in table format of the activities, listing both university personnel directly involved and external individuals who participated in planning. Provide a timetable of events necessary for the implementation of the proposed program.

The initial discussions related to the development of the MS MSO program took place in the Fall of 2013 between faculty in the College of Science and faculty at HBOI. These discussions led to the preparation of new syllabi developed specifically for the MS MSO; these syllabi were submitted for approval in December of 2013. The majority of the new courses were adopted into the catalog in 2014. A market demand survey for the new program was completed in September 2014. A survey of FAU students and their interest in an MS MSO degree was completed in January 2015. The program committee for the MS MSO was established in August 2015 with Dr. Sarah Milton and Dr. Peter McCarthy being named the co-Chairs from the College of Science and HBOI, respectively. The preproposal for the MS MSO was submitted to the CAVP on February 16, 2016

and approved for further development.

Planning Process

Date	Participants	Planning Activity
Fall 2013	**Faculty CoS and HBOI**	**Initial plan for a new degree program**
December 2013	**HBOI Faculty**	**Development of new syllabi**
August 2015	**CoS Dean, Executive Director HBOI**	**Nomination of program co-Chairs**
October 2015	**MS MSO Program Committee**	**Initial meeting of Program Committee to approve program requirements**
Spring 2016	**Program co-Chairs**	**Development of full Proposal**
Fall 2016	**Program co-Chairs, Megan Davis, Charles Roberts**	**Budget development**

Events Leading to Implementation

Date	Implementation Activity
Spring/Summer 2014	Approval of new syllabi and adoption into catalog
January 2015	Completion of surveys
February 2016	Approval of pre-proposal by CAVP
January 2017	Review of proposal and budget by Provost
January to May 2017	Review and approvals through all committees including BOT

VII. Program Quality Indicators - Reviews and Accreditation

Identify program reviews, accreditation visits, or internal reviews for any university degree programs related to the proposed program, especially any within the same academic unit. List all recommendations and summarize the institution's progress in implementing the recommendations.

HBOI:

An external evaluation of Harbor Branch Oceanographic Institution took place in January 2010. The following is excerpted from the review of the Marine Science Education program. The proposed MS program in Marine Science and Oceanography is a key step in the development of the formal education program at HBOI.

Strengths:
HBOI-FAU has maintained high levels of education and outreach. The strengths of the program are its location, its access to oceanographic research and cutting edge technology, and a dedicated staff. HBOI-FAU is well positioned to expand and strengthen its Marine Science Education program. The teaching facility is well-equipped for educational activities, and these activities are adequately funded.

Public outreach is a particularly strong component of the educational program that is far superior to that from comparable marine labs.

Weaknesses:

It was noted that there appeared to be a shortage of faculty to teach formal education at the graduate level. Collaborating with FAU faculty and offering faculty funding support for formal education instruction will increase graduate course offerings.

Potential Opportunities:
Now that HBOI is a part of FAU, a stronger formal academic program can be developed. There is an opportunity to expand formal education by offering more graduate level courses with an emphasis on marine science and oceanography.

Collaborations with FAU college faculty will increase the graduate student population and lead to joint grant applications (e.g. NSF education grants).

The program needs to exploit existing infrastructure and continue developing and offering more distant learning credit courses.

Charles E. Schmidt College of Science:

Both the Biology and the Environmental Sciences Programs at FAU underwent external review in winter 2014/spring 2015. Both of these programs are housed in the same academic unit (Charles E. Schmidt College of Science) as the proposed MS MSO degree.

Environmental Sciences:

The Program Committee of the **Environmental Science Program (ES)** met to review the Program Review Report (PRR) in March 2015. ES faculty participated in the development of the ES Strategic Goals and Action Plans that address and build upon the recommendations of the PRR.

The PRR was based on the 2014 ES Self-Study Report and a two-day site visit in February 2015. The review team commended the ES for its strengths, including outstanding graduate students with an excellent job placement rate, faculty who seek inter-disciplinary research opportunities and are well-connected with agency partners, good laboratory facilities, and a strong interest from the university-level administration in building the program and making it a key growth area.

The Strategic Goals and Action Plans focus on areas where the ES has the most potential to build strategically on its existing strengths, and address problem areas where the ES Program should consider alternative governance structures or changes in programmatic policies or procedures. These goals are very well aligned with the goals of the 2015-2025 FAU Strategic Plan, which identifies the Environmental Sciences as part of one of the four institutional pillars focused on creating knowledge that benefits society.

The following goals were specifically recommended for the ES Program:

Strategic Goal I. Build interdisciplinary faculty expertise in Environmental Science
The current ES faculty has considerable academic and research experience with the aquatic ecosystems in the Greater Everglades region, including Florida Bay, Caloosahatchee Estuary, Indian River Lagoon, the freshwater Everglades and the human interactions with these

ecosystems. However, the relatively small number of ES faculty is a limitation to further growth and the ability of the program to build and maintain research relationships with non-university partners. Action plans that the ES Director and faculty will implement to address this goal in the short-term include 1) providing input and support for departmental appointments of Affiliate Faculty with expertise in wetland, riparian and estuarine science and 2) seeking clear information from FAU administration about the metrics used for allocation of resources to academic units.

In the longer-term, the ES Director and faculty will continue to work with the Dean and faculty and staff from other academic units to develop a proposal for university-wide restructuring of governance and funding for environmental scholarship and research (e.g. a School for the Environment). A new administrative structure for environmental science could provide the support for: incentives for departments to prioritize interdisciplinary program needs and build expertise in wetland, riparian and estuarine science when making strategic hires; creation of a Visiting Fellows program to bring in senior researchers and faculty with expertise wetland, riparian and estuarine science; establishment of a sabbatical program to encourage national and international collaboration in interdisciplinary environmental research. The development of a School for the Environment is contingent on administrative support and has not been established to date.

Strategic Goal II. Capitalize on the multi-campus structure of the ES Program

The action plans that address this goal will build and maintain a critical mass at both HBOI and Davie in order to facilitate interaction between faculty, students, and researchers. At the same time, the ES will maintain a strong presence on the Boca Raton campus to sustain critical administrative connections and to facilitate interaction with students and relevant faculty from all colleges and schools. The ES will also make use of the multi-campus structure to increase recognition of the breadth and depth of environmental activities at FAU by supporting the expansion of the pool of Affiliate ES Graduate Faculty based at different campuses; this will help to develop a cadre of professionals to serve as adjunct facility and build connections among students and faculty with working professionals. To foster inter-campus connections, the ES retreat, which has been held at the Boca Raton campus since 2009, will be held at alternating campuses in the future. The ES Program Committee has made plans to move the ES retreat to different campuses, and has enlarged the list of Affiliate Faculty.

Strategic Goal III. Improve and strengthen scholarship and research and build a sense of community in the ES Graduate Program.

Small graduate stipends and lack of benefits, compared to other Universities in the region, have made it difficult to attract and matriculate top ES graduate students. The ES will continue to make the case to administrators to increase baseline stipends, and will evaluate the feasibility of alternative cost structures, such as fewer graduate stipends with higher baseline amounts. The terms and conditions of teaching assistantships across campuses will also be revisited to ensure workload equity.

In the future, the ES Retreat will be held semi-annually at alternating campuses to bring together all ES faculty and students during the fall and spring semesters. Attendance at the retreats will be mandatory for students; graduating students will give oral or poster presentations of their thesis or DIS research and all students will have the opportunity to interact informally with ES faculty. Student achievement and success will also be enhanced by holding an orientation session for new students at

the beginning of every fall and spring semester to clarify expectations and introduce students to the use of the ES Blackboard site. Enhancements of the ES website are an important component of the actions plans for this goal, and include the addition of current profiles of all ES faculty and graduate students, maintenance of an up-to-date dated rolling two-year schedule of core course availability on ES website, and website access to a downloadable online manual with all of the information that is currently accessed through the ES Blackboard site. The ES website is currently being updated, a number of improvements have already been implemented including placing most forms, course availability, and announcements on line.

Strategic Goal IV. Improve and expand undergraduate scholarship and research in Environmental Science

There is currently no undergraduate degree in Environmental Science at FAU that could meet growing demand and provide a conduit of top students into the ES graduate program. However, an accelerated BS-MS in Environmental Science has been approved, and will be revised to meet SACS accreditation requirements of 150 total credits, with 30 minimum credits at the graduate level. A feasibility study was undertaken by members of the ES Program Committee in spring 2016, and it was decided that the ES Program should seek to develop an undergraduate degree.

Strategic Goal V. Increase visibility and outside funding of environmental research and scholarship

In Spring 2015, Environmental Sciences was approved as an institutional pillar in FAU's Strategic Plan. This clear evidence of administrative support for environmental science will boost the effectiveness of ES action plans to increase the visibility and outside funding of environmental science at FAU. The ES Director will gauge the desire of the FAU administration to increase funding for outreach education to attract outside funding for short courses and workshops to industry, agencies, non-profits and other interested individuals. Outreach could be offered through the CES as the outreach arm of a School for the Environment.

The ES Director will work with the Office of Institutional Advancement to accomplish this goal, evaluating options such as outreach to attract funding for short courses and workshops and collaboration on K-12 education initiatives with the College of Education and Pine Jog Environmental Education, keeping in mind constraints on faculty time for service.

Biological Sciences:

The Biological Sciences Program Review Report (PRR) was received in March 2015. The PRR was based on the 2014 Self-Study Report and a two-day site visit in February 2015. Faculty participated in the development of the BS Strategic Goals and Action Plans that address and build upon the recommendations of the PRR.

The following goals were recommended for Biological Sciences:

Goal 1: To continue to build research and instruction on the Boca Raton, Jupiter and Davie campuses along the lines already established.

- BS will continue to shift commuter students to the Davie and Jupiter campuses, to re-distribute the teaching load and to maximize the use of space.
- FAU's president signed an agreement with Scripps Florida's CEO and Max Planck's CEO and Scientific Director in March 2015 fortifying our relationships, both in research and education on the Jupiter campus.
- A newly hired Director of the Center for Environmental Science is now established in Davie.
- Boca Raton faculty members are developing a new marine science MS degree; this will be followed by a marine science track for the Integrative Biology Ph.D. Program as part of the FAU strategic pillars.

Goal 2: To develop a reliable, efficient transportation system between the different campuses for students and faculty as soon as possible.

The President has proposed a bus link from Boca Raton to Jupiter campuses. This is thus contingent upon administrative support and has not yet been implemented.

Goal 3: To support the sense of community in the Biology Department by developing institutional habits and traditions that support it, such as a monthly departmental day on the Boca Raton campus that all are expected to attend.

BS plans to continue biannual retreats with improved consistency. These events will rotate between FAU's three main sites and be programmed around curriculum discussions or seminars. In Fall 2015 a retreat format was used to discuss some of the items in the PRR report followed by a welcome reception.

Goal 4: To raise the threshold for entry into the B.S. in Biology Program (by considering limiting future University growth in the largest undergraduate major to enable the faculty to plan for orderly instruction in this discipline).

The Biology Department has recommended to the College of Science Dean and Provost that in order to declare a major in Biology, students must meet a new threshold of requirements modeled after those required for declaring a major in FAU's Colleges of Nursing or Business.

Goal 5: To develop a first semester, one credit course that introduces first year students to exciting developments in the life sciences, explains the need for tools and concepts from the hard sciences and mathematics, and identifies career pathways in the life sciences other than pre-medicine.

Biology's Curriculum and Assessment committee, led by the Director of Undergraduate Research and Mentoring Program, suggests implementation as a part of the required freshman majors' biology courses. BS also needs to find ways to work with freshmen to reduce attrition from the major in the first year of their undergraduate careers. This is a nation-wide issue.

Goal 6. To create course sequences and major/minor combinations that lead to degrees in Biology/public policy, Biology/law, Biology/business and finance and non-profits.

This goal was not considered as it would be difficult to implement due to the very large student population in biology and the biology faculty workload.

Goal 7. To hire additional faculty or non-tenure-track instructors to reduce the student/faculty

ratio.

The number of faculty has grown recently due to hiring two junior faculty members and the return of the former President and the former Provost to their departmental status in Biology. The Life Science Initiative, based primarily in Jupiter, has also facilitated hiring in the Biology Department and this will help reduce the overall student to teacher ratio. The BS is seeking to hire two new instructors; a search in Spring 2016 resulted in an offer to an instructor for Anatomy and Physiology and Life Sciences, while other faculty have been shifted between campuses to better accommodate teaching loads. The current hiring of tenure-track faculty members at the rate of one to two per academic year will further sustain the department's productivity.

Goal 8: To create a formal faculty mentoring program.

The Biology Department has a faculty mentoring program in place. Under the departmental program, a tenured faculty member is assigned to each new faculty member to give one-on-one mentoring regarding the tenure process. There is also one Master Teacher and one Master Researcher designated in the Biology Department. The Master Teacher is responsible for giving workshops to new hires (and previous hires with low teaching evaluation scores) on teaching tips and pedagogies. The Master Researcher provides workshops on grant writing and various research concerns.

Goal 9: To consider course structures that increase the interaction of students and instructors.

Approximately 10% of Biology undergraduate students are engaged in research and 85% of faculty members are acting as mentors. In the four semesters from (and including) Spring 2014 through and including Spring 2015, there were an average of 70 undergraduate students engaged in *Directed Independent Study* (DIS) alone per semester.

For the past fifteen years, peer-led Lifeline sessions (24 students maximum per session) have been used to achieve more individual (peer) interactions in the introductory *Biological Principles* (BSC 1010) and *Biodiversity* (BSC 1011) courses for majors.

Another course structure that increases the interaction of students and instructors is engaging the students in molecular and field research during teaching labs. The Biology Department is one of the sites for the Small World Initiative from Yale University, which aims at initiating freshmen in biological research at the molecular level.

The Biology Department was also awarded a university technology fee grant to allow undergraduate students to obtain real field data in introductory labs for *Biodiversity* (BSC 1011). Pilot studies were launched in Fall 2016 with one BSC 1011 lab (24 students) participating in collecting data for long-term studies on gopher tortoises at the FAU preserve.

Goal 10: To bring advisement for sophomores and upper class students back to the department.

The current student to faculty ratio precludes this as a realistic goal. Financial backing will be discussed with the College of Science Dean and Provost to seek funding from the President's Office to establish staff lines, specifically designated for advising, in our department to bring some advising back to the department.

Goal 11: To engage the better students in peer-support activities by developing an undergraduate interest/service club.

Student organizations currently exist within the major, primarily among the students interested in clinical sciences: 1) Strategies for Ecology Education, Diversity & Sustainability (SEEDS) and 2) Scientific Mentoring for Academic Research Training.

Additionally, BS students have volunteered in many projects to protect and improve THE sensitive South Florida environment (which are initiated largely by field courses in marine and environmental biology).

Goal 12: To consult the better graduating seniors about what did and did not work for them, and how it can be improved.

Assessment process of student baccalaureate outcomes is not possible within the current FAU infrastructure. FAU's Office of Institutional Effectiveness and Analysis (IEA) data is obtained through Biology graduating senior surveys, but an average of only 25% of graduating seniors with Bachelor's degrees in Biology respond. This is an institution-wide issue that must be addressed by the College of Science Dean and Provost to establish staff lines within the Office of Student Affairs that will implement reliable methods to accomplish this student tracking.

The Biology Department plans to implement an exit interview program and utilize information gleaned to improve student retention. This program will occur near the end of the spring semester by inviting graduating DIS undergraduate students to a pizza party and having them fill out a survey and engage in a roundtable discussion with Biology's Exit Committee (consisting of faculty members and FAU graduate students that have completed FAU undergraduate studies) about their (positive and negative) FAU experiences.

Goal 13: To strengthen research productivity by encouraging more interdisciplinary ties with other departments and colleges.

BS will continue to pursue interdisciplinary ties by hosting and attending interdepartmental seminars. One of the newest hires, Marianne Porter, is a biomechanist who is forging new collaborations with FAU's Engineering Department. Sarah Milton and Peter McCarthy are leading Boca Raton and HBOI faculty members in developing a new marine science MS degree program, to be followed by a marine biology concentration for the Integrative Biology Ph.D. Program. These will serve to enhance cohesion between the marine scientists at Boca Raton and Fort Pierce.

Currently, four faculty members from other departments share space in the biology departmental labs, while one BS Assistant Professor in Biology is working with the Department of Ocean and Mechanical Engineering (also within the College of Engineering and Computer Science) and one Biology member at HBOI has a student who is working with a faculty member in the College for Design and Social Inquiry (School of Architecture) on a coral reef restoration-related project. BS faculty members work with faculty members in the College of Medicine (who also participate in the IB Program) and in the Department of Chemistry and Biochemistry.

Goal 14: To strengthen research productivity by improving the graduate student support

package offered to Ph.D. and M.A./M.S. students.

One of the main resource issues for our department is the limited support for graduate assistants. FAU is at the bottom of the ranking for M.S. stipends and health care across the SUS. Financial support is being discussed with the College of Science Dean and Provost to seek funding from the President's Office to establish more competitive graduate student support packages. This is an ongoing problem at FAU and all of the players involved are aware of the problem and are working to resolve it.

VIII. Curriculum

A. Describe the specific expected student learning outcomes associated with the proposed program. If a bachelor's degree program, include a web link to the Academic Learning Compact or include the document itself as an appendix.

The MS MSO Program will develop students' professional skills in marine science, through a flexible curriculum that accommodates a broad range of student goals and interests. To meet this goal, courses in the MSO Program curriculum are organized around interdisciplinary focal areas in engineering, biology, and the physical sciences. Courses offered within this framework include: traditional lecture-style, e-learning, and field courses; special topics courses that introduce students to the latest theories, methods, and emerging issues; seminar series; and experiential learning through thesis research, directed independent study (DIS), and internship programs. Through this framework, students will gain proficiency in the application of scientific principles such as, critical thinking, experimental design, synthesis, and quantitative analysis, as well as a sense of professional responsibility and integrity.

Both thesis and non-thesis graduate students will demonstrate a broad understanding of the multidisciplinary fields of marine science and oceanography and in-depth knowledge of their area of specialty. They will be able to use scientific research methods, perform analyses of scientific data and critically evaluate and communicate research findings. They will demonstrate professional skills in environmental science, as evidenced by scholarly interactions with professionals in the field, including participation in professional organizations, workshop and conference participation.

Graduate students enrolled in the thesis option will be able to conduct original research and perform in-depth analysis, as demonstrated by successful completion of a Master's Thesis. Specifically, students will demonstrate: 1) current knowledge of their field of study and the ability to critically review and interpret scientific literature 2) the ability to develop a hypothesis, design and execute scientific experiments, and draw logical conclusions from data and 3) the ability to write scientific reports and communicate effectively in scholarly presentations.

Specific Student Learning Outcomes – Master's Program

SLO 1: Professional Activities

Students will demonstrate substantial professional skills in marine and coastal science, as evidenced by scholarly interactions with professionals in the field, including participation in professional organizations and activities such as scholarly presentations, workshop participation, and conference attendance.

Implementing Strategy
Information on student participation in professional societies and organizations, scholarly interaction with faculty, and participation in professional workshops and conferences, will be collected by means of an online survey that is to be completed by students each academic year.

Assessment Method
The analyses and summary of the percentage of students reporting participation in specific professional activities will be reviewed annually by the MSO Program Committee.

SLO 2: Original Thesis Research
Students enrolled in the thesis option will be able to conduct original research and perform in-depth analysis, as demonstrated by successful completion of a Master's Thesis. Specifically, students will demonstrate:

1) current knowledge of their field of study and the ability to critically review and interpret scientific literature.
2) the ability to develop hypothesis, design and execute scientific experiments, and draw logical conclusions from data.
3) the ability to write scientific reports and communicate same effectively in oral presentations.

Implementing Strategy
Overall evaluation of student thesis work in the MSO Program will be performed by the thesis committee in accordance with the guidelines of the academic department of the faculty advisor. A thesis committee reviews the thesis proposal and thesis defense presentations, which are open to the university at large and to the public. Each member of the Thesis Committee will submit a written evaluation of the thesis proposal and defense to the Program Coordinators, utilizing standard assessment forms that will be established by the MSO Program Committee.

Assessment Method
Assessment of Thesis Proposal: During the first year, each student will write a thesis proposal and present a proposal seminar that is open to all faculty as well as the public. Each member of the Thesis Committee evaluates the proposal by a 5-pt scale (1=below expectation, 3= Meets expectation; and 5 = Exceeds expectation) for the established criteria such as:

1) Scientific Merit of Study
2) Adequacy of literature review
3) Ability to create testable hypothesis and define objectives
4) Soundness of research methods, including procedure for data analysis
5) Oral communication and seminar

Assessment of Thesis Defense: During the last semester of study, each student will submit a final written thesis and present a thesis defense seminar. Each member of the Thesis Committee evaluates the thesis by a 5-pt scale (1=below expectation, 3= Meets expectation; and 5 = Exceeds

expectation) for the established criteria such as:

1) Scientific Merit of Study
2) Critical analysis of literature in the field
3) Hypothesis and extent to which objectives are accomplished
4) Scope and quality of data collected and its presentation
5) Intellectual merit of data interpretation and analysis
5) Potential for journal publication from the work

SLO 3: Employment after Graduation

Students will demonstrate the skills required to successfully compete for professional positions in the workforce by gaining employment in a field of environmental sciences-related field in the public or private sector.

Implementing Strategy

The MSO Program will maintain contact with students after graduation through faculty advisors and annual email surveys.

Assessment Method

A system for collection and tracking post-graduation placement data (career path after leaving FAU) through email surveys will be developed by faculty and staff.

SLO 4: Critical Thinking and Communication

Students will demonstrate a broad understanding of the multidisciplinary field of environmental science and in-depth knowledge of their area of interest. They will be able to perform analyses of scientific data and research methods, critically evaluate research findings, and communicate effectively with colleagues in their field.

Implementing Strategy

All students must take the core Colloquium course during their initial fall semester, which will focus on these skills. Masters candidates will be evaluated via the Thesis and thesis seminar as above (SLO2); Non-thesis students will be evaluated through the exit exam (see graduation requirements, below)

Assessment Method

Student presentations and thesis seminars will be graded using a rubric that evaluates communication, critical thinking, and synthesis skills (to be established).

B. Describe the admission standards and graduation requirements for the program.

This is an interdisciplinary program designed to provide students with specialized training in Marine Science and Oceanography jointly administered by the Charles E. Schmidt College of Science and Harbor Branch Oceanographic Institute. Students are required to take most of the coursework spread across the core subject areas. The exact courses taken are to be determined by students and their advisory committees.

Admissions Standards

In addition to meeting all of the University and College admission requirements for graduate study, each applicant for the MS MSO program must:

1. Have a minimum of 3.0 GPA (B or better average) on the last 60 hours of undergraduate credits, or established graduate level proficiency.
2. Have minimum GRE scores of 151 Verbal and 151 Quantitative for GREs taken during or after August 2011 (or a cumulative score of 1000 on the Verbal and Quantitative portions of the GRE prior to Oct 2011). GRE scores older than 5 years prior to admission will not be accepted.
3. In addition, the applicant must provide two letters of recommendation and obtain a "sponsor" from within the faculty of the MS MSO program, who will then act as the student's advisor until a thesis topic has been chosen.

Graduation Requirements

Students may graduate with a thesis or non-thesis Master's degree; both require the successful completion of 37 credits as described below. For the thesis degree this includes research credits as well as the successful public defense of the thesis proposal and of the thesis by the Master's degree candidate. Non-thesis candidates will complete an exit exam specific to their area(s) of study in the spring of their second year, administered by the student's degree committee.

C. Describe the curricular framework for the proposed program, including number of credit hours and composition of required core courses, restricted electives, unrestricted electives, thesis requirements, and dissertation requirements. Identify the total numbers of semester credit hours for the degree.

The degree consist of 37 credits from three categories of courses:

Required Courses: Three courses (7 credits) are required of all MS MSO students. They should be taken at the beginning of the graduate program.

MSO Required Courses		
Physical & Geological Oceanography	OCE 6097	3
Biological and Chemical Oceanography	OCE 6057	3
MSO Colloquium Series	GEO 6920	1
Total Research Core		7

Core Subject Areas: A minimum of 24 credits from the core subject areas, with at least one course from four different core subject areas. Up to 6 credits designated as "Special Topics" courses may be taken with the approval of the Thesis Advisor.

Electives and Directed Independent Study: No more than 6 credits of electives taken outside

the core areas will be counted toward the degree, and electives may not be brought in from courses earned before admission to the degree program. No more than 3 credits of Directed Independent Study may be counted toward this degree.

D. Provide a sequenced course of study for all majors, concentrations, or areas of emphasis within the proposed program.

Marine Science and Oceanography is jointly administered by the Charles E. Schmidt College of Science and Harbor Branch Oceanographic Institute. This is an interdisciplinary program designed to provide students with specialized training in marine sciences. Participating faculty have appointments at HBOI and the College of Science.

Students are required to take most of the coursework spread across the core subject areas listed below. The MSO required courses must be taken in the first year. The remaining exact courses to be taken are to be determined by students and their advisory committees.

Thesis Option

A student curriculum consists of a minimum of 37 credits taken in the following three categories:

Required Courses: Three courses (7 credits) are required of all MS MSO students. They should be taken at the beginning of the graduate program.

MSO Required Courses		
Physical & Geological Oceanography	OCE 6097	3
Biological and Chemical Oceanography	OCE 6057	3
MSO Colloquium Series	GEO 6920	1
Total Research Core		7

Core Subject Areas: A minimum of 24 credits from the core subject areas, with at least one course from each of four different core subject areas. Up to 6 credits designated as "Special Topics" courses may be taken with the approval of the Thesis Advisor.

Electives and Directed Independent Study: No more than 6 credits of electives taken outside the core areas will be counted toward the degree, and electives may not be brought in from courses earned before admission to the degree program. No more than 3 credits of Directed Independent Study may be counted toward this degree.

No more than 6 credits of electives taken outside the core areas will be counted toward the degree. No courses under the 5000 level may be taken. No more than 3 credits of Directed Independent Study may be counted toward this degree.

Thesis: 3 to 6 credits.

Non-Thesis Option

A student curriculum consists of a minimum of 37 credits taken in the following categories:

Required Courses: Three courses (7 credits) are required of all MS MSO students. They should be taken at the beginning of the graduate program.

MSO Required Courses		
Physical & Geological Oceanography	OCE 6097	3
Biological and Chemical Oceanography	OCE 6057	3
MSO Colloquium Series	GEO 6920	1
Total Research Core		7

Core Subject Areas and Electives: 30 credits from the core subject areas and electives, with at least one course from each of four different core subject areas. Up to 6 credits designated as "Special Topics" courses may be taken with the approval of the student's Advisor.

No more than 6 credits of electives taken outside the core areas will be counted toward the degree. No courses under the 5000 level may be taken. No more than 3 credits of Directed Independent Study may be counted toward this degree.

Non-thesis candidates will complete an exit exam specific to their area(s) of study in the spring of their second year, administered by the student's degree committee.

E. Provide a one- or two-sentence description of each required or elective course.

Required Courses:

Physical and Geological Oceanography (OCE 6097) 3 credits
Provides an overview of the atmospheric, physical and geological processes that govern our oceans and coastal margins.

Biological and Chemical Oceanography (OCE 6057) 3 credits
Explores major biological and chemical processes within the world's ocean, including estuaries, continental margins and the open ocean.

Colloquium (GEO 6920) 1 credit

Conservation and Ecology Core Subject Area

Coastal Plant Ecology (BOT 6606) 2 credits
Provides an in-depth analysis of current topics of coastal plant ecology including marsh, mangrove, lagoonal, and reef ecosystems.

Coastal Plant Ecology Lab (BOT 6606L) 2 credits
Field studies of marsh, mangrove, lagoon, and coral reef ecosystems with an emphasis on the flora. Research techniques and data analyses for studying coastal plant ecology are stressed.

Natural History of the Indian River Lagoon (OCB 6810) 3 credits
An overview of the marine plants and animals, habitats, and environmental conditions in the Indian River Lagoon, including human

impacts. Field trips to local habitats complement lecture and labs.

Coral Reef Ecosystems (OCB 6266) 3 credits
Explores the structure, biology, ecology, significance and current status of coral reef ecosystems through a combination of lectures and discussions.

Coral Reef Ecosystems Lab (OCB 6266L) 1 credit
Field-and-laboratory-based exploration of coral reef ecosystems focused on coral identification and underwater scientific methods for coral research.

Conservation Biology (PCB 6045) 3 credits
A study of the principles and practice of conservation biology. Emphasis on the primary threats to biodiversity and the application of contemporary tools to solve conservation problems.

Advanced Ecology (PCB 6046) 3 credits
Provides graduate students with a background in development of ecology as a science and current ecological theory and application of ecology for ecosystem management.

Ecological Theory (PCB 6406) 3 credits
A functional approach to and a critical examination of the principles and concepts in ecosystem theory.

Marine and Estuarine Community Dynamics (PCB 6316) 3 credits
Community, landscape, food web and similar features of marine systems are studied. Both basic and applied (conversation and restoration) aspects of communities are included.

Marine Ecology (PCB 6317) 3 credits
A study of the principles, concepts, and techniques of marine and estuarine ecology. Environmental factors, adaptations, habitats, communities, and applications of current ecological theory are studied. Lecture, laboratory, and field work are included.

Marine Ecology Laboratory and Field Studies (PCB 6317L) 2 credits
A study of the Methods and Techniques of marine ecological research and their application in the field. Data collections, analysis and presentation.

Marine Global Change (OCE 6019) 3 credits
Introduction to long-term and global scale changes in terrestrial and marine environments and the impact those changes have in marine settings, especially the coastal ocean. Natural and anthropogenic changes are described and compared. Topics include invasions, extinctions, climate change, food web modifications, and freshwater issues in the coastal zone.

Marine Biology Core Subject Area

Advances in Finfish Aquaculture (BSC 6342) 3 credits
Prerequisite: Culture of Marine Organisms or permission of instructor
Explores issues affecting finfish aquaculture for food production and fisheries stock enhancement worldwide. Topics include sustainability, new and historic methods for fish culture and issues and controversies faced by finfish aquaculturists.

Introduction to Marine Biotechnology (BSC 6346) 3 credits
Introduces the principles and practices of Marine Biotechnology and its commercial applications: 1) the cultivation and genetic manipulation of marine microorganisms, invertebrates and vertebrates; 2) disease impacts in aquaculture systems; 3) the discovery and production of commercially relevant products; 4) policy related to the commercial development of marine resources.

Data Processing and Modeling of Marine Systems (OCB 6673) 3 credits
Provides tools, methods and numerical recipes to study ocean processes from in-situ observations and ocean numerical models. Provides an overview of current ocean models and biophysical and biogeochemical models, and their applications.

Marine Molecular Biology (PCB 6465) 3 credits
Examines emerging molecular technologies and their application in the marine sciences through a combination of lecture, discussion and debates.

Aquatic Animal Health (PCB 6772) 3 credits
A comprehensive study of basic processes in aquatic organisms, with an emphasis on marine fish and invertebrates.

Physiology of Marine Animals (PCB 6775) 3 credits
A study of how marine animals function in their environment.

Sensory Biology and Behavior of Fishes (PCB 6871) 3 credits
A study of the anatomy and physiology of sensory structures in fishes, as well as the neural processing and behaviors elicited by these senses. Topics include vision, olfaction, audition, gustation, lateral line.

Marine Invertebrate Zoology (ZOO 6256) 3 credits
A study of morphology, systematics, phylogenetic relationships, ecology, and life histories of marine invertebrates. It includes lecture, laboratory, and field problems.

Marine Invertebrate Zoology Lab (ZOO 6256L) 2 credits
Collection of marine invertebrates aboard a research vessel and various marine habitats in southern Florida.

The Biology of Sea Turtles (ZOO 6406) 3 credits
This upper-level lecture, lab and field course introduces the behavioral, ecological and evolutionary adaptations of sea turtles and conservation-related topics. Major topics include species identification, functional anatomy, reproduction, migration, navigation, feeding ecology, physiology, development, nets and hatchlings, threats to survival and conservation strategies.

Biology of Sharks and Their Relatives (ZOO 6409) 3 credits
Studies biology, ecology, physiology, behavior and taxonomy of the elasmobranch fishes. Includes a review of extant families and contemporary topics in elasmobiology through readings from the primary literature.

Natural History of Fishes (ZOO 6456) 3 credits
The natural history of marine and freshwater fishes, emphasizing anatomy, functional morphology, general classification, and phylogenetic relationships, as well as biology of fishes in different habitats. Lecture, laboratory, and field study are included.

Natural History of Fishes Lab (ZOO 6456L) 2 credits
A study of external and internal anatomy, osteology, and identification of fishes. Laboratory and field study are included.

Seminar in Ichthyology (ZOO 6459) 1-2 credits
A critical review of current literature dealing with fishes and fisheries. This course may be repeated for credit to a maximum of 4 credits. *Grading: S/U*

Histology of Fishes and Aquatic Invertebrates (ZOO 6757) 4 credits
Prerequisite: Graduate standing
An introduction to basic histology techniques and interpretation of normal and disease states of marine fish and invertebrates.

Biogeography (GEO 5305) 3 credits
Biogeography is the study of distributions of organisms and the processes responsible for the patterns. This course examines theories concerning spatio-temporal processes and patterns, populations, communities, ecosystems, biodiversity, disturbance, succession, speciation and conservation.

Restoration Implementation and Management (EVR 6358) 3 credits
Restoration projects require the approval of multiple government agencies and cooperation of affected landowners and stakeholders at every phase. This course covers the legal aspects of government approval, creating communication plans for coalition building and collaboration with stakeholders, conflict resolution and ethics in restoration.

Remote Sensing and GIS Core Subject Area

Digital Image Analysis (GIS 5033C) 3 credits
This course is the second in a three-course sequence that follows the national model for core curriculum in remote sensing. Digital techniques for processing and analyzing remotely sensed imagery include image enhancement, image classification, ground truthing, and accuracy assessment.

Remote Sensing of the Environment (GIS 5038C) 3 credits
The first of a three-course sequence, this one covers principles and concepts of remote sensing, aerial photograph and satellite image interpretation and analysis. Includes a survey of remote sensing data sources, hands on lab projects in a GIS environment and an introductory research project.

Principles of Geographic Information Systems (GIS 5051C) 3 credits
Prerequisite: GIS 3015C or equivalent
Basic concepts of geographic information systems. Evaluation of hardware and software components. Examination of data structures and fundamental GIS functions. Application potential and laboratory experience with GIS systems. Basic GIS project design and implementation.

Applications in Geographic Information Systems (GIS 5100C) 3 credits
Prerequisite: GIS 4043C or GIS 5051C or equivalent
Advanced techniques for raster modeling, network systems, and statistical analysis in geographic information systems. System planning and implementation issues in applying GIS in diverse areas. GIS-based spatial modeling issues.

Programming in Geographic Information Systems (GIS 5103C) 3 credits
Prerequisites: GIS 4043C or 5051C
Course covers basic computer programming concepts and methodologies. Issues for customizing and/or extending available functions in selected cutting edge GIS are discussed along with advanced geoprocessing modeling and data analysis with scripts. Project design and development are addressed.

LiDAR Remote Sensing and Applications (GIS 6032C) 3 credits
Prerequisites: GIS 5051C; Geosciences graduate students only
Introduces LiDAR principles, sensors and platforms, data processing and analysis and applications. Students master basic skills of

LiDAR needed to leverage the commercial LiDAR sources and information products in a broad range of applications.

Advanced Remote Sensing (GIS 6039) 3 credits
Prerequisites: GEO 4022 and GIS 4035C or permission of instructor
Advanced study of remote sensing applications. Project design, implementation and evaluation.

Topics in Geoinformation Science (GIS 6120) 3 credits
Prerequisites: GEO 4022 and GIS 4043C or equivalent
Technical, operational, and management issues in geographic information systems. Examination of GIS function algorithms, data structures, error analysis, and other topics in GIS applications.

Hyperspectral Remote Sensing (GIS 6127) 3 credits
Prerequisites: GIS 4035C and 4037C or GIS 5033C and 5038C
Course introduces state-of-the-art techniques for the processing and interpretation of hyper- and ultraspectral data with a focus on thematic information extraction from airborne and satellite-based hyperspectral sensors. Course covers the full hyperspectral remote sensing processing chain from data acquisition and calibration to image processing and thematic mapping.

Spatial Data Analysis (GIS 6306) 3 credits
Prerequisite: GIS 5051C
Introduces a range of spatial statistical methods commonly used in the analysis of geo-spatial data in GISciences. Emphasis on gaining insight into the overall framework for analysis and developing an understanding of various concepts with in-depth treatment of select techniques. Methods are mainly discussed within the context of GIS technology.

Ocean Monitoring System (OCE 6268) 3 credits
International agreements and conventions call for safety at sea, effective management of the marine environment and sustainable utilization of its resources. This course provides the international framework, concepts and tools used to measure, rapidly detect and provide timely predictions of changes in a broad spectrum of marine phenomena.

Marine Optics (OCE 6269) 3 credits
Marine optics is relevant to a diverse array of marine and environmental science disciplines. The course introduces the theoretical concepts of the irradiative transfer of light through natural waters and how electromagnetic waves interact with natural water and its constituents.

Underwater Optical Imaging for Marine Scientists (OCE 6267) 3 credits
This course introduces the key theoretical concepts in underwater optical imaging, the alternate imaging technologies and related data formats and science products. An overview of imaging and visualization using conventional photography and videography leads to more advanced techniques.

Coastal and Geological Science Core Subject Area

Comparative Carbonate Sedimentology (GLY 6352) 3 credits
Dedicated to the study of carbonate deposits in the process of formation, methods of studies, examination of sediment types and factors that control their distribution and tracking depositional environments, rocks and calcareous organisms into the recent geologic past (Pleistocene and Holocene).

Shore Erosion and Protection (GLY 5575C) 3 credits
Study of geomorphology and use of coasts, sediment budgets and dune-beach interaction, effects of engineering structures, coastal hydraulics, tides and currents, waves and structures, coastal water level fluctuations, shore erosion control, beach replenishment, coastal protection and restoration, fate of replenished beaches.

Marine Geology (GLY 5736C) 3 credits
Theoretical and applied earth science in the marine environment. Introduction to the history of marine geology, structure and evolution of continental margins and the world's basins in terms of modern plate tectonic theory, ocean sediments and sedimentary regimes, geologic effects of waves and currents, dynamics of coastal environmental processes, fluctuations of mean sea level through time, ocean mineral resources.

Advanced Topics in Applied, Coastal, and Hydrogeology (GLY 5934) 3 credits
Occasional advanced courses in specialized areas of engineering, coastal and hydrogeology not fully covered in other program courses.

Coastal Environments (GLY 6737) 3 credits
Examination of the biophysical framework and biogeography (zonation) of world coastal environments. Consideration of the areal (spatial) distribution of major coastal ecosystems and the natural processes and littoral materials that make up beaches, dunes, wetlands, tidal flats, rocky shores, and other coastal landforms.

Methods in Hydrogeology (GLY 6838) 3 credits
Prerequisite: GLY 4822 or equivalent with a grade of "C" or better, or permission of instructor
Designed to introduce students to practical aspects of hydrogeology, including project design, field methods and data analysis.

Coastal Hazards (GLY 6888) 3 credits
A global review of natural and human-induced hazards as they affect coastal zones, including the identification of site specific and regional coastal hazards. Mitigation and management are related to individual and community hazard perceptions, risk assessment

and response. Emphasis is placed on the susceptibility of the SE Florida region to oil (chemical) spills, coastal floods due to extreme events, and to the potential impacts of global sea level rise.

Global Environmental Change (GLY 6746) 3 credits
An introduction to the study of global climate change through time. Included and in-depth studies of the causes of and evidence for past environmental changes, major perturbations of global natural environmental systems, the effects of sea level changes, solar variations, and planetary dynamics on climate, and details of Quaternary paleoclimate models

Statistics and Communication Core Subject Area

Scientific Communication (BSC 6846) 3 credits
Introduces students interested in scientific research to various techniques and software important for data processing and presentation of research data. Students learn to effectively present research to the general public and to the scientific community in written form, such as research proposals, conference presentations, seminars and publications.

Experimental Design and Biometry (PCB 6456) 4 credits
Covers experimental design and statistical analysis in biology and ecology. Students learn probability theory basics, univariate and multivariate analyses, proper experimental design such as replication and blocking, and how to use the SAS software application.

Advanced Multivariate Biometry (PCB 6457) 3 credits
Involves learning advanced techniques for analyzing biological and ecological data including time-series analyses, structural equation modeling, MDS, multiple regression and other methods.

Chemistry Core Subject Area

Environmental Geochemistry (GLY 5243) 3 credits
Examination of current geochemical problems affecting the earth at global, regional, and local scales. Discussion of the natural geochemical background of substances including a review of geochemical principles.

Chemistry for Environmental Scientists (CHS 6611) 3 credits
Course is designed for environmental scientists and requires minimal chemical training (one year of general chemistry with a "C" or better or permission of instructor). Introductory chemical basics are covered to lay a foundation for the remainder of the course. Atmospheric chemistry (global warming, ozone layer) are covered. However, aquatic chemistry and its effects on biotic communities and humans are emphasized.

F. For degree programs in the science and technology disciplines, discuss how industry-driven competencies were identified and incorporated into the curriculum and indicate whether any industry advisory council exists to provide input for curriculum development and student assessment.

As indicated above the program has close ties to end users in both industrial and governmental sectors. The Program includes cross-disciplinary courses in aquaculture, engineering and biotechnology that meet the needs of the industry. An industry advisory council is not being formed; input from industrial sponsors will be solicited for relevant courses.

G. For all programs, list the specialized accreditation agencies and learned societies that would be concerned with the proposed program. Will the university seek accreditation for the program if it is available? If not, why? Provide a brief timeline for seeking accreditation, if appropriate.

The existing GIS certification course will continue and will be a part of the course schedule available for this program. At this time we are not seeking additional accreditation as the Masters in Marine Science and Oceanography as this is not a professional development program.

H. For doctoral programs, list the accreditation agencies and learned societies that would be concerned with corresponding bachelor's or master's programs associated with the proposed program. Are the programs accredited? If not, why?

N/A

I. Briefly describe the anticipated delivery system for the proposed program (e.g., traditional

delivery on main campus; traditional delivery at branch campuses or centers; or nontraditional delivery such as distance or distributed learning, self-paced instruction, or external degree programs). If the proposed delivery system will require specialized services or greater than normal financial support, include projected costs in Table 2 in Appendix A. Provide a narrative describing the feasibility of delivering the proposed program through collaboration with other universities, both public and private. Cite specific queries made of other institutions with respect to shared courses, distance/distributed learning technologies, and joint-use facilities for research or internships.

Courses will be delivered through distance learning, purely online, traditional classroom and laboratory work; many of the courses have significant field components. There are many potential courses that already exist within FAU colleges and many new courses developed by the HBOI faculty that there is not a perceived need to look outside the university. With five courses delivered in the traditional way at HBOI, some broadcasted from the HBOI campus each semester, and others fully online or available through faculty based in Boca Raton and Davie, there will be no shortage of courses in the first years. What is more important is an assessment and monitoring of the effectiveness of the courses offered, and a reevaluation each year based on the assessment goals established in conjunction with the college assessment officer.

Given that many courses will have to be delivered through distance learning/elearning methods, the strength of the program is that the remaining courses are field inquiry intensive, laboratory intensive and in both cases, research intensive.

We expect that the majority of the students will be performing research towards their Master's thesis, DIS opportunities are available to all students and, when possible, Research Assistantships will be available for the students working on sponsored programs within the research labs. As indicated above, many of the courses are geared towards areas which are of interest to industrial partners. We will work with the partners to develop opportunities for students to gain relevant experience with the partners. Harbor Branch Oceanographic Institute runs a competitive intern program which provides hands-on experience for selected students including those in this program. Scientific communication skills are important and these will be provided through preparation for the student's thesis defense. Students will also be encouraged to participate in a scientific communication class. Students will be required to take part in a seminar series.

IX. Faculty Participation

A. Use Table 4 in Appendix A to identify existing and anticipated full-time (not visiting or adjunct) faculty who will participate in the proposed program through Year 5. Include (a) faculty code associated with the source of funding for the position; (b) name; (c) highest degree held; (d) academic discipline or specialization; (e) contract status (tenure, tenure-earning, or multi-year annual [MYA]); (f) contract length in months; and (g) percent of annual effort that will be directed toward the proposed program (instruction, advising, supervising internships and practica, and supervising thesis or dissertation hours).

Table 4 in Appendix A lists the faculty associated with the program. No new hires are required. Courses offered by Harbor Branch faculty are calculated as 0.25 % effort, the equivalent rate used to calculate tenure-track faculty effort. Harbor Branch faculty are considered existing faculty hired on contracts and grants since they are research faculty (non-tenure). In one case the course

is co-taught with an OPS College of Science adjunct faculty member (W. Louda) and is therefore calculated at 0.125 % effort. CES College of Science tenured and tenure-track faculty are considered faculty on a regular line. They are teaching existing courses that are offered as electives in the new degree program are calculated as 0.035% effort (1 student in a class of 7). Based on these calculations, the operation of the program will require 2.40 PY in faculty support each year; 0.26 PY will come from existing faculty on a regular line (CES College of Science) and 2.13 PY will come from existing faculty hired on contracts/grants (Harbor Branch research faculty).

B. Use Table 2 in Appendix A to display the costs and associated funding resources for existing and anticipated full-time faculty (as identified in Table 4 in Appendix A). Costs for visiting and adjunct faculty should be included in the category of Other Personnel Services (OPS). Provide a narrative summarizing projected costs and funding sources.

Faculty Salaries and Benefits associated with the program will be derived from Reallocated Base E&G ($102,230) and Enrollment Growth E&G ($110,875). Reallocated Base includes both the Administrative roles of the Program Leaders (S. Milton and P. McCarthy) and the costs associated with teaching existing courses by tenured and tenure-track faculty. Enrollment Growth E&G will pay the Harbor Branch research faculty who are existing faculty hired on grants and contracts. They will be developing and teaching new courses associated with the degree program. The expense associated with one adjunct College of Science faculty member (W. Louda, $3,983) is included as an OPS cost in the Enrollment Growth E&G. See section III A for more details.

C. Provide in the appendices the abbreviated curriculum vitae (CV) for each existing faculty member (do not include information for visiting or adjunct faculty).

D. Provide evidence that the academic unit(s) associated with this new degree have been productive in teaching, research, and service. Such evidence may include trends over time for average course load, FTE productivity, student HC in major or service courses, degrees granted, external funding attracted, as well as qualitative indicators of excellence.

Shown in the Biology and ES Program self-studies (attached) and in the attached curriculum vitae.

X. Non-Faculty Resources

A. Describe library resources currently available to implement and/or sustain the proposed program through Year 5. Provide the total number of volumes and serials available in this discipline and related fields. List major journals that are available to the university's students. Include a signed statement from the Library Director that this subsection and subsection B have been reviewed and approved.

The FAU Boca campus and HBOI have onsite libraries, with extensive physical and electronic collections.

The print volume count for books that could be categorized as Marine and Coastal Sciences totals **51,709**, plus an additional **4,930** unique e-book titles.

The number of print and electronic serials subscribed includes **16 print journals** (titles are listed in "BiologicalSciences_Print"; "Geosciences_Print"; "HBOI_Print", see attached) and **1,800 electronic journals** (titles are attached: MarineandCoastalScience_October2016.xls)

The libraries also have access to a number of journal titles through aggregator databases such as ProQuest Biological Science Collection or Academic Search Premier. All of the subscribed and aggregator titles are listed on the "Pivot" tab of the spreadsheet, attached.

B. Describe additional library resources that are needed to implement and/or sustain the program through Year 5. Include projected costs of additional library resources in Table 2 in Appendix A. Please include the signature of the Library Director in Appendix B.

No additional resources are being requested. This type of research has been done under other degree programs for many years at FAU, so the needed materials are already in place.

C. Describe classroom, teaching laboratory, research laboratory, office, and other types of space that are necessary and currently available to implement the proposed program through Year 5.

The existing space at each of the sites participating in the program is sufficient to meet the needs of both teaching and research opportunities. Facilities and research areas are described below.

FAU Harbor Branch Oceanographic Institute

Research Facilities. FAU Harbor Branch Oceanographic Institute has 34 buildings dedicated to marine science and technology research and education, and is located on 144 acres along the highly biodiverse Indian River Lagoon estuary in Fort Pierce, Florida. Major research facilities include a 30-acre aquaculture park, marine mammal critical care center and necropsy laboratory, and laboratories dedicated to natural products chemistry, cancer cell biology, bacteriology, molecular ecology, ancient DNA, coral health, harmful algal blooms, fisheries ecology, marine botany, aquaculture nutrition, aquatic animal health, dolphin photo identification, sensor development, undersea optics, and autonomous underwater and surface vehicles. Harbor Branch also has a machine shop, and facilities for conducting fabrication, robotics, hydraulics and pressure-testing work.

The HBOI boat marina contains several small vessels that can be used for fieldwork. This includes a 20' Mako and two 24' pontoon boats. The boats can either be launched from HBOI boat marina or transported by HBOI vehicle to a boat ramp for field work in that location. HBOI has a fully dedicated staff member who maintains the boats and HBOI boat marina.

Education Facilities. FAU Harbor Branch Oceanographic Institute's location offers a unique environment that provides immediate access to a range of marine ecosystems and close interaction with researchers from a broad range of disciplines. Harbor Branch is located along the Indian River Lagoon, an estuary well known for its high amount of biodiversity, and close to an Atlantic Ocean inlet. Nearby habitats include seagrass beds, mangrove forests, salt marshes,

mud and sand flats, beaches, rock ledges and sabellarid worm reefs.

The 21,000 square-foot Johnson Education Center contains classroom facilities, teaching laboratories, and an auditorium. The two classrooms can each accommodate up to 30 students or can be combined to hold a larger group. The classrooms are equipped for distance learning. The Auditorium, equipped with sophisticated audio-visual capabilities, can accommodate an audience of up to 350. The two teaching labs can be used with groups of up to 12 and 25 students respectively. Additional classroom space is available in the Link Engineering Building where the two main classrooms can each accommodate up to 50 students, while a smaller room can be used for classes with up to 15 students. A small training lab designed for computer-based training is also available for up to 8 students. The Exploration Command Center enables remote participation in ocean research expeditions through videoconferencing technology and can accommodate 20 researchers and students.

Research at Harbor Branch Oceanographic Institute

The following describes some of the research taking place at HBOI under the direction of members of the faculty:

Aquaculture and Stock Enhancement:

Dr. Susan Laramore: Interests: aquatic animal health, crustacean and bivalve diseases, with an emphasis on viral diseases; the effect of the environment on the progression of these diseases and immune system function.

Dr. Paul Wills: Interests: production of finfish for food, and for sportfish enhancement; use of chromosome set manipulation and sex control for improving production characteristics of finfish.

Dr. Marty Riche: Interests: fish nutrition and physiology including bioenergetics, nutrient requirements and availability, and development of broodstock and larval finfish diets.

Biomedical and Biotechnology:

Dr. Esther Guzmán: Interests: the design of high-throughput assays to test the potential anti-tumor or anti-inflammatory activities of marine natural products isolated from sponges and corals, and the elucidation of the mechanism of action of those compounds that exhibit biological activity to assess their potential as therapeutics.

Dr. Peter McCarthy: Interests: heterotrophic microbes associated with sponges and their use in biotechnology; the discovery of new antibiotics; exploring the microbial biodiversity of local waterways and the interaction of microbes with human activities.

Dr. Guojun Wang: Interests: elucidation of biosynthetic pathway of medically potent marine natural products isolated from microorganisms and invertebrates, studies of interesting enzymes found in pathways, and development and application of novel metabolic engineering methods. Current research activities include gene cluster cloning by genomic and metagenomic approaches, profiling of metabolites in cultured marine microorganisms, and biochemistry of enzyme functions.

Dr. Amy Wright: Interests: the bioassay-guided purification and structure elucidation of novel

marine natural products that may have utility in the treatment of human diseases. Of special interest are marine invertebrates derived from deep-water habitats accessible through the use of the Johnson-Sea-Link manned submersibles. Research projects include investigation of deep-water sponges and gorgonians as sources of novel antibacterial, antifungal, anti-inflammatory, anti-malarial, and antitumor agents.

Marine Ecosystem Health:

Dr. Matthew Ajemian: Interests: ecology and behavior of marine and estuarine fishes, particularly fisheries species and elasmobranchs (sharks and rays). Research projects include enhancement potential of artificial reefs, fish feeding ecology, habitat use, and migratory behavior.

Dr. Dennis Hanisak: Interests: physiology and ecology of marine plants (primarily macroalgae and sea grasses), including their primary production, nutrient uptake, and photobiology, as well as their cultivation and utilization as resources. Research projects include seagrass ecology, seaweed mariculture, coral reef ecology, and community dynamics of estuarine macrophytes.

Dr. Brian Lapointe: Interests: bottom-up controls on harmful algal blooms in subtropical and tropical coastal ecosystems on a variety of scales, ranging from organismal to multiple, linked ecosystems. Research projects include coral reef and seagrass ecology, physiological ecology of invasive macroalgae, and stable isotope analysis for assessing nutrient sources to coastal waters.

Dr. Gregory O'Corry-Crowe: Interests: Behavioral ecology and molecular genetics of top predators, including marine mammals. Research fields include conservation genetics, polar ecology, immune function, genomics and the evolution of social organization. Research projects include the application of molecular genetics to Arctic marine mammal conservation including polar bears, beluga whales and ice seals, and the genetics of health and fitness in Florida whales and dolphins.

Dr. Joshua Voss: Interests: coral reef ecology and community dynamics, environmental drivers and impacts of coral diseases, development of advance molecular technologies with field-based ecological applications, molecular profiling of bacterial communities, marine conservation and management.

Ocean Dynamics and Modeling:

Dr. Laurent Cherubin: Interests: vortex and current dynamics and interaction with topography; Lagrangian transport; ocean numerical modeling; physical processes that control larval transport and connectivity; cross-shelf exchange mechanisms and plankton dynamics; instrument and field studies.

Dr. Mingshun Jiang: Interests: estuarine and coastal dynamics, ocean iron and carbon cycles, water quality, ecosystem functioning, and coastal inundation. Research projects include modeling carbon cycle and pH for understanding ocean acidification in estuarine and coastal oceans, modeling water quality and harmful algal blooms in estuarine and coastal oceans, modeling iron (Fe) and carbon cycle in shelf and open oceans.

Ocean Engineering and Ocean Optics:

Dr. Fraser Dalgleish: Interests: underwater LASER and optical sensors for ocean observatories, imaging, and communications networks. Projects are based in the Ocean Visibility and Optics Laboratory (a large underwater test facility at HBOI) and/or involve field deployments of autonomous underwater vehicles, remotely operated vehicles, profilers, landers, or gliders.

Dr. Bing Ouyang: Interests: underwater laser imaging system, image and signal processing and oceanographic data analysis, visualization and management. Projects are based in the Ocean Visibility and Optics Laboratory to develop techniques for data analysis, visualization and/or management.

Dr. James Sullivan: Interests: mechanisms controlling the spatial-temporal dynamics of phytoplankton populations, bio-physical interactions, ocean optics and remote sensing, Harmful Algal Bloom (red tide) dynamics, bioluminescence in the ocean, and the development and use of optical and autonomous instrumentation and analytical techniques.

Dr. Mike Twardowski: Interests: optical sensor design-development-application for environmental characterization in oceans and coastal/estuarine areas, oceanic particle field dynamics, ocean color remote sensing, active laser remote sensing, underwater imaging, long-term monitoring strategies

Dr. Anni Vuorenkoski Dalgleish: Interests: optical sensor technology for environmental characterization in oceans and coastal/estuarine areas, underwater laser imaging and communication, benthic mapping and classification. Projects include the use of engineering software (such as CAD, FEM, CFD, Matlab, LabVIEW, or Raytrace) and/or prototype development, construction, and experimental evaluation.

Ocean Exploration:

Dr. Shirley Pomponi: Interests: cell biology, physiology, and systematics of marine sponges with an emphasis on tropical shallow and deep-water species that produce biologically active metabolites.

The Biological Sciences Department at FAU

Classroom and teaching laboratory space are located in the Sanson Science building, with recent renovations permitting distance learning between FAU campuses from some classrooms. No additional teaching space is required to implement the proposed MS MSO degree program.

Major focal areas of the Department of Biological Sciences in the marine sciences area include marine conservation, invertebrate and vertebrate physiology and behavior, sensory biology of marine invertebrates and vertebrates (particularly sea turtles and sharks), and coastal ecology and nutrient cycling, including climate change and ocean acidification.

Pelagic Fish Program (Drs.John Baldwin, Tim Theisen): The FAU pelagic fish program is primarily investigating the horizontal and vertical movements of highly mobile pelagic fish species, and the stock structures that are in many cases maintained by selective movements**.**

Sea Turtle Program (Drs. Jeanette Wyneken, Mike Salmon, Sarah Milton): FAU is a regional center for sea turtle research and conservation. Faculty currently work with staff of the Office of

Protected Resources (OPR) in NOAA's National Marine Fisheries Service program. The sea turtle research at FAU is primarily focused on behavior, population ecology, and physiology. This research is primarily comparative including morphological, behavioral, and physiological studies on hatchlings, juveniles, and adults.

Elasmobranch Program (Dr. Stephen Kajiura): The FAU Elasmobranch Research Laboratory is currently one of the premier facilities in North America for the study of elasmobranch sensory physiology. Although the research is based upon the pure science aspect of sensory physiology, recent work includes applied projects relevant to NOAA's NMFS. One recently funded NMFS project applies shark electroreception to decreasing the incidental bycatch of sharks in commercial longline fisheries. A current project examines olfaction in oiled waters. In addition to small equipment, the Kajiura lab has a small boat for nearshore shark research, including tagging and migration work.

Florida Bay Ecosystem Program (Dr. Koch): The majority of this work is in shallow tropical carbonate environments of South Florida, The Bahamas and wider Caribbean. The FAU Florida Bay program's current research focuses on biogeochemical changes in tropical marine ecosystems in response to climate change and their effects on marine plant communities.

Each research group/PI has their own laboratory and office space, with benchtop equipment appropriate to their area of research. Department facilities available include secretarial support, fax machines, and computer and technical support. University facilities include a machine shop, electronics shop, comprehensive library, and graphics and computer departments.

Gumbo Limbo Nature Center (GLNC) complex. The GLNC extends over 20 acres of habitat with an emphasis on SF coastal and marine resources, and includes two 80,000gal reef tanks, a shallow mangrove habitat tank, and sea turtle rehabilitation facilities with available public viewing. Within the FAU lab are facilities for marine studies with multiple tanks supplied with running seawater. Current research at the FAU lab includes projects on sea turtle sex determination in hatchlings, tracking of juvenile turtles, shark electromagnetic reception, and ocean acidification.

The Geoscience Department at FAU

Biogeography Research Lab. Dr. Scott Markwith
The Biogeography Lab contains all of the equipment necessary to conduct population genetic analysis (with the exception of an ABI 300 or 3000 series DNA analyzer for capillary gel electrophoresis). However, the lab does contain a Biorad PTC 200 DNA Engine for PCR, New Brunswick I-Series Incubator Shaker, Savant Speed Vac, Mettler Toledo XP Series Balance, non-refrigerated Eppendorf microcentrifuge, refrigerated Fisher Accuspin 1R centrifuge, Ultra-low temp freezer (-80ºC), -20ºC enzyme/sample freezer, 4ºC refrigerator, vortexers, Fisher Isotemp Digital Stirring Hotplate, horizontal gel electrophoresis systems, Photo-Doc-it electrophoresis documentation system and UV transilluminator, microwave, Eppendorf Research Series 2100 Adjustable Volume Pipettors, and assorted glassware, plasticware, mortar and pestles etc., and a fume hood just a couple doors down.

Other equipment associated with and used by the lab for field research include Dodge Ram king cab truck for towing, SonTek/YSI Flowtracker Handheld-ADV acoustic dopler velocity meter, Marsh-McBirney Flow-Mate 2000 velocity meter, Advanced Telemetry Systems receiver and antenna, laser rangefinder/clinometer, light meter, portable pH meter, dbh tape, dbh caliper, 2 tree corers, and numerous 30 m measuring tapes.

Coastal Studies Lab: (Dr. Tiffany Roberts Briggs) The Coastal Studies Lab at FAU supports field and laboratory research focusing on coastal morphodynamics (i.e., morphology, sedimentology, and physical processes). The lab is equipped with state-of-the-art surveying equipment, including a high-accuracy (sub-centimeter) Real-Time Kinematic Global Positioning System (RTK GPS) and a rugged electronic total station. Field research is facilitated by a Ford F150 4x4 for transportation/towing and a Polaris Ranger UTV for off-road accessibility. A Ro-Tap Sediment Shaker (with 1/4 phi interval sieves), low-temperature oven, fume hood, wave staffs, streamer traps, and several computer workstations support a variety of undergraduate and graduate research projects.

The Department of Geosciences also has a lab and equipment space in T5, which is a building that served as a barracks when the site of FAU's Boca Raton campus was used as an Air Force base. That space is used for field sampling staging, dirty sample processing, and storage for two fully equipped 12 ft kayaks and transport rack system, a 17 ft Carolina Skiff with 45 hp Johnson outboard motor, and a 14 ft Carolina Skiff.

FAU Greenhouse, Boca Raton

A greenhouse located on FAU's Boca Raton campus is openly available for use. The greenhouse has fully automated controls for cooling and watering, and has been used for seed germination tests, growing native and exotic apple snails (*Pomacea paludosa and P. insularum*), and herbivory studies of snails on *Vallisneria americana*, for studies on the impacts of increased salinity (rising sea levels) on freshwater marsh communities, and on hyperspectral research on the spectral response of vegetation to increased levels of salinity

Environmental Geophysics Lab: (Dr. Xavier Comas) The Department of Geosciences Environmental Geophysics Labat FAU focuses in near-surface hydrogeophysical methods to investigate a wide array of environmental issues at both the laboratory and field scales, particularly in the Everglades. Projects range from limestone and peat studies in the Everglades and northern peatlands abroad, to stratigraphic and archaeological applications. The lab is equipped with state-of-the-art geophysical equipment with emphasis in electromagnetic methods such as ground penetration radar and terrain conductivity, and provides hands-on research opportunities for both undergraduate and graduate students.

Water Analysis Lab: (Dr. Tara Root) Provides high quality analyses of water samples to support environmental research done by faculty in the department, the university, and their collaborators. The lab places a strong emphasis on providing educational and research opportunities for both undergraduate and graduate students. The lab is being equipped with state-of-the-art instrumentation to perform nutrient, alkalinity, and elemental analyses. We also

analyze for stable isotopes of water.

Geovisualization Lab: (James Gammack-Clark) A specialized lab for courses and projects involving 3D mapping, 3D visualization, virtual mapping, map animation, and other Geovisualization projects. Twenty workstation dell computers with level NVidia Quadro GPUs, NVidia 3D vision system, supporting stereo 3D applications with active shutter glasses.

Geospatial Computing Labs (Dr. Tobin Hindle) In Boca Raton, an Open Instructional lab: Forty two seat VDI computer lab, HP Thin clients accessing Citrix Xendesktop virtual machines on three Dell servers with 112GB RAM each and 15K SAS drives in RAID. In Davie, Open Instructional lab Twenty four seat VDI computer lab, Wyse Zero clients accessing Citrix Xendesktop virtual machines on two Dell servers with 48GB RAM each and SATA drives in RAID 10.

D. Describe additional classroom, teaching laboratory, research laboratory, office, and other space needed to implement and/or maintain the proposed program through Year 5. Include any projected Instruction and Research (I&R) costs of additional space in Table 2 in Appendix A. Do not include costs for new construction because that information should be provided in response to X (E) below.

We do not see a need for additional space to implement and run this program through year 5. As described above, an extensive research infrastructure is available for student research. Classes will be taught within the existing space.

E. If a new capital expenditure for instructional or research space is required, indicate where this item appears on the university's fixed capital outlay priority list. Table 2 in Appendix A includes only Instruction and Research (I&R) costs. If non-I&R costs, such as indirect costs affecting libraries and student services, are expected to increase as a result of the program, describe and estimate those expenses in narrative form below. It is expected that high enrollment programs in particular would necessitate increased costs in non-I&R activities.

N/A

F. Describe specialized equipment that is currently available to implement the proposed program through Year 5. Focus primarily on instructional and research requirements.

This would be a very extensive list as there are many labs involved. However, there are no new requests for additional equipment and all the courses that exist or have been developed have considered the impact of additional students. As the students will be spread across a number of areas, the impacts will be minimal and they will likely increase the probability that some low enrollment courses will be offered.

G. Describe additional specialized equipment that will be needed to implement and/or sustain the proposed program through Year 5. Include projected costs of additional equipment in Table 2 in Appendix A.

Nothing has been anticipated as the program is modeled on existing master degree programs in Geoscience, Biology and Environmental Science. Students have been undertaking work in marine and coastal science at FAU for many decades using existing equipment, but now the research facilities at Harbor Branch will become part of the teaching mission of FAU.

H. Describe any additional special categories of resources needed to implement the program through Year 5 (access to proprietary research facilities, specialized services, extended travel, etc.). Include projected costs of special resources in Table 2 in Appendix A.

Given the large diversity of existing facilities, courses and research labs, the primary focus in the early years will be to review the curriculum and identify the long term program needs once it is understood in which labs the students will concentrate, and where specifically our students will fit into the workforce in Florida.

I. Describe fellowships, scholarships, and graduate assistantships to be allocated to the proposed program through Year 5. Include the projected costs in Table 2 in Appendix A.

Student enrollment is expected to provide a headcount of 37 students in the program by Year 2 increasing to over 70 students by Year 5. These students will be supported from varied sources: Research Assistantships associated with grants and contracts; scholarships and fellowships from competitive sources such as the Indian River Lagoon Graduate Research Fellowship and the FAU Harbor Branch ForEverglades Scholarship; and Teaching Assistantships at Indian River State College. We request Teaching Assistantships be assigned as the program grows starting with two in Year 2 and rising to seven in Year 5. The TAship assignments will be allocated across the colleges. There may be opportunities for TAship assignments at Harbor Branch if additional FAU Semester-by-the-Sea courses are offered or other courses that the colleges would like for Harbor Branch faculty to deliver in specialized areas such as aquaculture, marine biomedical and biotechnology research.

J. Describe currently available sites for internship and practicum experiences, if appropriate to the program. Describe plans to seek additional sites in Years 1 through 5.

An arrangement with the FPL Marine Life center established by Dale Gawlik through Joanne Fontaine and Sarah Marmion of FP and L has created a series of self-funding internships for FAU marine mammal students as docents. Currently eight have been hired, and it is anticipated that they will continuously support applicants from across FAU. These internships are timed to coincide with FAU semesters. Internships at Harbor Branch are available at Harbor Branch on a competitive basis during the Summer semester, these provide paid opportunities to work on a research project with a member of the HBOI research faculty. A meeting with Jennifer Blythe of the Career Development Center established ways in which we could set up internship graduate courses and internship positions in industries external to FAU. Once the degree is in place, meetings with HBOI faculty will explore industry connections that can be used to expand the internship programs through the Career Development Center.

APPENDIX B

Please include the signature of the Equal Opportunity Officer and the Library Director.

Signature of Equal Opportunity Officer	**Date**
Signature of Library Director	**Date**

This appendix was created to facilitate the collection of signatures in support of the proposal. Signatures in this section illustrate that the Equal Opportunity Officer has reviewed section II.E of the proposal and the Library Director has reviewed sections X.A and X.B.

RE: New MS degree proposal

Katrina Oliver
Sent: Monday, October 03, 2016 2:41 PM
To: Peter McCarthy
Cc: Sarah Milton; Len Baker

Peter,

I have reviewed the information you submitted and I am satisfied with the diversity response. I have no additional questions. EIC approves. I will sign and have Len submit as you have requested.

Best,

Katrina Oliver, J.D.

Executive Director ‖ Equity, Inclusion, and Compliance
Florida Atlantic University
777 Glades Road, ADM 268
Boca Raton, FL 33431
Tel: 561.297.2345 ‖ Fax: 562.297.2402

From: Peter McCarthy [mailto:PMCCART5@fau.edu]
Sent: Friday, September 30, 2016 3:37 PM
To: Katrina Oliver <katrinaoliver@fau.edu>
Cc: Sarah Milton <smilton@fau.edu>
Subject: New MS degree proposal

Dear Ms. Oliver

Dr. Sarah Milton and I are preparing a proposal for a new MS program at FAU, the current version of this document is attached. Could you please review Section II.E. "Indicate what steps have been taken to achieve a diverse student body in this program..." and, if appropriate, sign and date Appendix B. If we are missing something please let me know. If it can be signed, please return to me as both a scanned version and an original via inter-office mail.

Thank you for your time.

Regards
Peter

Peter J. McCarthy, Ph.D.

Research Professor
Marine Biomedical and Biotechnology Research

Associate Director for Education

Harbor Branch Oceanographic Institute
Florida Atlantic University
5600 US#1 North
Fort Pierce, FL 34946
(772) 242 2632
(772) 468 0757 (Fax)
Pmccart5@hboi.fau.edu

APPENDIX B

Please include the signature of the Equal Opportunity Officer and the Library Director.

Signature of Equal Opportunity Officer — Date 10/3/16

Signature of Library Director — Date

This appendix was created to facilitate the collection of signatures in support of the proposal. Signatures in this section illustrate that the Equal Opportunity Officer has reviewed section II.E of the proposal and the Library Director has reviewed sections X.A and X.B.

APPENDIX B

Please include the signature of the Equal Opportunity Officer and the Library Director.

Signature of Equal Opportunity Officer	**Date**
Signature of Library Director	10/10/16 **Date**

This appendix was created to facilitate the collection of signatures in support of the proposal. Signatures in this section illustrate that the Equal Opportunity Officer has reviewed section II.E of the proposal and the Library Director has reviewed sections X.A and X.B.

APPENDIX A

TABLE 1-B
PROJECTED HEADCOUNT FROM POTENTIAL SOURCES
(Graduate Degree Program)

Source of Students (Non-duplicated headcount in any given year)*	Year 1		Year 2		Year 3		Year 4		Year 5	
	HC	FTE	HC	FTE	HC	FTE	HC	FTE	HC	FTE
Individuals drawn from agencies/industries in your service area (e.g., older returning students)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Students who transfer from other graduate programs within the university**	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Individuals who have recently graduated from preceding degree programs at this university	6	5.2	14	12.1	18	15.6	20	17.3	20	17.3
Individuals who graduated from preceding degree programs at other Florida public universities	5	4.3	12	10.4	16	13.8	16	13.8	17	14.7
Individuals who graduated from preceding degree programs at non-public Florida institutions	1	0.9	3	2.6	5	4.3	8	6.9	9	7.8
Additional in-state residents***	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Additional out-of-state residents***	3	2.6	8	6.9	11	9.5	14	12.1	20	17.3
Additional foreign residents***	0	0.0	0	0.0	1	1.0	3	3.0	7	7.0
Other (Explain)***	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Totals	**15**	**13.0**	**37**	**32.0**	**51**	**44.3**	**61**	**53.2**	**73**	**64.1**

* List projected annual headcount of students enrolled in the degree program. List projected yearly cumulative ENROLLMENTS instead of admissions.

** If numbers appear in this category, they should go DOWN in later years.

APPENDIX A

TABLE 2

PROJECTED COSTS AND FUNDING SOURCES

Instruction & Research Costs (non-cumulative)	Year 1 Funding Source								Year 5 Funding Source						
	Reallocated Base* (E&G)	Enrollment Growth (E&G)	New Recurring (E&G)	New Non-Recurring (E&G)	Contracts & Grants (C&G)	Philanthropy Endowments	Enterprise Auxiliary Funds	**Subtotal coulumns 1+…+7**	Continuing Base** (E&G)	New Enrollment Growth (E&G)	Other*** (E&G)	Contracts & Grants (C&G)	Philanthropy Endowments	Enterprise Auxiliary Funds	**Subtotal coulumns 9+…+ 14**
Columns	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Faculty Salaries and Benefits	102,230	110,875	0	0	0	0	0	**$213,105**	219,498	0	0	0	0	0	**$219,498**
A & P Salaries and Benefits	46,242	0	0	0	0	0	0	**$46,242**	47,629	0	0	0	0	0	**$47,629**
USPS Salaries and Benefits	5,845	0	0	0	0	0	0	**$5,845**	6,020	0	0	0	0	0	**$6,020**
Other Personal Services	0	3,983	0	0	0	0	0	**$3,983**	3,983	0	0	0	0	0	**$3,983**
Assistantships & Fellowships	0	0	0	0	50,000	50,000	0	**$100,000**	92,634	0	0	150,000	150,000	0	**$392,634**
Library	0	0	0	0	0	0	0	**$0**	0	0	0	0	0	0	**$0**
Expenses	0	0	0	0	0	0	0	**$0**	0	0	0	0	0	0	**$0**
Operating Capital Outlay	0	0	0	0	0	0	0	**$0**	0	0	0	0	0	0	**$0**
Special Categories	0	0	0	0	0	0	0	**$0**	0	0	0	0	0	0	**$0**
Total Costs	**$154,317**	**$114,858**	**$0**	**$0**	**$50,000**	**$50,000**	**$0**	**$369,175**	**$369,765**	**$0**	**$0**	**$150,000**	**$150,000**	**$0**	**$669,765**

*Identify reallocation sources in Table 3.

**Includes recurring E&G funded costs ("reallocated base," "enrollment growth," and "new recurring") from Years 1-4 that continue into Year 5.

***Identify if non-recurring.

Faculty and Staff Summary

Total Positions	Year 1	Year 5
Faculty (person-years)	2.40	2.39
A & P (FTE)	0	0
USPS (FTE)	0	0

Calculated Cost per Student FTE

	Year 1	Year 5
Total E&G Funding	$269,175	$369,765
Annual Student FTE	13	64.1
E&G Cost per FTE	$20,705.77	$5,769

Table 2 Column Explanations

Reallocated Base* (E&G)	1	E&G funds that are already available in the university's budget and will be reallocated to support the new program. Please include these funds in the Table 3 – Anticipated reallocation of E&G funds and indicate their source.

APPENDIX A

TABLE 3
ANTICIPATED REALLOCATION OF EDUCATION & GENERAL FUNDS*

Program and/or E&G account from which current funds will be reallocated during Year 1	Base before reallocation	Amount to be reallocated	Base after reallocation
P. McCarthy, HBOI (0.3 FTE)	170,205	51,062	**$119,144**
S. Milton, CES College of Science (3 months Summer salary)	131,037	32,759	**$98,278**
0.26 FTE CES College of Science faculty from Table 4 (MSO student participation in courses already taught by CoS)	128,860	18,409	**$110,451**
0.5 FTE admin support (A&P, HBOI - Year 1)	92,484	46,242	**$46,242**
0.1 FTE admin support (USPS, HBOI - Year 1)	58,452	5,845	**$52,607**
Totals	$581,038	$154,317	**$426,721**

*** If not reallocating funds, please submit a zeroed Table 3**

APPENDIX A

TABLE 4
ANTICIPATED FACULTY PARTICIPATION

Faculty Code	Faculty Name or "New Hire" Highest Degree Held Academic Discipline or Speciality	Rank	Contract Status	Initial Date for Participation in Program	Mos. Contract Year 1	FTE Year 1	% Effort for Prg. Year 1	PY Year 1	Mos. Contract Year 5	FTE Year 5	% Effort for Prg. Year 5	PY Year 5
D	Laurent Cherubin, Ph.D. Marine Science	Assoc. Prof	Non-Tenure	Fall 2017	12	1.00	0.25	0.25	12	1.00	0.25	0.25
D	Mingshun Jiang, Ph.D. Physical Oceanography	Assoc. Prof	Non-Tenure	Spring 2018	12	1.00	0.25	0.25	12	1.00	0.25	0.25
D	James Sullivan, Ph.D. Oceanography	Prof	Non-Tenure	Fall 2017	12	1.00	0.13	0.13	12	1.00	0.13	0.13
D	Peter McCarthy Biochemistry	Prof	Non-Tenure	Fall 2017	12	1.00	0.25	0.25	12	1.00	0.25	0.25
D	M. Dennis Hanisak, Ph.D. Biological Sciences	Prof	Non-Tenure	Fall 2017	12	1.00	0.25	0.25	12	1.00	0.25	0.25
D	Fraser Dalgleish, Ph.D. Engineering	Assoc. Prof	Non-Tenure	Spring 2018	12	1.00	0.25	0.25	12	1.00	0.25	0.25
D	Anni Dalgleish, Ph.D. Engineering	Asst. Prof	Non-Tenure	Spring 2018	12	1.00	0.25	0.25	12	1.00	0.25	0.25
D	Joshua Voss, Ph.D. Biological Sciences	Asst. Prof	Non-Tenure	Spring 2018	12	1.00	0.25	0.25	12	1.00	0.25	0.25

D	Susan Laramore, Ph.D. Biological Sciences	Asst. Prof	Non-Tenure	Spring 2018	12	1.00	0.25	0.25	12	1.00	0.25	0.25
D	Paul Wills, Ph.D. Zoology	Prof	Non-Tenure	Fall 2018	12	0.00	0.00	0.00	0	0.00	0.00	0.00
D	Bing Ouyang, Ph.D. Electrical Engineering	Asst. Prof	Non-Tenure	Fall 2018	12	0.00	0.00	0.00	0	0.00	0.00	0.00
A	Sarah Milton, Ph.D. Marine Biology and Fisheries	Assoc. Prof	Tenured	Fall 2017	9	0.75	0.04	0.03	9	0.75	0.04	0.03
A	Stephen Kajiura, Ph.D. Zoology	Prof	Tenured	Fall 2017	9	0.75	0.04	0.03	9	0.75	0.04	0.03
A	Marguerite Koch-Rose, Ph.D. Biological Science: Marine	Prof	Tenured	Fall 2018	9	0.00	0.00	0.00	0	0.00	0.00	0.00
A	Marianne Porter, Ph.D. Biological Science	Asst. Prof	Tenure Track	Spring 2018	9	0.75	0.04	0.03	9	0.75	0.04	0.03
A	Nathan Dorn, Ph.D. Zoology	Assoc. Prof.	Tenured	Fall 2018	9	0.00	0.00	0.00	9	0.00	0.00	0.00
	Dale Gawlick, Ph.D. Wildlife Science	Prof.	Tenured	Fall 2018	9	0.00	0.00	0.00	9	0.00	0.00	0.00
A	Tanja Godenschwege, Ph.D. Biology	Assoc. Prof.	Tenured	Spring 2017`	9	0.75	0.04	0.03	9	0.75	0.04	0.03
A	Jeanette Wyneken, Ph.D. Biological Science	Prof.	Tenured	Summer 2018	9	0.75	0.04	0.03	9	0.75	0.04	0.03
A	Scott Markwith, Ph.D. Geography	Assoc. Prof	Tenured	Fall 2017	9	0.75	0.04	0.03	9	0.75	0.04	0.03
A	Anton Oleinik, Ph.D. Geology	Assoc. Prof.	Tenured	Fall 2018	9	0.00	0.00	0.00	9	0.00	0.00	0.00
A	Charles Roberts, Ph.D. Geography	Assoc. Prof	Tenured	Spring 2017	9	0.00	0.00	0.00	9	0.00	0.00	0.00

A	Tiffany Roberts Briggs, Ph.D. Geology	Assist. Prof.	Tenure Track	Fall 2017	9	0.75	0.04	0.03	9	0.75	0.04	0.03
A	Tara Root Ph.D. Geology and Geophysics	Assoc. Prof.	Tenured	Spring 2018	9	0.00	0.00	0.00	9	0.00	0.00	0.00
	Caiyun Zhang, Ph.D. Geospatial Information Sciences	Assoc. Prof.	Tenured	Spring 2018	9	0.00	0.00	0.00	9	0.00	0.00	0.00
A	Erik Noonburg, Ph.D. Biological Sciences	Assoc. Prof.	Tenured	Spring 2018	9	0.75	0.04	0.03	9	0.75	0.04	0.03
A	Zhixiao Xie, Ph.D Geography	Prof	Tenured	Fall 2017	9	1.00	0.04	0.04	9	0.75	0.04	0.03
A	David Warburton, Ph.D. Geophysical Sciences	Assoc. Prof.	Tenured	Fall 2017	9	0.75	0.04	0.03	9	0.75	0.04	0.03
	Total Person-Years (PY)							**2.40**				**2.39**

Faculty Code		**Source of Funding**	**PY Workload by Budget Classsification**		
			Year 1		**Year 5**
A	Existing faculty on a regular line	Current Education & General Revenue	0.27		0.26
B	New faculty to be hired on a vacant line	Current Education & General Revenue	0.00		0.00
C	New faculty to be hired on a new line	New Education & General Revenue	0.00		0.00
D	Existing faculty hired on contracts/grants	Contracts/Grants	2.13		2.13
E	New faculty to be hired on contracts/grants	Contracts/Grants	0.00		0.00
		Overall Totals for	**Year 1** 2.40		**Year 5** 2.39

RE: new Master's degree porgram in Marine Science and Oceanography

William Brooks
Sent: Tuesday, October 04, 2016 8:04 PM
To: Sarah Milton; Rodney Murphey
Cc: Peter McCarthy; Charles Roberts; Russ Ivy; Janet Blanks; Michelle Cavallo; Kenneth Dawson Scully; David Binninger; Dale Gawlik; Sarah Milton; William Brooks

Dear Sarah,

As a chair of a Biology Graduate Programs Committee (a committee within the Department of Biological Sciences), we offer full support for the MS Program in Marine Science and Oceanography.

Regards,
Randy

W. Randy Brooks, PhD
Professor of Biology
Chair, FAU Biology Undergraduate & MS Graduate Program Committees
Boca Raton, FL 33431, Phone: 561-297-3888, Email: wbrooks@fau.edu

http://www.science.fau.edu/biology/faculty/brooks.html

http://www.science.fau.edu/biology/masters/masters.html

http://www.science.fau.edu/biology/masters/masters-faqs.html

From: Sarah Milton
Sent: Monday, October 03, 2016 4:16 PM
To: Rodney Murphey; William Brooks
Cc: Peter McCarthy; Charles Roberts; Russ Ivy; Janet Blanks; Michelle Cavallo
Subject: new Master's degree porgram in Marine Science and Oceanography

Dear Drs. Murphey and Brooks:

Please find attached a program description for a new Masters Degree Program in Marine Science and Oceanography (MS-MSO) with an attached memo from myself and Peter McCarthy as Program co-Directors.

Under the "Consult and list departments that might be affected by the change and attach comments" box, we are including both the Department of Biological Sciences IB-PhD program and the Masters of Biology degree.

Kindly send a letter of support or an email with your comments.

Thank you very much for your time and attention.

Regards,

Dr. Sarah L. Milton
Associate Professor
Department of Biological Sciences
FAU

FAU
FLORIDA ATLANTIC UNIVERSITY

Charles E. Schmidt College of Science
Department of Biological Sciences
777 Glades Road
Boca Raton, FL 33431
tel: 561.297-3320
fax: 561.297-2749

MEMORANDUM

DATE: October 5, 2016

TO: Drs. Sarah Milton and Peter McCarthy, Co-Directors, Marine Science and Oceanography Master's Program

FROM: Rod Murphey, Professor and Chair
Department of Biological Sciences

SUBJECT: Graduate Program Proposal: Marine Science and Oceanography Master's Program

The Department of Biology has reviewed and supports the proposal to establish the Marine Science Master's Program.

cc: Charles Roberts, Associate Dean for Graduate Studies, CESCOS

RE: new Masters degree program in Marine Science and Oceanography

Zhixiao Xie
Sent: Wednesday, October 05, 2016 10:36 AM
To: Sarah Milton; Charles Roberts
Cc: Peter McCarthy; Russ Ivy; Janet Blanks; Sarah Milton

Dear Dr. Milton,
The Geosciences Department supports the proposal.

Zhixiao

Dr. Zhixiao Xie
Professor and Chair
Geosciences Department
Florida Atlantic University
Tel: 561-297-2852

From: Sarah Milton [mailto:smilton@fau.edu]
Sent: Monday, October 3, 2016 4:10 PM
To: Zhixiao Xie <xie@fau.edu>; Charles Roberts <croberts@fau.edu>
Cc: Peter McCarthy <PMCCART5@fau.edu>; Russ Ivy <IVY@fau.edu>; Janet Blanks <blanks@fau.edu>; Sarah Milton <smilton@fau.edu>
Subject: new Masters degree program in Marine Science and Oceanography

Dear Drs. Xie and Roberts:

Please find attached the Graduate Program Change Request form to add a new Masters Degree Program in Marine Science and Oceanography (MS-MSO) with an attached memo from myself and Peter McCarthy as Program co-Directors.

Under the "Consult and list departments that might be affected by the change and attach comments" box, we are including the Department of Geosciences.

Kindly send a letter of support or an email with your comments.

Thank you very much for your time and attention.

Regards,

Dr. Sarah L. Milton
Associate Professor
Department of Biological Sciences
FAU

HARBOR BRANCH

FLORIDA ATLANTIC UNIVERSITY

October 10, 2016

Sarah Milton, Ph.D.
Associate Professor
Associate Director, IB Ph.D. Program
Department of Biological Sciences
FAU CES College of Science

Peter McCarthy, Ph.D.
Research Professor
Associate Director of Education
FAU Harbor Branch Oceanographic Institute

Dear Sarah and Peter,

This letter of support is from FAU Harbor Branch Oceanographic Institute (Harbor Branch) to support the creation of the new MS degree program in Marine Science and Oceanography. Harbor Branch administration and faculty have been involved in the degree program conception and design. We have worked closely with administration and faculty in the CES College of Science specifically in the Departments of Biological Sciences and Geosciences.

We are excited about the new degree program and look forward to offering this graduate program in conjunction with FAU college faculty. FAU Harbor Branch research faculty will be able to offer outstanding courses in the fields of marine science, ocean exploration and technology, and oceanography along with providing excellent research experiences for the graduate students that will prepare them for continued graduate studies at the doctoral level and/or for the workforce.

In order to offer these courses and research opportunities for graduate students it is important to note that since Harbor Branch 12-month research faculty are non-tenure faculty, Harbor Branch will need university funding to support the development of the courses, continued support for the teaching of the courses, and other additional support may be necessary for the degree program delivery.

FAU Harbor Branch appreciates this opportunity to provide a letter of support and to be a major participant in the success of this degree program.

Sincerely,

Megan Davis

Megan Davis, Ph.D., Harbor Branch Interim Executive Director

cc: Patrick Boles, FAU Harbor Branch Associate Executive Director
Anton Post, Ph.D., FAU Harbor Branch Incoming Executive Director
Daniel Flynn, Ph.D., FAU VP of Research

New MS Program in Marine Science and Oceanography

Dale Gawlik [dgawlik@fau.edu]
Sent: Tuesday, October 11, 2016 1:16 PM
To: Sarah Milton
Cc: Peter McCarthy

Dear Sarah and Peter,
The Environmental Science Program administers the interdisciplinary Environmental Science MS degree. As such, it could be affected by the proposed new MS degree in Marine Science and Oceanography (MSO).
Although there is some overlap in courses between the two MS programs, I appreciate the effort to reduce that overlap from earlier versions of this degree, thus giving the MSO a distinct interdisciplinary domain. The effort to focus the MSO degree to areas of marine science that are not currently covered by the Environmental Science MS degree make it likely that the MSO degree will attract a new cohort of applicants that might not have been interested in the Environmental Science MS degree.

As such, the Environmental Science Program supports the development of the Marine Science and Oceanography MS degree.
Dale Gawlik

--
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Dr. Dale E. Gawlik, Director
Environmental Science Program
Professor of Biological Sciences
Florida Atlantic University
777 Glades Road
Boca Raton, FL 33431-0991
561.297.3333
561.297.2749 (fax)
dgawlik@fau.edu
www.science.fau.edu/biology/gawliklab
www.science.fau.edu/biology/envirosci
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Library Resources for the Proposed New Master's Program in Marine and Coastal Science

Zach English / October 3rd, 2016

Related Print Volumes (held in the Boca Raton, Jupiter and Harbor Branch campus libraries' collections)

G (Geography – General): 3,015

GA (Mathematical Geography/ Cartography): 297

GB (Physical geography): 6,177

GC (Oceanography): 2,482

GE (Environmental Sciences): 1,139

QC (Physics):

(Optics): 735

(Meteorology and Climate): 1,081

QD (Chemistry): 8,064

QE (Geology): 6,839

QH (Natural history – Biology): 9,439

QK (Botany): 2,964

QL (Zoology): 7,451

QR (Microbiology): 2,026

Current Titles

Title: CARIBBEAN GEOGRAPHY

NOTIS Print: 329701
NOTIS Elec.:
CallNo: G1 C37
Amount: $57.00

Format Print
Type:

Department/College
GEOSCIENCES / SCIENCE

Title: NAUTILUS

NOTIS Print: 155873
NOTIS Elec.: 1562700
CallNo: HBOI
Amount: $123.34

Format Print
Type:

Department/College
BIOLOGICAL SCIENCES / SCIENCE
GEOSCIENCES / SCIENCE
HARBOR BRANCH / SCIENCE

Title: PERSPECTIVE NATIONAL COUNCIL FOR GEOGRAPHIC EDUCATION

NOTIS Print: AEX4180
NOTIS Elec.:
CallNo:
Amount: $0.00

Format Print
Type: Child

Department/College
GEOSCIENCES / SCIENCE

Title: PROFESSIONAL GEOGRAPHER

NOTIS Print: ACM0845
NOTIS Elec.: 803848
CallNo: G3 P7
Amount: $0.00

Format Print, Electronic
Type:

Department/College
GEOSCIENCES / SCIENCE

Title: SCIENTIFIC AMERICAN

NOTIS Print: 156343
NOTIS Elec.: 1562701
CallNo: HBOI

Amount: $199.50

Format Print
Type:

Department/College
BIOLOGICAL SCIENCES / SCIENCE
GEOSCIENCES / SCIENCE
HARBOR BRANCH / SCIENCE
PSYCHOLOGY / SCIENCE
SOCIAL WORK / COLLEGE FOR DESIGN AND SOCIAL INQUIRY

Title: SOUTHEASTERN GEOLOGY

NOTIS Print: 370628
NOTIS Elec.:
CallNo: QE1 S716

Amount: $62.00

Format Print
Type:

Department/College
GEOSCIENCES / SCIENCE

6 Records.

$441.84

THIS REPORT IS BASED ON FOLLOWING CRITERIAS
COLLEGE: SCIENCE.

DEPARTMENT: GEOSCIENCES.

FORMAT: PRINT.

Current Titles

Title: CONTRIBUTIONS FROM THE UNITED STATES NATIONAL HERBARIUM

NOTIS Print: AFB6569
NOTIS Elec.:
CallNo:
Amount: $0.00

Format Print
Type:

Department/College
BIOLOGICAL SCIENCES / SCIENCE

Title: JOURNAL OF THE TORREY BOTANICAL SOCIETY

NOTIS Print: 591639
NOTIS Elec.:
CallNo: QK1 T7
Amount: $137.00

Format Print
Type:

Department/College
BIOLOGICAL SCIENCES / SCIENCE

Title: NATIONAL WILDLIFE

NOTIS Print: 834122
NOTIS Elec.:
CallNo: S964 U6 N35
Amount: $20.00

Format Print
Type: Membership

Department/College
BIOLOGICAL SCIENCES / SCIENCE

Title: NAUTILUS

NOTIS Print: 155873
NOTIS Elec.: 1562700
CallNo: HBOI
Amount: $123.34

Format Print
Type:

Department/College
BIOLOGICAL SCIENCES / SCIENCE
GEOSCIENCES / SCIENCE
HARBOR BRANCH / SCIENCE

Title: SCIENTIFIC AMERICAN

NOTIS Print: 156343
NOTIS Elec.: 1562701
CallNo: HBOI

Amount: $199.50

Format Print
Type:

Department/College
BIOLOGICAL SCIENCES / SCIENCE
GEOSCIENCES / SCIENCE
HARBOR BRANCH / SCIENCE
PSYCHOLOGY / SCIENCE
SOCIAL WORK / COLLEGE FOR DESIGN AND SOCIAL INQUIRY

5 Records.

$479.84

THIS REPORT IS BASED ON FOLLOWING CRITERIAS
COLLEGE: SCIENCE.

DEPARTMENT: BIOLOGICAL SCIENCES.

FORMAT: PRINT.

HBOI Current Titles

Title: BULLETIN OF PLANKTON SOCIETY OF JAPAN

NOTIS Print: 1562692
NOTIS Elec.:
CallNo: HBOI

Amount: $52.34

Format Print
Type:

Department/College
HARBOR BRANCH / SCIENCE

Title: FLORIDA SCIENTIST

NOTIS Print: 335491
NOTIS Elec.: 1562695
CallNo: HBOI

Amount: $89.81

Format Print
Type:

Department/College
GENERAL / SCIENCE
HARBOR BRANCH / SCIENCE

Title: GULF OF MEXICO SCIENCE

NOTIS Print: 1562697
NOTIS Elec.:
CallNo: HBOI

Amount: $15.00

Format Print
Type:

Department/College
HARBOR BRANCH / SCIENCE

Title: MALACOLOGIA

NOTIS Print: 1562698
NOTIS Elec.:
CallNo: HBOI

Amount: $125.28

Format Print
Type:

Department/College
HARBOR BRANCH / SCIENCE

Title: NAUTILUS

NOTIS Print: 155873
NOTIS Elec.: 1562700
CallNo: HBOI

Amount: $123.34

Format Print
Type:

Department/College
BIOLOGICAL SCIENCES / SCIENCE
GEOSCIENCES / SCIENCE
HARBOR BRANCH / SCIENCE

Title: SCIENTIFIC AMERICAN

NOTIS Print: 156343
NOTIS Elec.: 1562701
CallNo: HBOI

Amount: $199.50

Format Print
Type:

Department/College
BIOLOGICAL SCIENCES / SCIENCE
GEOSCIENCES / SCIENCE
HARBOR BRANCH / SCIENCE
PSYCHOLOGY / SCIENCE
SOCIAL WORK / COLLEGE FOR DESIGN AND SOCIAL INQUIRY

Title: WORLD AQUACULTURE

NOTIS Print: 1562704
NOTIS Elec.:
CallNo: HBOI

Amount: $32.50

Format Print
Type:

Department/College
HARBOR BRANCH / SCIENCE

7 Records.

$637.77

THIS REPORT IS BASED ON FOLLOWING CRITERIAS
COLLEGE: SCIENCE.

DEPARTMENT: HARBOR BRANCH.

FORMAT: PRINT.

Florida Atlantic University
Academic Program Review
Department of Biological Sciences
Self-Study Report (11-24-14)

Program:	Biological Sciences
Program Director/ Coordinator Name:	Dr. Rod Murphey
Program Self-Study Contact:	Dr. Diane Baronas-Lowell
Self-Study Contact Email:	dlowell@fau.edu
Self-Study Contact Phone Number:	561 799-8073

Table of Contents Page

A. Mission and Purpose of the Program

The 21st Century brings new career opportunities in the area of life sciences, ranging from biomedical research to environmental sciences. Many of these new jobs require a non-traditional education that crosses disciplinary boundaries. The mission and challenge for the Department of Biological Sciences is to train students for traditional careers such as medicine as well as the emerging careers in a global economy. The Department of Biological Sciences offers both B.S. and B.A. degree programs in biological sciences. These programs are designed to prepare students for careers in life sciences and advanced education in graduate and professional schools. We also provide graduate education leading to M.S. degrees in biological sciences and environmental sciences; Masters in Teaching degrees (M.S.T.); Professional Science Masters in Business Biotechnology (P.S.M.); as well as Ph.D. degrees in Integrative Biology (IB). Our IB Ph.D. degrees will soon offer the options to focus on neuroscience or environmental sciences (currently pending review by the University Faculty Senate).

Overview of the Department

The Department of Biological Sciences is now the largest department in the University and a leader in three areas of effort; teaching, research and service. The number of undergraduate majors has been growing steadily; we now have over 2500 declared majors and 300 students graduate per year with Bachelors degrees in Biology. The number of student hours of instruction for majors and non-majors is the largest in the Charles E. Schmidt College of Science (CESCOS). In spite of the large size and consequent workload of faculty, the Department is an innovator in education and has obtained NSF education grants, developed an Honors program that was the blueprint for the University wide Honors program and has engaged greater than 10% of the undergraduate majors (>250 students) in some form of research. A significant number of the honors students have worked on capstone thesis projects and many published papers with their mentors.

The Department has three primary geographic sites with roughly equal faculty distribution: Davie, Boca Raton and Jupiter as well as one faculty member at Fort Pierce. The Department's teaching load is dominated by teaching in Boca and we accommodate this by faculty commuting to Boca as well as with tele-conferencing. We are also shifting commuter students to the two satellite campuses to re-distribute the teaching load and to maximize the use of space. We have done this very successfully with the Davie campus where we increased the number of seats filled in classes from less than 100 in 2007 to more than 400 in 2013.

In research, we have focused on the local resources at each geographic site and developed Neuroscience in Jupiter, Environmental Science in Davie, Organismal Biology in Boca and Marine Biology in Fort Pierce. The neuroscience group has begun to gel since moving to Jupiter (18 months ago) and we have published more papers than our famous neighbor the Max Planck Florida Institute with similar number of faculty. There is considerable on-going funding and in the last few months our faculty have received new grants from federal agencies: Dr. Marguerite Koch based on the Boca campus with the collaboration of Dr. Xing Hai Zhang has received $422,788 for

work on climate change and Dr. Kailang Jia based in Jupiter received $356,678 from NIH for his work on molecular aspects of aging.

B. Previous External Reviews
Findings and Recommendations
Our last Program Review was in 2009 and the strengths in research at the time of were: 1) A new Director of Environmental Sciences who was developing strong connections to the National Park Service and the South Florida Water Management District and 2) The recent establishment of The Scripps Research Institute in Florida (2004) and the Max Planck Florida Institute (2009) on the MacArthur campus in Jupiter, Florida.

The major weaknesses were listed as the relatively small size of the faculty in comparison to the ever-growing undergraduate population. Additionally, the lack of resolution in the Marine Science Program within the Department as it connects to the Harbor Branch Oceanographic Institution (HBOI) was criticized.

The major research recommendation was to enhance our collaborations with local institutes, state agencies and the biotechnology industry. In particular, it was suggested that we foster research alliances with The Scripps Research Institute and the Max Planck Florida Institute, both located on our Jupiter campus, and continue to develop our connections to the National Park Service and South Florida Water Management District and enhance our connections with HBOI.

Major Changes Since Last Review
Since the last Program Review in 2009, several new faculty members have joined the department and established their own research programs; Drs. Kailiang Jia in 2009; Brian Benscoter in 2010; Greg Macleod in 2013; and Marianne Porter and Rindy Anderson in 2014. Dr. Macleod is the first joint faculty member between the CESCOS and the Honors College. All of these investigators, except those hired this year, have obtained external funding and are engaging in competitive research. In addition, two former administrators, Drs. M.J. Saunders and Brenda Claiborne joined the department in August, 2013. Unfortunately, we have also lost two faculty members during this period (Ayanathan in 2011 and Nambu in 2014).

<u>The Davie Environmental Science Initiative</u>
At the time of the last review a new building, called Davie West, was being built on the Davie campus. The building is finished and now houses nine FAU Biology faculty members with research specialization in Environmental Science. The building is shared with scientists engaged in environmental research and everglades restoration efforts from the University of Florida, the Institute for Food and Agriculture (IFAS) and the US Geological Survey (USGS). The most recent Biology faculty member is a behavioral ecologist who will be based in Davie. A separate administrative unit, The Center for Environmental Science has recently (2014) moved to Davie and this will add cohesion and focus to the Davie effort. In brief, although it is a multi-departmental endeavor, biologists have led the way in establishing Davie as a focal point for Environmental

Science. At the graduate level, we are establishing a track within our Ph.D. program called Integrative Biology and Environmental Science (IB-ES).

The Jupiter Life Science Initiative

One of the recommendations of the last review was to develop connections to the large research institutes being built in Jupiter, Florida. The state invested nearly $1 billion dollars to bring the Scripps Research Institute in Florida and the Max Planck Florida Institute to the MacArthur campus. In order to enhance our interaction with these two large research institutes in Jupiter we transferred a group of seven neuroscience faculty members from Boca to the MacArthur campus in Jupiter (1). We renovated a building adjacent to Scripps and Max Planck on the Jupiter campus to our specifications and it now houses the neuroscience group consisting of six Biology faculty members, and one Psychology faculty member and 40 staff and students, with two more biologists being recruited. At the graduate level, in collaboration with Max Planck and Scripps Florida we are establishing a track within our Ph.D. program called Integrative Biology and Neuroscience (IB-N) and this is attracting attention and beginning to grow.

Undergraduate Initiatives

The number of majors in Biology has continued to increase at the rate of 5-10% per year and now stands at over 2500 majors. This stresses our resources and we have had to adjust our methods of program delivery to accommodate the growth while continuing to bring innovative pedagogies to the classroom.

At the undergraduate level a joint Neuroscience and Behavior program between the Biology and Psychology departments, resulting in a certificate for students, has suddenly gathered momentum on the Boca campus and has grown to 300 majors in three years.

We used an NSF Undergraduate and Mentoring grant (NSF# 0829250, $700,570, entitled “URM: Integrative Biology for Future Researchers”, 2008-2013) to design research experiences for undergraduates placing students in research labs, mentoring them toward research careers and helping place them after graduation. Based on the results of this NSF-funded program, we established a research intensive Honors Program (2). Although the NSF grant has ended, the Biology Honors program continues to operate and has become the model for the entire University in the form of the Quality Enhancement Plan (QEP) program (3).

Using a grant from the FAU Technology Fee program, we have established two computer teaching labs in the department that are being used for a growing number of courses. We are using simulation studies as a proxy for research projects. For example, a new neuroscience course uses simulation software to teach neuronal function and to teach students to think critically and creatively about brain function as they develop projects of their own creation. This facility has allowed us to expand bioinformatics beyond a select graduate population to the undergraduate level.

Finally, we are reorganizing the curriculum as we try to enhance the student experience to introduce critical thinking and move research-like experiences into the lower level of the curriculum. For instance, we are now offering “Life of a Scientist” to sophomores to expose students early-on to research and why do we do it and to encourage them to become actively involved. Recently we have written two educational grants focused on moving research experience to the sophomore year since studies have shown that this enhances retention in the STEM fields (4). These grants are focused on using simulation and *in silico* experiments to introduce large numbers of students to the research enterprise.

C. Instruction

Establishment of Student Learning Outcomes (SLOs)

Our NSF-URM Program is being sustained as FAU’s Biology Honors Program and received high rating from the Southern Association of Colleges and Schools Commission on Colleges (SACS). Both NSF-URM and the Biology Honors Programs, served as models of institutional best practices for FAU’s QEP (as mentioned above). The goals for the Department of Biological Sciences undergraduate programs are consistent with FAU’s definitions of: 1) content knowledge, 2) critical thinking skills and 3) communication skills, within our discipline. Our program is designed to educate and evaluate our students in biological sciences in each of these student learning outcomes (SLOs):

1. Content Knowledge

Declarative knowledge: Students will demonstrate knowledge of the vocabulary, history, theories or concepts. Declarative knowledge is usually assessed via in-class or standardized tests, typically in an objective (multiple-choice; short answer) format.

Procedural knowledge of research skills: Students will demonstrate knowledge of the procedures involved in research (e.g., process of scientific inquiry, idea generation, literature review, data collection, reporting). These skills are usually measured via the evaluation of a research project, thesis, or dissertation.

Procedural knowledge of technical skills: Student will demonstrate technical skills (e.g., microscopy, staining, dissections, cell culture, electrophoresis). This type of procedural knowledge is assessed by both written and practical laboratory examinations.

2) Critical Thinking

Analytical skills: Students will analyze, evaluate, compare/contrast or judge discipline-specific theories, issues, events, or other content. This is usually assessed through examining the quality of argument in a student essay, oral presentation or formal report.

Practical skills: Students will put into practice their knowledge and skills within the laboratory.

Creative skills and ability to formulate questions: Students will create a product by synthesizing knowledge from a discipline.

3) Communication

Written communication: Students will produce writing that is grammatically correct, well organized, and properly formatted for the purpose of the assignment and the discipline. This is usually assessed via individual paper assignments where instructors assess the quality of written expression.

Oral communication: Students will prepare and deliver informative and/or persuasive oral presentations that attend to the audience and are well organized. This is usually assessed via individual oral presentations in a classroom setting.

Team/collaborative communication: Students will demonstrate team-oriented, collaborative skills in which they contribute to group products. This is usually assessed via group laboratory exercises.

4) Ethical Conduct

Ethical conduct is monitored during all academic components including working with live animals. Some of the ethical issues discussed directly during the lectures include responsibilities while: working in a laboratory, collecting and recording data, writing and discussing results and working with live animals.

All individuals working in a lab setting are required to take three Environmental Health and Safety (EH&S) courses: 1) Lab Safety, 2) Biosafety and 3) Hazardous Waste Handling and Awareness. Additional trainings are offered by EH&S and depend on the nature of the research being carried out. For example: individuals working with cells in culture will be required to complete Blood-Borne Pathogens Training.

Throughout the curriculum, faculty members are encouraged to model ethical behavior when mentoring at both academic and research levels. Academic integrity is emphasized and practiced during data collection in the lab and during classroom activities. Scientific dishonesty is not tolerated.

Assessment of SLOs and Program Improvement

The Department, with help from the Environmental Science Program, routinely assesses its two undergraduate programs, three certificates and seven graduate programs through overlapping courses. The B.A. and B.S. degrees are assessed together, using the same criteria. These four criteria listed above are aligned with the University's overarching goals of having students learn content, and develop their skills in critical thinking and communication. The three certificates that are offered in the department are: 1) Biotechnology, 2) Neuroscience and Behavior and 3) Environmental Science.

SLO Outcome #1 is assessed in four classes with broad coverage, taken by all, or nearly all Biology majors. These are Biological Principles, Biodiversity, Microbiology, and Genetics. During summative assessments in these classes, a suite of anchor questions are used, that test the broad range of knowledge. Anchor questions range

from simple to complicated so that poor, acceptable, and good performance can be determined.

SLO Outcome #2 is also assessed with anchor questions, in which critical thinking is required.

SLO Outcome #3 is assessed from the written and oral communication of students in labs. Currently the average student scores for these outcomes exceed the criteria set for success.

SLO Outcome #4 is partially assessed by EH&S on exams. Monitoring for plagiarism is conducted by individual professors using the SafeAssign or Turnitin programs (available on FAU's BlackBoard site). A more formal assessment of plagiarism is needed and under discussion.

The Academic Learning Compacts (ALCs) for both the Bachelors of Science and the Bachelors of Arts are included in Appendix A. Assessment of graduate programs is described below in the "Graduate Programs" section.

Baccalaureate Programs

i. State-approved prerequisites –

The Department of Biological Sciences has four Intellectual Foundations Program (IFP) core curriculum courses; see also Appendix A. These are:

BSC 1005 & BSC 1005L: Life Science and Life Science Lab (three credits includes lab)
BSC 1010 & BSC 1010L and BSC 1010D: Biological Principles (four credits includes lab and discussion)
BSC 1011 & BSC 1011L and BSC 1011D: Biodiversity (four credits includes lab and discussion)
BSC 2085 & BSC 2085L: Anatomy & Physiology (four credits includes lab).

The University's Core Curriculum Committee has thoroughly reviewed these courses for compliance with Florida State University System (SUS) requirements per regulation 6.017. The University Undergraduate Programs Committee (UUPC) recommended these courses for approval to the faculty senate and they were all approved.

ii. Limited access – Not applicable.

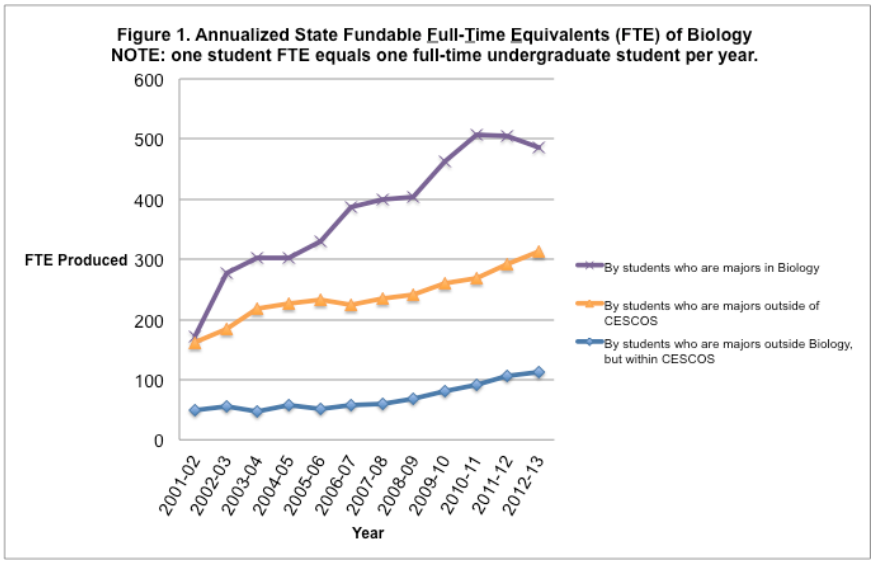
iii. Admissions criteria –

Incoming Biology majors must meet admissions criteria established by the University as described in the University catalogue:
http://www.fau.edu/academic/registrar/FAUcatalog/admissions.php

iv. Undergraduate enrollment information –

As Figure 1 [full-time equivalents (FTE) by major or not] and Figure 2 (FTE across the CESCOS) and Table 1 demonstrate, the number of undergraduate majors in Biology

represents approximately 45% of the total CESCOS and 10% of the entire university. Placed in the context of the student credit hours the department generates approximately 30% of the teaching in the CESCOS and 5% of the entire institution. The graphs also show that these numbers have been growing steadily for the last decade and growth has been especially strong since the last program review in 2009. See Tables A and B in Appendix B for raw data.



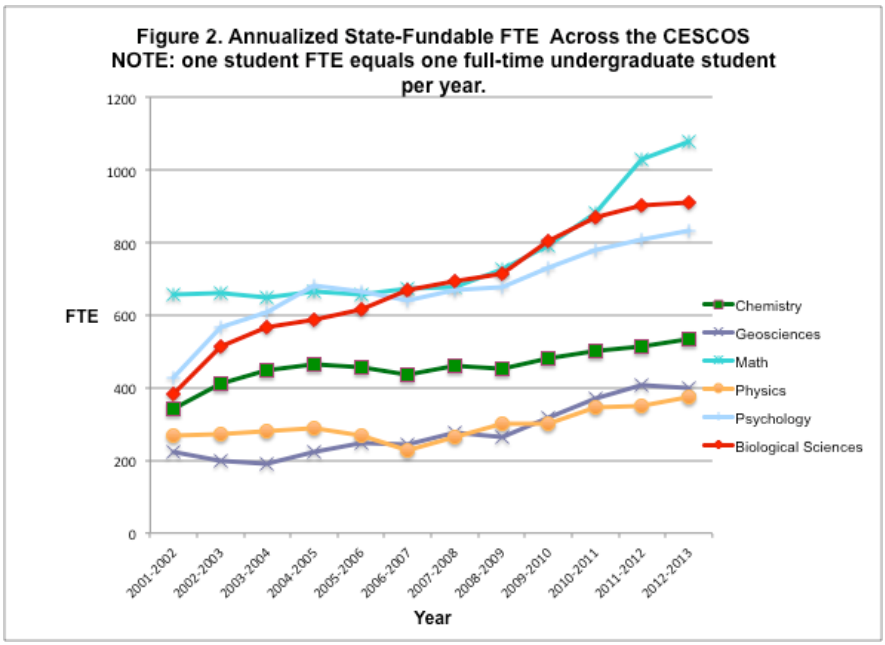
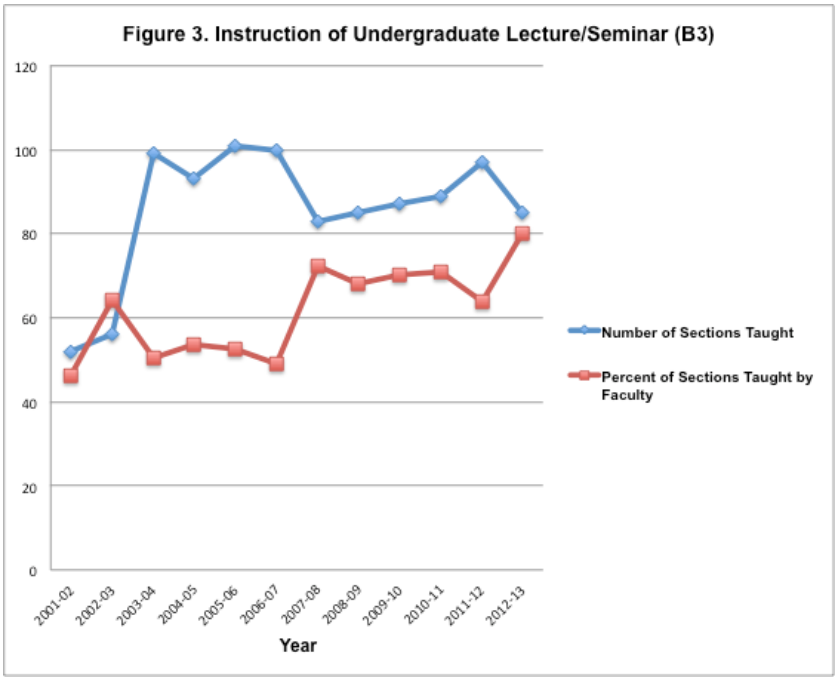


Table 1: Undergraduate Annual Headcount
And Annualized State-Fundable FTE In Biology (2011-2013).
NOTE: one student FTE equals one full-time undergraduate student per year.

Annual Headcount (Program CIP: 260101)	**Biological Sciences**		**College Total**	**University Total**
	2011-2012	**2012-2013**	**2012-2013**	**2012-2013**
Bachelors	2,486	2,582	5,617	28,523
Annualized State-Fundable FTE	**Biological Sciences**		**College Total**	**University Total**
	2011-2012	**2012-2013**	**2012-2013**	**2012-2013**
	828.1	846.4	3,948.6	15,335.0

v. Undergraduate average class size and faculty/student ratio
The faculty/student ratio has increased from 1:67 to 1:96 over the past five years. **Eighty percent** of our undergraduate lectures and seminars were taught by faculty members in 2012-2013, regardless of the huge student population, (shown in Figure 3 below and Table B in Appendix B).



vi. Curriculum –
The curricula for both Bachelors of Science and Bachelors of Arts in Biology are attached in Appendix A and are available on-line at:
http://www.fau.edu/uas/curriculum.php

vii. Internships, practicum, study abroad, field experiences –
The Department now places undergraduate research students in a variety of institutions and programs to enhance their education and career prospects. We used an NSF-URM grant (mentioned previously) to design research experiences for undergraduates placing students in research labs, mentoring them toward research careers and helping place them after graduation. Ninety percent of the students were placed in graduate school or professional school after the program. We have built on this experience to create an Honors Thesis program to accomplish the same thing and have maintained the same number of students in research labs even after the end of the NSF grant (NSF did not allow renewal of these grants as they cancelled the program). With our expansion in Environmental Science and Neuroscience we have expanded the number of slots available in a number of institutions. At the Jupiter campus both Scripps and Max Planck investigators are willing to take undergraduates into their labs. In Environmental Science numerous faculty take undergraduates into their labs and provide environmental field experiences and the National Park Service funds fellowships to work in the Parks.

viii. Pedagogy/pedagogical innovations –
Biology regularly supports faculty to attend the HHMI/National Academies of Science (NAS) Summer Institute. In order to take advantage of educational trends and advances around the country we have sent eightof our faculty to the HHMI/NAS summer institute. Most recently, Dr. Tim Theisen (an Instructor) and Dr. Brian Benscoter (an advanced Assistant Professor) attended the summer institute in 2014. These faculty members then returned to the department and have taken over various curriculum improvements. Dr. Evelyn Frazier, helped develop and now runs the Honors Programs in Biology, including mentoring of undergraduate researchers. Dr. Colin Hughes, has taken over departmental curriculum and assessment oversight. Dr. Joe Caruso is implementing the California Critical Thinking Test for assessment purposes. Other faculty members have developed new interactive pedagogies for large enrollment courses in human ecology and genetics, “flipped” their classes, use iClickers in their large courses and implement inquiry-based teaching.

Dr. Jay Lyons uses computer simulations in his undergraduate courses: PCB 3703 and PCB 3704 Human Morphology and Function 1 and 2. He uses both iWorx stations (5) to simulate human physiology and Neurons in Action (6, 7) to simulate neuronal responses. Although these are primarily upper division undergraduate course, the iWorx stations are being used on the Davie campus to assist in teaching BSC 2085 & BSC 2085L Anatomy and Physiology at the sophomore level.

In the Introductory courses, LifeLine discussions (a required component of both freshmen Biology courses: BSC 1010 Biological Principles and BSC 1011 Biodiversity and described in more detail later) a number of new pedagogies have been implemented:

- With the help of Honors students, we have developed an inquiry based activity used in BSC 1010 Biological Principles now as one of the Experimental Design

labs, where students make observations, draw conclusions from historical data and present day observations about the FAU Preserve, gopher tortoise habitat and invasive plant species.

- We have developed a “Best Practices” activity where TAs and LifeLine leaders are filmed teaching in the Spring, and shortly after the Fall semester begins, we do mandatory Teaching Effectiveness training for TAs. This activity evolved after faculty members went to the Summer Institute in Madison. Our TAs love to see them selves in video, so we have their undivided attention, and they learn something, too. We do peer evaluations of each TA and LifeLine leader every semester, giving faculty members some feedback early in the semester.
- We have implemented a bioethics unit for both BSC 1010 Biological Principles and BSC 1005 Life Sciences labs having to do with stem cell use that has students thinking critically about the viewpoints of others as well as other types of people as stakeholders versus their opponents. This was adopted and edited from a Northwest Association for Biomedical Research activity where students assume the role of one of a variety of stakeholders (e.g., a Catholic priest, a parent of a child with juvenile diabetes, a family member of someone with a severed spinal cord, a Muslim clergyman, a conservative congressman, a biotech CEO) so that students, after learning about the sources and variety of stem cells, argue for or against their use, not as individuals, influenced by their own beliefs, but as whatever person they pull out of a hat, causing them to see things from another point of view. We also have a pre lab activity where we give a quiz about their prior knowledge on this subject.

In BSC 2085, BSC 2085L, BSC 2086 and BSC 2086L Anatomy and Physiology 1 and 2 and labs, with the help of our TAs, we have created and are using the Practical Anatomy Review (PAR) on-line quiz tool. Created to provide the Anatomy and Physiology lab students weekly “practical-like” timed questions to enable readiness for their lab practicals, as well as opportunities to earn quiz credit and extra credit points to improve the passing rates. PAR has significantly lessened the withdrawal rate prior to the midterm and definitely reduced the number of D’s and F’s in these labs.

We are farther reorganizing the curriculum as we try to enhance the student experience to introduce critical thinking and move research-like experiences into the lower levels. We have written two educational grants focused on moving research experience to the sophomore year since studies have shown that this enhances retention in STEM majors (4). Our primary goal is to use simulations in order to introduce large numbers of students to research. For example, Dr. Dawson-Scully has begun teaching Neuroscience Simulations in small classes using the Neurons in Action software (6, 7). About two thirds of the course is devoted to knowledge acquisition of the simulation software and the examination of the basic cellular function of neurons and synapses. The other one third of the course is devoted to students inventing their own approaches to their own questions using this flexible software. Many variations were presented as past students used the software for projects as diverse as heat stroke in bulldogs, Alzheimer’s disease effects on neuronal function and climate change effects on neuronal function.

Our tri-institutional (FAU, Scripps Florida and MPFI) neuroscience program is exceptional in providing outstanding equipment and facilities to our students, from molecular biology to highly technical imaging and electrophysiology methods. MPFI has started an MPFI-scholars program for FAU undergraduates that lasts from 1-2 years and has engaged more than twenty students. Earlier this year TSRI was awarded a three-year NSF-REU grant "SURFing the Interface between Chemistry and Biology" to support undergraduate students in their programs. Our tri-institutional (FAU, TSRI and MPFI) neuroscience program not only expands FAU's ability for research mentoring by increasing the faculty number, but also offers more state-of-the-art prospects for scientific meetings, discourse and dissemination.

Upon completion of their research projects, students disseminate their research findings at the undergraduate research symposium sponsored by OURI, as well as, at numerous scientific meetings and symposia ranging from regional meetings for neuroscience at the University of Miami (UM) to a local Drosophila neuroscience meeting (organized jointly by FAU, TSRI and UM). Students will also report their findings at major national and international meetings (e.g., the Society for Neuroscience).

Though data on scholarly activity is not officially available for undergraduate students, an internal poll of the departmental faculty demonstrates that in 2012-2013 (including the summer of 2012) **224** undergraduate students engaged in scientific research in the biology department. Our undergraduate researcher population reflects FAU's overall undergraduate population with 47% URM. See Table C in Appendix B. The undergraduate directed independent research reflects the diversity of the department with studies including bacterial metagenomics, turtle environmental stress, everglades ecotone seagrass, Sphyrma swimming kinematics, cancer, drug discovery and seizure characterization.

The biology department offers paid full-time summer research experiences for undergraduates in Jupiter. These are exciting and once-in-a-lifetime chances for undergraduates to perform research in sophisticated neuroscience labs while expanding their scientific expertise, networking, critical thinking skills, reasoning and troubleshooting abilities. Undergraduates are competitively chosen, work full-time in the lab and spend at least one hour per week with the fellow undergraduates in the program and a faculty mentor delving deeper into the scientific experience. At the end of the summer, each student presents his/her research findings in a mini-symposium open to the public. Our experience has been that all of the summer students continue working in the same labs during the next academic year.

ix. Scope of institutional contributions –

The Department of Biological Sciences is the largest contributor to FAU's Institutional Honors Program. Our NSF-URM program is being sustained as FAU's Biology Honors Program (2) and received high rating from the Southern Association of Colleges and Schools Commission on Colleges (SACS). Both NSF-URM program and the Biology Honors Program, served as models of institutional best practices for FAU's QEP. FAU's

university-wide QEP has and continues to expand undergraduate research and inquiry opportunities as part of our accreditation's reaffirmation by SACS. The QEP provides curricular and co-curricular opportunities for students and faculty across all disciplines and colleges to be engaged both by and with research using a framework of developmental scaffolding (i.e. exposure, followed by suitable prospects for facilitated skill-building, and culminating in intensive, more independent research projects). The previously mentioned SLOs comprising the research cycle were articulated as part of FAU's QEP. FAU has established the Office of Undergraduate Reach and Inquiry (OURI) that offers a clearinghouse for information for both curricular and co-curricular research and inquiry opportunities within FAU to support the QEP.

The Department of Biological Sciences has a long-standing commitment to improving educational outcomes in STEM fields. We have programs in place for over ten years to enhance student success in introductory biology courses, typically the first STEM courses taken by undergraduates Our peer-led sessions, known as LifeLine, include conceptually oriented lectures, interactive classroom strategies, lab experiments and learning activities. These required sessions consist of 24 students and provide a more intimate context than the lecture (which consists of 300 to 400 students). During these LifeLine sessions, activities reinforce key concepts using various instructional approaches, including construction of physical models and concept mapping. These programs have reduced the failure and drop out rates of the targeted courses significantly and have been continually supported by consecutive Deans of the College of Science.

The department presents very large service courses for the benefit of non-major undergraduate students including BSC 1005 Life Science (1600 students per semester) and BSC 2085 Human Anatomy and Physiology (1000 students per semester).

A joint Neuroscience and Behavior undergraduate cross-disciplinary program between the Biology and Psychology departments offering students a certificate has gathered momentum on the Boca campus and has grown to 300 majors in just three years.

The Environmental Science Program is another cross-disciplinary program and involves faculty members from many participating colleges and departments, including Biological Sciences, Geosciences, Chemistry, Philosophy, Economics, Urban and Regional Planning, HBOI and the Center for Environmental Studies. Biology faculty and staff members comprise over 40% of this program.

The Department of Biology has hired a joint faculty member with the Honors College and has brought an array of CESCOS courses to the Jupiter campus, strengthening cross-college ties.

x. Undergraduate student profile –
Undergraduate and graduate students with a Biological Sciences Major have the ethnic composition of 43% white, 19% black, and 24% Hispanic and 3% non-resident aliens. Indeed, of the 30,429 students enrolled at FAU (all colleges) in fall 2013 whose ethnicity was known, 16,810 were white and 13,619 were URM. Over the last five years, black

and Hispanic enrollments have increased more than that of any other groups; FAU's student body will soon be a "majority minority" mirroring the predicted demographic composition of the USA in the near future. The data on the undergraduate student profile is included in Table D in Appendix B.

Undergraduate Pell eligible students in the biology department averaged 44.7% since fall 2010. The OURI has awarded Biology undergraduates $7,700 in research funds (2013-2014). Biology undergraduates have published four articles in the FAU undergraduate research journal (since its inception in 2012). Finally, Biology undergraduates had 25 presentations (four talks and 21 posters) and 21 presentations (two talks and 19 posters) at the OURI symposia in 2013 and 2014, respectively.

A wide variety of scholarships are available to incoming freshmen and transfer students from FAU's Office of Undergraduate Admissions and are listed in Appendix A. Additional scholarships are available through FAU's Office of Financial Aid.

xi. Advising procedures –
Advising of undergraduate science majors in centralized in the CESCOS Student Services Office. The advisors assigned to biological sciences work closely with administration of the department to ensure students are given correct guidance.

Advising begins at orientation and continues through the first 60 credits in the Freshman Advising Office and includes:

- Evaluation of IFP/General Education and Language Requirements.
- Initial advising for foundational coursework in the major including: Biological Principles, Biodiversity, General Chemistry I and II with laboratory, Organic Chemistry I and Mathematics through Algebra, Trigonometry and Methods of Calculus.
- Guidance in minors and certificates appropriate to vocational career objectives.

Ongoing advising occurs in the CESCOS Student Services Office for the remainder of the program and includes:

- Follow up on IFP/General Education and Language Requirements.
- Recommendations for required core courses.
- Continued guidance in minors and certificates appropriate to vocational career objectives.
- Students are directed to seek individual faculty advising regarding research experiences.

In our Honors Program, undergraduates are advised one-on-one by the faculty member in-charge, Dr. Evelyn Frazier.

xii. Licensure rates –
Not applicable.

xiii. Placement rates/employment profile –

Though it is true that no official effective procedure/system is in place to track what students do career-wise post-graduation, internal recruiting suggests that ~27% of IB Ph.D. enrollees have completed a B.S. at FAU and 22% have completed a M.S. at FAU and 9% have completed both B.S. and M.S. degrees at FAU prior to entering the IB Ph.D. Program.

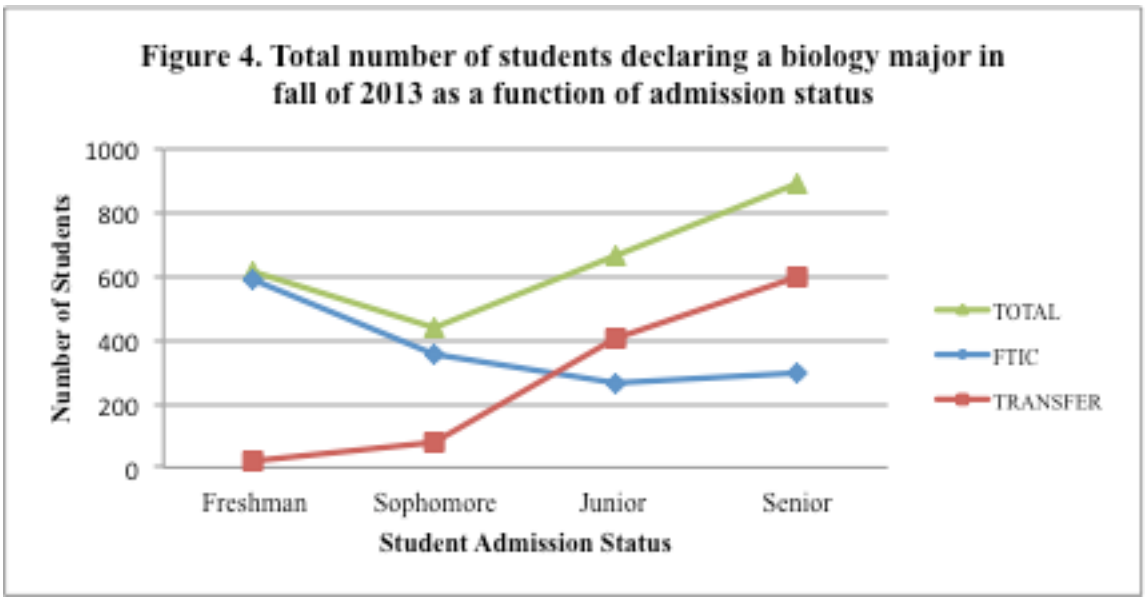
In our NSF-URM Program (previously described), 77% of the students were placed in graduate school or professional school after graduation. Another 10% were employed in life science-oriented careers and 10% were unknown.

Table E shows IEA data obtained through Biology graduating senior surveys. Although an average of only 25% of graduating seniors with Bachelors degrees in Biology responded, over 73% of graduates reported that they will pursue graduate or professional education, and are very satisfied or satisfied with FAU's preparation for graduate or professional school and will reside in South Florida. This data demonstrates the motivation from the biology department towards the pursuit of education, as well as our ability to fuel the local economy.

xiv. Retention rates –

The 2012 PCAST report (8) suggests there is an emerging problem for the future national scientific work force because college students drop out of the STEM disciplines at very high rates. It has been demonstrated in a variety of contexts that large numbers of students (60% in most studies) exit the STEM curriculum in the first two years of college, never to return. For minorities, the numbers are even worse. Numerous studies have demonstrated that 80% of minorities exit the sciences by the end of the sophomore year. Students switch to non-STEM degree programs, they fail to demonstrate adequate academic progress (e.g. doing poorly in STEM courses), or they become bored (9). As a result, many leave the university.

Recent analysis of Biology student data shows an interesting caveat to the typical "STEM death march". An examination of enrollments in life science degree programs indicates an interesting "turnover effect" in our undergraduate majors. As shown in Figure 4, the number of first time in college (FTIC) students in the Biology major drops precipitously by the end of the sophomore year, just as shown in national studies of persistence in STEM programs. However, at FAU these students are replaced by an equivalent or greater number of incoming transfer students. So, although our Biology degree programs appear to sustain some net persistence, many individual students are not persevering. This is why it is important to consider measures of retention and success in STEM at the student level, per se. If we can intervene during sophomore year and the transition to the junior year, we can increase the retention rate for life science majors. Thus, we have written two educational grants to pursue funds for reorganizing our curriculum (as discussed above).



xv. Graduation rates –

The University and the Board of Governors (BOG) have established three performance matrices to specifically evaluate retention and graduation data for institutions in the Florida State University System (SUS). These metrics are being used to rank the institutions in the SUS. These are: BOG Metric 4: six-year graduation rate for full- and part-time FTIC students (46% see Table F in Appendix B); 2. BOG Metric 5: academic progress rate, which is measured by the second year retention of students with a Grade Point Average (GPA) above 2.0 (75% see Tables G and H in Appendix B); and 3. BOG Metric 6: Bachelors degrees awarded in areas of strategic emphasis (includes STEM) (see Table 2 below). In summary, the data show that roughly 15% FTIC Biology majors graduate after four years; while 46% graduate after six years. These metrics match the FAU as a whole and this means the biology department with its large student body is part of the problem that the BOG has created. These FAU graduation rates are similar to national averages; FAU is being penalized for this metric in spite of the arguments that can be made justifying these numbers. We could change these rates by raising the GPA requirements for biology majors but this will presumably simply shift the problem to other departments.

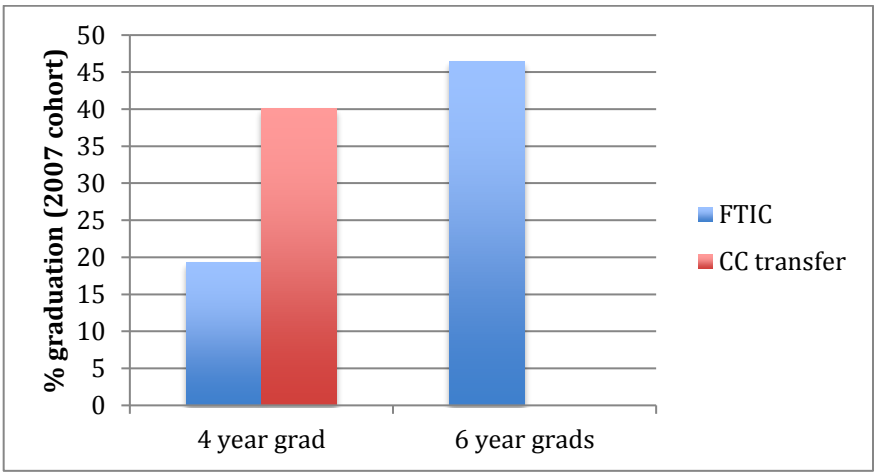
Table 2 from IEA shows the total number of B.A./B.S. degrees in Biological Sciences awarded, by year, since 2001-2002. A degree awarded with a single major contributes one degree, and a double major, contributes one-half degree.

Table 2: Total Number Of B.A./B.S. Degrees In Biological Sciences Awarded, By Year, Since 2001-2002.

	Year Degree Granted													All
	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	
Bachelors	156.0	157.5	188.0	173.0	225.5	236.5	235.0	239.5	248.0	275.0	317.0	296.5	370.0	3,117.5

Figure 5 with data taken from IEA tables (Tables F through H in Appendix B) shows the retention and graduation rates for undergraduate Biology majors from the 2007 cohort of FTIC and community college (CC) transfers through their fourth and sixth years.

Figure 5: 2007 Biology Cohort Graduation Rates.



We have chosen to plot the graduation rates of the 2007 cohort of FTICs and CC transfers because it is the most recent cohort on which there is six-year graduation rate data. As can be seen in Figure 5, 40-47% of both FTIC and CC transfer students take six years to graduate (assuming that CC transfers come to FAU with two years of school already).

xvi. Student recruitment –

Recruiting High School Students: The Jupiter campus has a strong recruiting program in the sciences targeted for high school students. For instance, the Tiger Woods Foundation STEM Career and College Conference was held in September 2014. A hands-on session was organized by the neuroscientists in the biology department and provided an opportunity for middle and high school students and parents to participate in specialized instruction. More than 300 parents and students in grades 7-12 attended this free one-day conference.

High School Students Routinely Volunteer: Many of our laboratories in the biology department, on every campus, routinely host high school student volunteers.

Phone Calls to Accepted Freshmen: In an effort to recruit successful students to FAU, all of the Biology faculty members took part in calling students that were admitted as FAU freshmen, but had not yet accepted, in August 2014.

The Annual Science Olympiad: Some of our faculty and graduate students participate in the Annual Science Olympiad that is hosted by the CESCOS. The event targets participant high schools with larger minority populations.

Clinic at Palm Beach State College: In October 2014, the Student Coordinator and a Student Advisor held an event for students who were interested in transferring into one of FAU's Biology programs either before or after completion of their A.A. or A.S. degree. The different undergraduate and graduate degree programs offered by the Department of Biological Sciences at FAU (including required coursework) were discussed with emphasis on the range of classes, research, and professional development opportunities offered on the Jupiter Campus. In attendance were mostly college students, a dual-enrolled high school student and a few non-traditional/non-degree-seeking students. We have additional clinics scheduled for other CC campuses in the future.

Graduate Programs

Overview and assessment of the graduate programs

Masters. The Biological Sciences Department offers thesis and non-thesis M.S. degrees in both Biology and Environmental Sciences, a Masters degree in Teaching (M.S.T.) and a recently introduced P.S.M. degree in Business Biotechnology. The program is tailored to the needs and interests of the student, in multiple areas including Bacteriology, Cell Biology, Immunology, Molecular Genetics, Virology, Biotechnology, Microbiology, Anatomy and Development, Behavioral Biology, Ecology, Evolutionary Biology, Marine Biology, Environmental Sciences, Neuroscience, Physiology and Systematics. A Masters degree in biology prepares students for graduate study for the Ph.D. or health profession programs, teaching, research, or careers in business or government.

A thesis option is designed for students with career goals that include a research emphasis, such as the possibility of enrolling in a Ph.D. program. A non-thesis option is designed for students interested in the field of medicine, education at the elementary, middle and high school level, or those who simply wish to further their knowledge of biology. The M.S.T. is designed for graduate students who are interested in furthering their knowledge in biological sciences to pursue a career in teaching at various levels, including elementary, secondary, early childhood education and Community College. In 2011, the department started the P.S.M. program with the goal of placing graduating students into the biotechnology workforce.

Doctorate. Our IB Ph.D. Program was initiated in 2003 and has grown to a total of 70 students and has been stable at that number for five years. The first Ph.D. student graduated in 2007 and fifteen students graduated in 2012-13. The program was designed primarily by the Departments of Biology and of Biomedical Science prior to the emergence of our independent Medical School. It was intended to be flexible and allow growth in various research areas. This flexibility has been utilized recently as we are in the process of establishing two concentrations within the IB Ph.D.: 1.) IB-Neuroscience (IB-N) and 2.) IB-Environmental Science (IB-ES). Recently, both concentrations were approved by the University Graduate Programs and we are actively recruiting students.

The Department, with help from the Environmental Science Program, routinely assesses its seven graduate programs. The Masters degree with thesis is assessed for

four learning outcomes that also address content, critical thinking, and communication. These outcomes are evaluated in graduate level classes, the research proposal, research thesis and oral presentation of the research. The Masters degree, non-thesis, is assessed for the same general learning outcomes. However, they are evaluated by both in-class work and a written/oral exit exam. The MST program has similar learning outcomes; they are assessed in class work. Certain classes incorporate oral presentation and significant term papers. The Masters students have met or exceeded the criteria set for success.

The IB Ph.D. Program is distributed between the CESCOS and the College of Medicine, with participation from the Center for Molecular Biology and Biotechnology (CMBB), HBOI, Torrey Pines Institute for Molecular Sciences (TPIMS), Max Planck Florida Institute, the Scripps Research Institute, Florida and Vaccine and Gene Therapy Institute of Florida (VGTI). However, the IB Ph.D. Program is housed and assessed within Biological Sciences. As with the other programs described above it has four learning outcomes: 1) students will have mastered the content necessary for their progress and the skill of learning from the literature 2) they will be able to develop and test hypotheses 3) they will be able to communicate their results and 4) they will exhibit ethical conduct. These learning outcomes are assessed during the dissertation proposal and defense, both of which include written and oral components. The Assessment of Ph.D. Defense form and the Assessment of Ph.D. Proposal form are attached in Appendix A.

i. Limited access – Not applicable.

ii. Admissions criteria –
Incoming graduate students must meet admissions criteria established by the University as described in the University catalog:
http://www.fau.edu/academic/registrar/FAUcatalog/admissions.php

iii. Enrollment information –
Figure 6 shows the annual headcount since 2001 for all students in the biology department. Data for this figure can be found in Table I of Appendix B. It is interesting that the number of graduate students has stopped growing. There may be a variety of reasons for this. The number of faculty has been constant over this period and this may limit the number of positions in labs. Since many of our students are local Floridians, the graduate pool locally may be saturated and we need to recruit from outside southeast Florida.

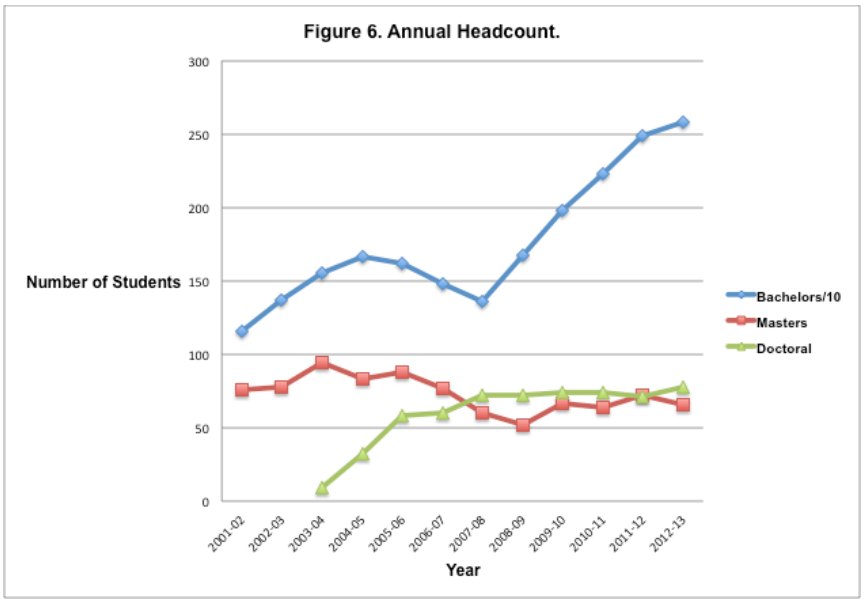
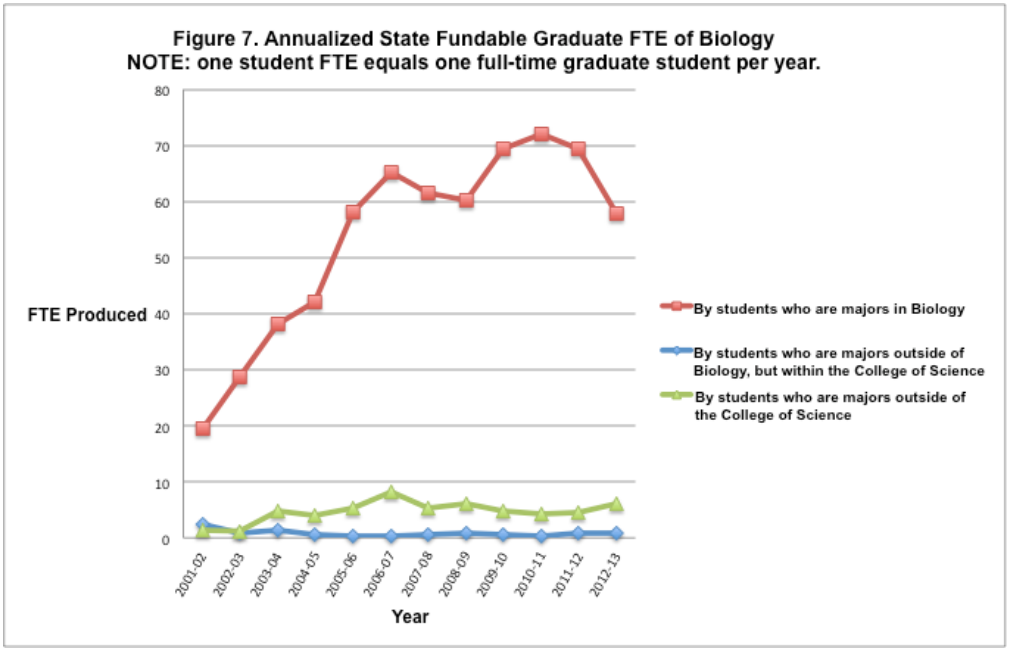


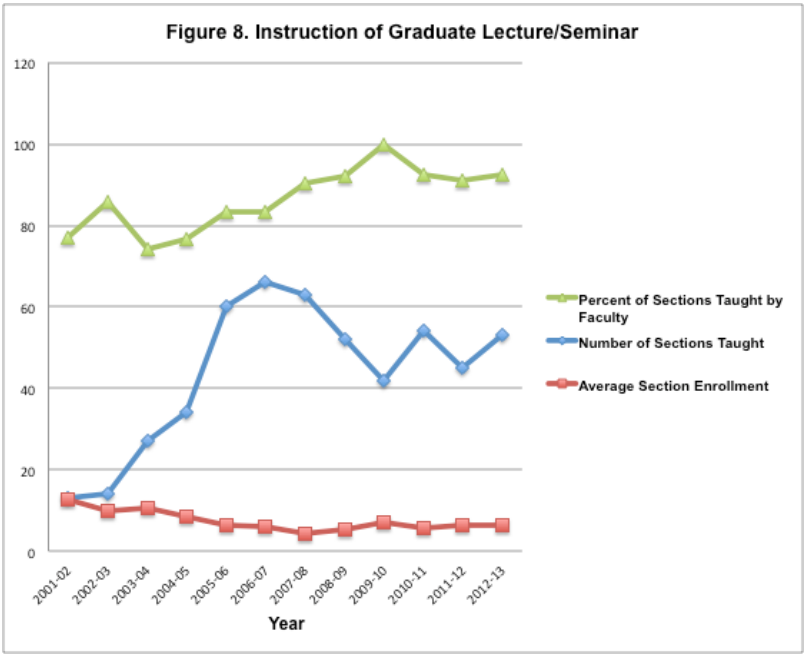
Figure 7 (Table J in Appendix B) details the annualized state fundable graduate FTE in/out of Biology or the CESCOS. It is clear that most of our effort goes into our own students. There is some service to majors outside of the CESCOS (green line in Figure 7) but this is a relatively small component.



iv. Average class size and faculty/student ratio

Table K in Appendix B lists the graduate average class size and Figure 8 plots the data below. The faculty/student ratio in lecture is approximately 1:2.7 and, in other course types approximately 1:3.4. Over the past five years an average of 93.7% percent of our graduate lectures were taught by faculty members, with 92.5% of graduate lectures

taught by faculty in 2012-2013. In other graduate course types, an average of 90.1% over the past five years, with 88% in 2012-2013 were taught by faculty.



v. Curriculum –
The Department of Biological Sciences offers thesis and non-thesis M.S. degrees in both Biology and Environmental Science, a Masters degree in Teaching (M.S.T.), and a recently introduced P.S.M. degree in Business Biotechnology. The Curricula are listed in the university graduate catalog at the following site:
http://www.fau.edu/academic/registrar/FAUcatalog/science.php

Course work requirements
Doctoral degrees at FAU require at least 80 semester credits beyond the baccalaureate degree (a Masters degree is considered equivalent to 30 semester credits). The following are course requirements of the Integrative Biology Program: a minimum of 18 credits of course work with a cumulative grade point average of 3.0 or higher.

Required core courses
1) Integrative Biology I (BSC6390) (three credits): Through lectures, readings, journal club, classroom discussions and student papers, this course explores the idea of integrative biology and connectivity in biological systems. The course also provides an introduction to the IB program and the expectations of Ph.D. students. Integrative Biology 1 is offered only in the fall semester and must be taken within the first year.

2) One course in Biostatistics: A course in statistics appropriate to the area of specialization of the student (minimum three credits):
Experimental Design and Biometry (BSC 6206) (four credits)
Experimental Design 1 (PSY 6206) (four credits)

3) Scientific Communication (BSC 6846) (three credits): Introduces students to proposal writing and presentations for scientists.

Other course requirements for the doctoral degree

1) A minimum of three one-credit seminar/journal club courses over the entire term of residence in the program. Students are expected to give at least one presentation in one of the seminar/journal club courses.

2) A minimum of three elective courses, from the list of graduate courses in the CESCOS and the College of Medicine that are relevant to Integrative Biology. See for a list of potential courses is attached in Appendix A (from the Integrative Biology web page http://www.science.fau.edu/biology/intbio/course_selection.html). This list of elective courses is not exhaustive. The selection of elective courses to meet degree requirements will be determined by consultation between the student and the Ph.D. supervisor and/or the student's advisory committee. Other elective courses than those listed on the website may be chosen, but must be 5000, 6000, or 7000 level courses in biology, biomedical science, chemistry, or approved cognates. Courses designated as proficiency or remedial may not be used to satisfy the course requirements.

Other degree requirements

1) Research Credits:
   a) First and second semester: IB Lab Rotations (BSC 6905) when appropriate.
   b) After first/second semester but prior to candidacy: Advanced Research in Integrative Biology (BSC 7978)
   c) After attaining Candidacy: Dissertation Research Credits (BSC 7980). A minimum of 25 credits of doctoral dissertation research is required.

Preparation, presentation and defense of dissertation proposal

1) Written Dissertation proposal: The student shall submit a research proposal for review by the student's Dissertation Committee at least two weeks prior to the oral defense. Failure to do so may result in a delay of the oral defense. The proposal should be written in the format and structure using the IB guidelines (see VI) and Proposal guidelines laid out in detail in the Scientific Communication course (ENC 6258), unless the Dissertation Committee unanimously decides on another format. Finally, the student must seek guidance from his/her Ph.D. supervisor and/or other members of the Dissertation Committee with regard to the content of the proposal before submitting and defending it.

2) Oral Dissertation proposal defense: The student will be required to present and defend the research proposal in a meeting with the Dissertation Committee in which the student's proposed research and relevant scientific background will be explored in a comprehensive oral format.

3) Successful defense of the oral and written proposal shall qualify the student for candidacy, contingent upon satisfactory completion of the core and elective course requirements. Students may propose and defend before completion of the course

requirements, but formal advancement to candidacy will be delayed until the core course requirements are satisfied.

Dissertation research and defense of the dissertation

Dissertation research shall be conducted under the guidance of the student's Dissertation Committee. Students shall meet with the Ph.D. supervisor and other committee members on a regular basis (at least once a year) as the dissertation research proceeds. Students are expected to submit research findings for publication in scientific journals on a continuing basis. The student and the Ph.D. supervisor shall submit an annual research progress report approved by the dissertation committee via the program assistant to the director and associate directors at the end of each academic year. The IB Ph.D. Annual Research Progress Report is attached in Appendix A (and found on http://www.science.fau.edu/biology/intbio/form_download.htm). Without the annual research progress report a TA contract for the next semester will not be approved and students will not be allowed to register for any further course or research credits.

vi. Internships, practicum, study abroad, field experiences –

The FAU neuroscience group at Jupiter is forging alliances with Max Planck (MP) Institutes in Germany as well as with the local Max Planck Florida (MPFI). Two MP Institutes in Germany are working with FAU to develop international collaborations built around graduate students and postdocs who will work in exchange programs between the institutions. The initial contact was with the MP in Goettingen Germany where six Florida Faculty, three from MPFI and three from FAU visited the Georg August University in 2011 and learned how their program runs and explored ways to develop an international connection. One of our FAU students attended their short course in electrophysiology, attended a student-run international meeting and then returned to Florida where he served as TA for a new electrophysiology lab that we established. Again this year faculty members of FAU neuroscience attended the Horizons in Molecular Biology meeting (at The Max Planck Institute for Biophysical Chemistry) and two of the Ph.D. students attended the meeting and presented their work. Recently MPFI was awarded funds to establish an International Max Planck Research School (IMPRS) school in collaboration with FAU and the MPI in Bonn Germany. This program includes six FAU faculty members and the distribution of international students within the IB-N Program.

The P.S.M. degree in Business Biotechnology (with the goal of placing graduating students into the biotechnology workforce) places students in internships in biotech companies. More than 80% of the graduates were offered jobs while they were still in the internship or shortly after graduation. This success rate is as good or better than the national average for PSM graduates. The P.S.M. program enhances our collaborations with the local biotechnology industry.

The Environmental Science (ES) Program promotes internships for its students as a form of experiential learning where students learn by doing. South Florida is rich in institutions involved in resource management and research so it is an ideal place to

have students engaged in experiential learning as part of their academic studies. Internships are available for ES students at private consulting companies, state agencies (the South Florida Water Management District and the Florida Department of Environmental Protection), national agencies (US Environmental Protection Agency) and nearby parks and wildlife reserves (everglades, state and local).

A new (summer 2014) study-abroad program is available to ES students. FAU recently concluded arrangements, originated by two members of the ES graduate faculty, in which the Tropical Forestry Research Institute (TFRI) in Guangzhou, China will provide funds for students to conduct a portion of their research at the TFRI. This collaboration will benefit students at FAU who are interested in mangrove ecology.

Field experiences are an important, but small part of the ES curriculum. The courses take advantage of the varied environment around South Florida, from the everglades to the ocean, and from estuaries to urban areas and most are in the Conservation and Ecology core subject area (examples of courses are Flora of South Florida, Marine Ecology, Marine Invertebrate Zoology and Natural History of the Indian River Lagoon).

vii. Pedagogy/pedagogical innovations –
Our graduate programs offer the students state-of-the-art innovative projects, which in turn allow the students to present at local, national and international conferences and to publish in peer-reviewed journals.

Both FAU undergraduate and graduate students have the opportunity to do research in the world-renowned institutes: Scripps Florida and MPFI. The sheer size of these institutes increases our ability to place students in research labs. It is worth noting that nowhere else in the country is a university nestled amongst two renowned world-class research institutes. FAU's unique physical location provides tremendous opportunities for STEM education and research training of all its students.

We have expanded our graduate course offerings to include several courses in Genetics, Development and Biotechnology. We are also expanding the neuroscience curriculum to include Advanced Neurophysiology (an intensive instrumentation course), Neuroanatomy, Practical Cell Neuroscience (based on Neurons in Action simulations) and Neurophysiology (with both wet and *in silico* labs). These four courses successfully run as special topics courses now and are pending approval to become formal graduate courses.

Video-conferencing rooms have been upgraded in the biology department on all campuses. Upgrading these spaces greatly increases access to CESCOS coursework, scientific seminars (including graduate student seminars and advisory meetings) and other academic meetings allowing our students and faculty greater access to all campuses and other research institutes.

viii. Scope of institutional contributions –
The IB Ph.D. Program, based in the biology department was jointly established between the CESCOS and the College of Medicine, with participation from the CMBB, HBOI, TPIMS, MPFI, Scripps, Florida and VGTI. As mentioned above this program has served as an effective platform to extend our graduate programs. The IB Ph.D. Program is being broadened by creating two research foci, one in Neuroscience (IB-N) and one in Environmental Science (IB-ES). These concentrations within IB are multi-college, multi-departmental and multi-institutional programs that benefit a larger community than just the biology department (see Figure 7 above and Table J in Appendix B).

The IB program includes faculty and students in all of the Colleges and Institutes listed above. Additional faculty and students will enter from Scripps, Florida and MPFI for the IB-N degree, as well as, from the South Florida Water Management District, the USGS, Florida Fish and Wildlife and the US IFAS for the IB-ES degree.

Finally, the P.S.M. in Business Biotechnology Program requires students to take courses in both the CESCOS and the College of Business benefitting inter-college ties.

ix. Student profile –
Approximately 17% of the graduate students in Biology belong to underrepresented minority groups. This number continues to grow each year and we assume that it will eventually reach numbers similar to the undergraduate distribution of 45% URM. Table L in Appendix B shows the graduate student profile.

Departmental scholarships available to Biology graduate students are listed in Appendix A. There are multiple other scholarships available to graduate students through the Graduate College, the Alumni Association and directly through Financial Aid.

x. Advising procedures –
Supervisory committee (formed in the first semester of the first academic year)
The student's supervisory committee should be constituted before the end of the first semester; the chair of the committee shall be the Ph.D. supervisor of the student and constitute the supervisory committee in consultation with the student. For students without a Ph.D. supervisor, the Program Director or one of the Associate Directors will serve as a temporary chair until a Ph.D. supervisor is identified.

Identification of Ph.D. supervisor and research credits
Research conducted prior to candidacy:
1) All new incoming students (with the exceptions in #2 below) should register in the first semester for IB Lab Rotations BSC 6905. In the second semester students can either continue to do lab rotations until the end of the first calendar year, or can register for Advanced Research in Integrative Biology BSC 7978, with the approval of their identified Ph.D. supervisor.

2) Students who transfer from an FAU Masters with thesis program or who are being supported by RAs, and hence already have an identified Ph.D. supervisor, are not

expected to rotate and can enroll for Advanced Research in Integrative Biology (BSC 7978) starting in the first semester.

Procedure for lab rotations and identification of the Ph.D. supervisor
Short-term laboratory rotations (three labs, each four weeks, first semester only) or long-term rotations (three to four labs, each eight weeks) over the first and second semester are an opportunity for faculty and students to meet without making a long-term commitment. Rotations allow the students to be exposed to a broader range of science, to network within the program, and to help the student make a well-informed choice of laboratory and the Ph.D. supervisor to conduct their thesis research. By trying out several laboratories, students can identify an area of research in which they are particularly interested, and a faculty member with whom they can develop a productive mentor-mentee relationship.

Students are encouraged to select a laboratory for their dissertation work by the beginning of their second semester but may continue to do rotations until end of the second semester. However, all students shall have an identified and approved Ph.D. supervisor at the latest by the end of the first academic year in the program.

Advancing to candidacy
Dissertation committee: (formed one semester before candidacy exam)
Once students have an identified Ph.D. supervisor they shall continue their course as well as research by registering for Advanced Research in Integrative Biology BSC 7978. After a sufficient amount of research, as approved by their Ph.D. supervisor and/or supervisory committee, the student shall form their Dissertation Committee. The Dissertation Committee shall consist of four members, including the chair, whose responsibility is to guide the development of the dissertation research and administer the Dissertation Proposal review and Dissertation Defense.

xi. Licensure rates –
Not applicable.

xii. Placement rates/employment profile –
Analysis of the 69 IB Ph.D. degrees awarded thus far show 41 alumni have pursued their careers at a University, either as a postdoctoral fellows, adjunct faculty or non-tenure-track faulty or tenure-track faculty. These universities include: Indiana University/Purdue University, University of Michigan at Ann Arbor Duke University, University of Florida, Texas A&M Health Science Center, Washington University School of Medicine, University of Tennessee Health Science Center, University of Illinois at Urbana, Johns Hopkins University, FAU, Wheaton College, Albert Einstein College of Medicine, University of Miami, Miller School of Medicine, Boston University, University of California at San Francisco and Stanford School of Medicine.

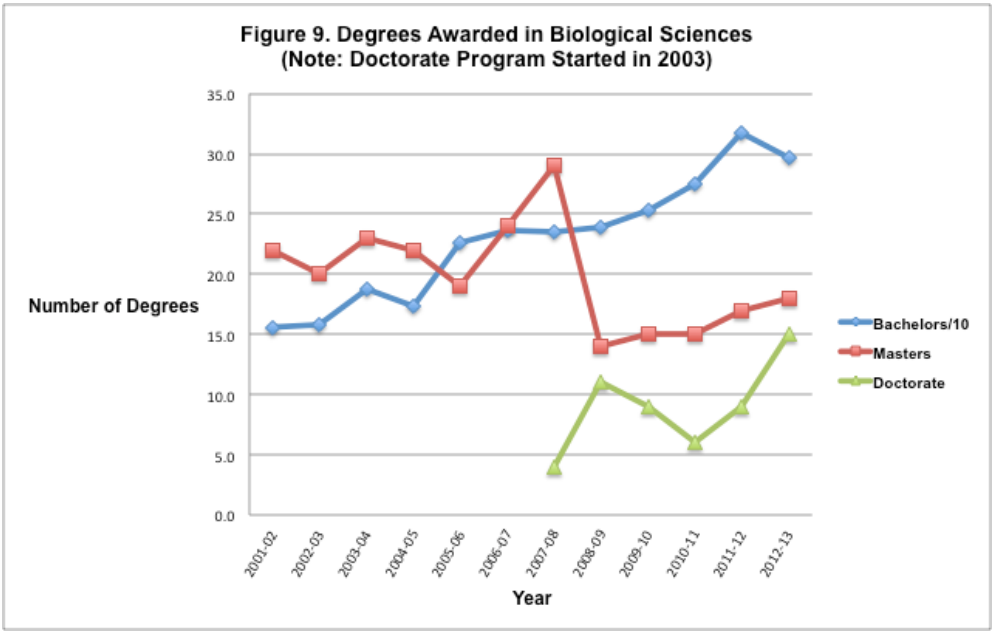
Eight alumni are/were postdoctoral fellows at research institutes in the region (Scripps, Florida, MPFI or VGTI). Two alumni are scientists at Pharmaceutical Companies (GlaxoSmithKline and Eli Lilly and Company).

Three alumni teach at the High School level. Other alumni are employed currently at various institutes including the USGS, Pacific Biodiversity Institute, EA Engineering, Integrated Health Care Associates, Teens4Oceans, Holy Cross Hospital, Nickel Producers Environmental Research Associates, Impact Medical Strategies, the Institute for Regional Conservation and the Palm Beach Zoo. One of our most recent IB Ph.D. graduates has just started a science policy fellowship with the Congressional Black Caucus in Washington, D.C.

We don't have employment information for only six IB Ph.D. alumni.

xiii. Retention rates –
The total number of students that have been enrolled in the IB Ph.D. Program (i.e. accepted and attended) since its conception is 181. Sixty students are currently enrolled. Sixty-nine students have graduated with an IB Ph.D. from FAU. Currently enrolled and graduated students represent 71% of the total enrolled students. Fifty-two students have left the program without completing the Ph.D.

xiv. Graduation rates –
Tables 2 (above) and Table M (in Appendix B) from IEA show the data for Figure 9 below. A degree awarded with a single major contributes one degree, and a double major, contributes one-half degree. It can be seen from the data that M.S. degree-seeking student numbers dropped when the doctorate program started.



xv. Student recruitment –
IB Ph.D. Student Retreat: The 7th annual IB Ph.D. Student Retreat will take place in 2015. At the retreat, IB Ph.D. students showcase their research in a poster session. The retreat also gives perspective Ph.D. students the chance to tour the Boca campus and

learn about the IB Ph.D. Program's research opportunities at the poster session. Every year a distinguished keynote speaker is invited; our speaker in 2015 will be Dr. Martin Chalfie, Nobel Laureate, and in 2014, it was Dr. Polly Matzinger, from the NIH, one of Discover magazine's Top 50 Most Important Women in Science. As part of recruitment, an IB alumnus is invited to the retreat and delivers a talk on what they learned during the IB Ph.D. Program, their success after completing the program and how the IB Ph.D. Program contributed to their success. The invited alumnus is awarded the "Distinguished Alumnus Award" based on outstanding contributions to the program. Alumni nominees for this honor are evaluated on the basis of their outstanding contributions to: 1) The IB Ph.D. Program (e.g. committee member, service to faculty or students), 2) Representation of the IB Ph.D. Program during their time in the program (e.g. invited talks, conferences, air-time on national TV), 3) Originality and creativity of their research (scope of the research project and techniques used to solve the problem), 4) Impact (significance in the field) and 5) Awards and funding received during their time in the IB Ph.D. Program. Honors undergraduate students and Masters students are invited to the retreat for recruitment purposes. Finally, the IB Ph.D. Retreat offers the opportunity to mingle with Ph.D. Program faculty, current students and the invited keynote speaker at a social mixer.

Our Graduate Program Coordinator and current graduate students hosted a biology graduate programs recruitment table at the 2014 Annual Graduate College Open House and will continue to do so here at FAU.

We submitted and were awarded a request for a $1,000 graduate recruitment grant and a $2,500 Provost's fellowship for the 2015-16 academic year from the FAU Graduate College. We have used previous recruitment grants to reimburse prospective students for travel to our annual recruitment event, the IB Ph.D. Student Retreat. The Provost's fellowship is meant to assist the program with recruitment by adding funds to the student assistantship (teaching or research) and increasing the program's appeal to incoming students.

We are expanding student recruitment for the Ph.D. Program to include popular scientific meetings. We hosted an IB-N recruitment table at the Society for Neuroscience (SfN) meeting (with over 31,000 attendees) in November 2014 in Washington, D.C. There were only 50 booths at the SfN Graduate Program Fair and many students stopped at our booth to discuss the program and its particulars. We handed out program brochures, a list of over 35 presentations by our IB-N faculty and students at the conference, pens and phone chargers with IB-N web sites and logos. We had two iPADs for students to input their data so that we may farther recruit interested students with more electronic information.

Our undergraduate Honors Program acts as a feeder to our graduate programs (as discussed in the "Undergraduate placement rates section" previously).

Academic clubs are always attractive to incoming students and thus serve as useful recruitment tools. The Association of Biological and Biomedical Students (ABBS) is run by our graduate students in Biological Sciences and the College of Medicine, and

consists mostly of IB Ph.D. graduate students. ABBS hosts social mixers, seminars and workshops for students at both the undergraduate and graduate levels with the goal of getting students involved and has positively impacted recruitment for the IB Ph.D. Program.

The IB Ph.D. students are starting up a new club called the IB Club and will parallel the efforts of the ABBS club but focus more on IB Ph.D. students specifically. The IB Club also plans to have a stronger emphasis on professional development.

Faculty

i. Administrative structure -

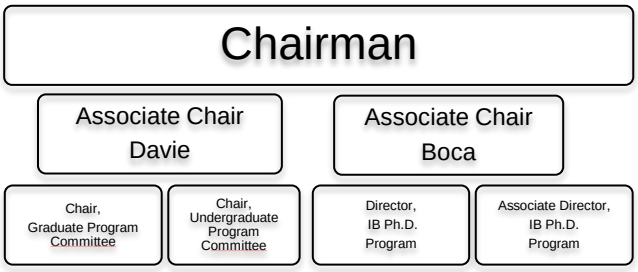
The large size of the Department of Biology and the distributed nature of the campus require considerable care in holding the pieces together. The overall strategy was designed to take advantage of the distributed campus and make it a positive aspect of the department for both teaching and research.

There are two Associate Chairs, one in Boca Raton and one in Davie. Dr. David Binninger, the Associate Chair in Boca Raton maintains and controls the course schedule, works with staff to assign teaching assistants to the laboratories and implements the assignments for the large teaching operation in Boca Raton. He also coordinates the course schedule and teaching assignments with Dr. Jay Lyons, the Associate Chair in Davie. The Boca Raton Associate Chair is also in charge of the molecular core facilities in Boca Raton and works with the Chairman to assign office, research and teaching space in Boca Raton.

Dr. Rod Murphey, the Chairman of Biology, speaks each morning with the Associate Chair in Davie to make sure that everyone is working toward the same goals. Since Davie ran relatively independently prior to Fall of 2000, and the Associate Chair guided the Davie operation, this has worked well to integrate the two parts of the Department. The Chairman and two Associate Chairs have worked together to increase the number of courses and the number of students using the Davie campus. We did this by taking advantage of the commuter campus and adding courses that are in heavy demand to the Davie campus; this has increased the number of seats from less than 100 per semester to more than 400 per semester in three years. The Associate Chair for Davie was also the point person for the new building and he coordinated the design and construction of the new Biology laboratories that moved to this new site.

In addition to the Associate Chairs, both the undergraduate program and the graduate program committees are chaired by another senior faculty member, Dr. Randy Brooks, who manages the programs and represents the biology department on the College-Level Committees for graduate and undergraduate programs. Finally, the interdepartmental IB Ph.D. program is under the direction of both the Chairman of Biology and Dr. Ken Dawson-Scully, Associate Director. Figure 10 is a schematic of the Department of Biological Science’s administrative structure.

Figure 10. Administrative Structure of the Department of Biological Sciences.



ii. Faculty profile –

At the time of this writing in fall 2014 there are 28 faculty members in the Department: four Assistant Professors, thirteen Associate Professors, eleven Full Professors (two of the Full Professors are former administrators, M.J. Saunders, the former President and Brenda Claiborne, the former Provost, who have tenure positions in Biology and have returned to teaching this year. Nine of these faculty members are based primarily in Davie, thirteen are primarily in Boca, five primarily in Jupiter and one at HBOI in Fort Pierce. Finally, we have three Instructors who carry major teaching loads as lecturers and three full time staff who develop, maintain and operate the teaching labs. Including the Instructors, nine of these faculty members are women, three are black, four are Asian and one is Hispanic. Faculty diversity data can be found in Tables N1 and N2 in Appendix B and Table 3 below.

iii. Faculty teaching load –

The faculty teaching assignments for research active faculty are typically one large majors course (>100 students, some as large as 300) and one upper level undergraduate/graduate course. In addition, most research active faculty members mentor at least one graduate student and one undergraduate student (in our Research Experience for Undergraduates/Honors Programs). Figure 11 illustrates the workload for the Department as a whole. It shows a steady increase in FTEs doubling in the past decade. In contrast the number of faculty members has grown much more slowly, approximately 10%, for that same decade. Table 3 outlines teaching and academic responsibilities outside of research.

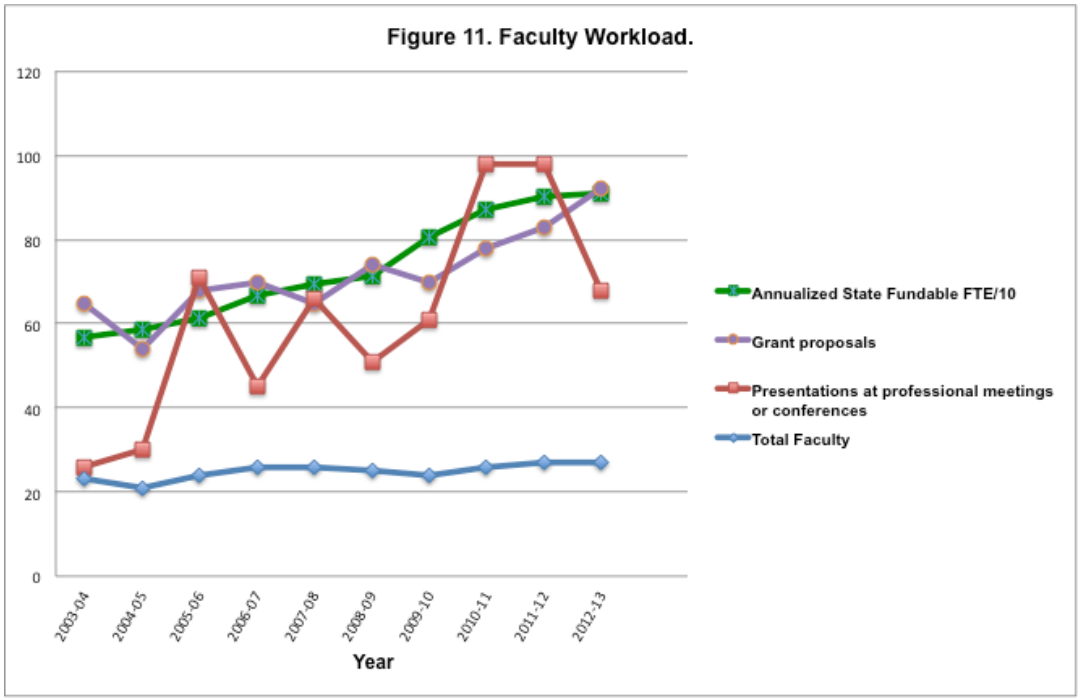


Table 3. Faculty Teaching And Academic Responsibilities For Academic Year 2012- 2013.

Biological Sciences	**All**	**URM ***	**%**	**Women**	**%**	**TL****	**UTA*****	**%**	**FD#**	**%**	**CC##**	**%**
Tenure Track: Tenured & Non-Tenured	22	3	14%	5	23 %	1.7	22	100%	3	14 %	7	32 %
Non-Tenure Track: Full Time	6	1	17%	3	50 %	2.2	6	100%	3	50 %	1	17 %
Non-Tenure Track: Part Time	4	0	0%	1	25 %	0.8	4	100%	0	0%	1	25 %
Total Faculty	**32**	**4**	**0.1 %**	**9**	**28 %**	**N/A**	**32**	**100%**	**6**	**19 %**	**9**	**28 %**

* Black, African American, Hispanic, Latino/a, American Indian, Alaska Native, and Native Pacific Islander.
** Teaching Load (average per term)
*** Had an Undergraduate Teaching Assignment
# Participated in Faculty Development Activities (non-scientific research)
Participated in Undergraduate Curricular Changes

The FTEs produced per instructional person-year provides one measure of the teaching workload being carried by the average faculty member. The numbers are fairly consistent across the CESCOS; in Biology the number is 15-16 FTE per person-year compared to 20 FTEs for the college as a whole (Table 4). However, these FTE numbers incorporate and thus are influenced by the number of graduate TAs in a given department.

If we adjust for the number of graduate TAs, then departments with large laboratory components and a large cadre of TAs (such as Psychology or Biology), increases by a factor of two-three fold and reaches 45 FTE per person-year. Such adjustments put the FTE production of a Biology Faculty member in the top echelon of the institution.

Table 4. Annualized FTE Produced Per Instructional Person-Year.

	Biological Sciences			College Total	University Total
	2010-11	**2011-12**	**2012-13**	**2012-13**	**2012-13**
Undergraduate	14.1	14.5	15.1	19.4	19.1
Graduate	1.4	1.3	1.2	1.1	2.8
Total	**15.4**	**15.8**	**16.2**	**20.5**	**21.9**

Source: Instruction and Research File and Student Data Course File, IEA.
Includes Instructional Person-Years from all personnel categories.
Annualized FTE produced for each person-year devoted to instruction.

iv. Summary of faculty research productivity –
As Figure 11 and Tables O, P1 and P2 in Appendix B illustrate, research productivity has increased steadily over the last decade. The number of publications has more than doubled, as has the number of grant proposals submitted. In spite of the steady increase in grant proposals the number funded has decreased as the research funding agencies have tightened their criteria and the competition has become quite fierce. We have added patents and business funding to the departmental portfolio and one of the Jupiter biologists has funding from a Biotech company. The number of graduate students who support the research endeavor has nearly doubled in the past decade and the distribution has shifted from exclusively Masters students to a 50:50 split of M.S. and Ph.D. students as the IB Ph.D. program became established and grew to its present size of 60 to 70 students.

v. Strategic Planning for Hires –
The guiding principle is to hire faculty who will add to our research clusters and strengthen research groups while taking care of the teaching assignments. The faculty agreed as a whole to the most recent hires at a retreat two years ago. After a thorough discussion of the options the faculty decided the number one priority was a behavioral ecologist. We recently accomplished this goal with the hiring of a young behavioral ecologist, Dr. Rindy Anderson, who is an unusually good fit for the department as a whole. She will serve a number of constituencies, teaching in animal behavior, doing research in social behavior, sensory mechanisms and cognition and thereby making

connections to all three research foci in the department. A second hire, Dr. Marianne Porter, is a biomechanics researcher. This second hire was a more opportunistic hire and was part of a retention package. However, she fit the long-range plan established by the faculty and added nicely to our organismic group in Boca. Her research interests are making connections to the engineers among other interdisciplinary groups that have been lacking in our department. Finally, the administration has provided the resources to hire neuroscientists to the Jupiter wing of the department and we are trying to hire faculty who will complement the group in Jupiter as well as the other neuroscientists at MPFI and Scripps, Florida. We have hired one such faculty member in a joint hire with the Honors College, Dr. Greg Macleod. We are searching for mid-career faculty who are already funded and who will fit with the group in Jupiter.

D. Research

i. Review of part II of DDIs –

See "Summary of faculty research productivity" section above, Figure 11 above and Tables O, P1 and P2 in Appendix B.

ii. Interdisciplinary efforts and community engagement efforts –

Much of the Chairman's effort for the last 18 months has been focused on the Jupiter Life Science Initiative that was designed to establish strong links to Scripps, Florida and MPFI. We organized the move of a half dozen neuroscience faculty members (five from Biology and one from Psychology) and their associated personnel from Boca to Jupiter. The goal has been to establish research collaborations with the two institutes and enhance the overall neuroscience program on the MacArthur campus. This is working well and every FAU faculty member has one or more collaborations with a group or groups at one of the two research institutes. In addition, we established a neuroscience track within our IB Ph.D. program that includes faculty from FAU, Scripps, Florida and MPFI.

In parallel the Director of the Environmental Sciences program (a senior member of the Biology Faculty, Dr. Dale Gawlik) led refinement of their Masters Program and has now added a track in the IB Ph.D. program. In addition, the Dean of the CESCOS has moved a free standing Center for Environmental Science from Jupiter to Davie further enhancing the Environmental emphasis. One example of the value of this interaction is a recent symposium initiated by CESCOS which brought together FAU Deans of Business, Education, Architecture, Science and Economics together with community leaders, researchers and educators concerning environmental issues to begin communication and outreach to increase the public awareness of environmental concerns and initiatives.

iii. Establishment of goals for research –

The research goals for the Department are pretty standard for a life science department – publish in high quality journals and succeed in the grant competition. In the long run we want the faculty to be successful at both grants and publications. This department has been relatively successful over the last decade as we have brought in young investigators who have succeeded because we chose good people, gave them the

resources to succeed, monitored their progress carefully and mentored them as they moved toward tenure. In this decade all the junior faculty have succeeded in publishing regularly and obtaining grants as they proceed toward tenure and everyone we put up for tenure has received tenure. A broad-based department like ours has to adjust for the history of its faculty as well as the aspirations of the department. The older faculty may make their contributions by mentoring the young faculty and taking on more of the teaching load.

iv. Assessment of how well the goals are being met –
Assessment is relatively straight forward because most faculty members know the rules and appreciate the standards toward which are working. The tenure system at FAU has clearly tightened in this last decade and the rules are clear. Each of our new junior faculty has succeeded and has established their research projects, trained students, received grants and published their papers. My view is the goals are being met.

E. Service/Community Engagement
Table Q in Appendix B reviews Part II of the Department Dashboard Indicators for service and community engagement.

F. Other Department Goals
N/A

G. Strengths and Opportunities
The biology department has an amazing set of opportunities, some scientific, some geographic, some political, and we are working to take advantage of them.

- In environmental science the natural environment and especially the everglades and the marine environments are opportunities that our faculty routinely take advantage to enhance their research projects. The political and financial commitment to restoring the everglades provides an amazing research resource that our faculty utilize to fund their research.
- In neuroscience, the state of Florida has invested nearly $1 billion in establishing Scripps, Florida Institute and MPFI on our MacArthur campus. The biology department led the way in establishing connections to these institutes by moving a group of neuroscience faculty into a building on the MacArthur campus adjacent to Scripps and Max Planck.

H. Weaknesses and Threats

- The distributed faculty between three main sites is a double-edged sword. It allows us to cluster faculty by common interests and common techniques, but it divides our relatively small faculty into even smaller groups.
- The distributed faculty also handicaps students from several perspectives. In some cases they must spend time and expense to travel in order to enroll in upper division and graduate courses, work in specific research laboratories and take advantage of university facilities and programs. We have made great strides at utilizing new technologies to broadcast courses and meetings to distributed sites, but still find many weakness in their application.

- Our ethnically diverse student body and urban campuses present unique problems in improving student retention. Most of our students are employed either full- or part-time in order to remain in college. It is difficult to significantly improve our retention rate in light of this situation. What programs can we facilitate to improve the rate of progress of our students through the program and their retention?

I. Resources

Further growth in enrollment and staff will require expansion of our current facilities. In Boca, although we have some limited faculty office and research laboratories available, our student laboratory and classroom space in practically exhausted. We are especially in need of large lecture facilities (enrollments in excess of 350) to present our undergraduate courses such as Life Science, Anatomy and Physiology and Evolution. Our staff facilities in Davie and Jupiter are filled, as we have no more faculty offices or research laboratories at either site. We still have capability to expand our student laboratory offerings at both sites, however we also need more large classrooms (enrollments above 150 in Davie).

We are in need of an additional faculty line in the field of Aquatic Biology to add expertise in freshwater biology, limnology, fisheries science, and/or invasive species biology, which is of particular relevance to the Marine and Coastal Issues Signature Research Theme. The individual will complement existing expertise within the department and college, increasing the breadth of applicability to external funding sources as well as facilitating interdisciplinary research in the Environmental Sciences Program. Additionally, he/she will contribute to undergraduate instructional capacity by teaching an additional section of a high-enrollment upper-division course required for the Biology B.S. major (e.g., Principles of Ecology), enabling the department to keep pace with anticipated increases in enrollment in the major, as well as add breadth to graduate instruction through development of an advanced course in their area of expertise.

In order to grow the neuroscience group in Jupiter we are recruiting mid-career faculty in cellular and molecular neuroscience. These faculty members will contribute to the growth and development of the new neuroscience focus at the MacArthur campus complementing the neuroscience groups at the Scripps Florida Institute and MPFI. These people will enhance our reputation by bringing extramural funding to the campus as well as our ability to compete for umbrella grants in the field in joint grants with the two local research institutes. Finally they will contribute to the teaching mission at the undergraduate and graduate levels as well as providing mentoring for undergraduate and graduate students in the neurosciences.

One of the main resource issues for the department is the limited support for graduate assistants. As Table 5 shows below, FAU is at the bottom of the ranking for MS stipends and health care. Only FIU pays a comparable stipend ($11,250 per nine months). Every other SUS institution surveyed pays a significantly larger stipend with UF paying double the salary for nine months. And every SUS institution surveyed pays

most if not all of the student health care costs. Similar results are available for the Ph.D. students. These numbers can be directly linked to success in recruiting graduate students.

Table 5. Support For MS Students Across The SUS.

University	MS Stipend	Months	Tuition waiver	Health insurance
FAU	**9,636**	9	100% (in-state)	**No**
FIU	15,000	12	9cr/sem.	75% of cost
USF	18,600	9	100%	100%
UF	18,000	9	100%	100%
FSU	20,000	12	100%	$900 supp.
UCF	10,000	9	100%	Y

J. Future Direction-Overall Vision for the Next Five to Ten Years

Three to five broad questions for the review team:

- How do we maximize our strong points yet prevent the department from fragmenting due to interest clusters as well as geographic clusters that tend to separate the interest groups? Clustering the faculty by interest enhances intellectual cohesion but separates the various sub-groups of the department. How do we maintain cohesion?
- In keeping with President Kelly's plan to enhance STEM, particularly at the Jupiter campus, how can Biology enhance its cross-disciplinary efforts with other areas of science such as chemistry, psychology and math as well as engineering?
- Is our new "flexible curriculum" allowing students to customize their degree program towards a career goal? Early indications show very significant shifts in enrollment between the four required major courses.
- What programs can we establish to improve the retention rate of our uniquely diverse, urban and commuter student body?

K. Student Feedback

Similar to the lack of undergraduate student follow-up, FAU does not have an official procedure in place to collect this data for the graduate students. We surveyed IB Ph.D. graduate students and received nine responses. It became clear that the distance between the various campuses posed some difficulty, as well as the communication between the different parts of FAU and the graduate policy changes. This data is provided with the disclaimer that it may not be representative of all graduate students. The questions and graduate student responses are in Appendix A.

L. References

1. Spotlight on Florida: a hotbed of neuroscience research. 2014. NatureJobs, doi:10.1038/nj0420

2. Undergraduate Research Programs in the Biological Sciences. Introduction to the Honors Program in the Biological Sciences. http://www.science.fau.edu/biology/undergraduate/Honors.html (accessed 7 October 2014).

3. FAU's Distinction Through Development Quality Enhancement Plan. 2011. http://www.fau.edu/ouri/Quality_%20Enhancement_Plan_1_11_13.pdf (accessed 7 October 2014).

4. Nagda, B, Gregerman, S, Jonides, J, VonHippel, W and J Lerner. 1998. Undergraduate student research partnerships affect student retention. Rev Higher Edu **22**: 55-72.

5. http://www.iworx.com/teaching-landing/ (accessed 20 November 2014).

6. Stuart, AE. 2009. Teaching neurophysiology to undergraduates using *Neurons in Action*. J Undergrad Neuro Edu **8**(1):A32-A36.

7. Masurkar, AV. 2008. Neurons in action 2: Tutorials and simulations in Neuron. Yale J Biol Med **81**(1):50-51.

8. Gates, SJ Jr, Handelsman, J, Lepage, GP and C Mirkin, Co-chairs. STEM Undergraduate Education Working Group. 2012. *Engage to Excel: Producing one million additional college graduates with degrees in science, technology, engineering, and mathematics.* President's Council of Advisors on Science and Technology. http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-engage-to-excel-final_feb.pdf (accessed 7 October 2014).

9. Seymour E and Hewitt NM. 1997. Talking about leaving. Westview Press, Boulder, CO.

Florida Atlantic University

Biological Sciences Department

Program Review

March 22, 2015

Review Team:

Donald Edwards (Georgia State University)

Lynne Fieber (University of Miami)

Michael Horswell (Florida Atlantic University)

OVERVIEW

The team of Dr. Lynne Fieber, Dr. Donald Edwards, and Dr. Michael Horswell reviewed FAU's Department of Biological Sciences on March 15-17, 2015. Ms. Lynn Sargent, Executive Assistant to the Dean of the College of Science provided the reviewers with a self-study and a detailed itinerary. Ms. Marjorie Cazeau provided logistical support. Additionally the review team met (in approximate order) with:

- Rod Murphey, Chair of Biological Sciences
- Russ Ivey, Interim Dean, College of Science and Associate Provost
- Several small groups of the Department faculty over meals
- Charles Roberts, Associate Dean for Graduate Studies
- Ingrid Johanson, Senior Associate Dean for Student Affairs
- Evonne Rezler, Assistant Dean for Assessment
- Ed Pratt, Dean of Undergraduate Studies
- A group of senior (tenured) faculty
- A group of non-tenure track faculty and junior faculty
- Michele Hawkins, Associate Provost for Planning and Budget
- Deborah Floyd, Dean of the Graduate College
- Daniel Flynn, Vice President for Research
- Graduate students in Biological Sciences
- Undergraduate majors in Biological Sciences.

For the names of all the individuals met, see "People Met list" in appendix.

More formally, the review team was asked to identify the steps needed for significant improvement in the department's effectiveness and recognition in research and instruction. We were also asked to respond to the points raised towards the end of the self-study, in the sections on Strengths and Opportunities, Weaknesses and Threats, and Resources, and Future Directions. We have attempted to address these in the context of the discussions we had on these issues with the students, faculty, and administrators whom we met.

Department and University Strengths

Collegiality. Progress in developing the strengths of the department and university depend on the character, vision and energy of the people involved. We were very happy to find that all of the people we met in our interviews, including students, faculty, and administrators, appeared to us to be friendly, thoughtful people who are keen to improve Biological Sciences at FAU. They all had very favorable views of the Department, its programs and accomplishments, but were aware of the challenges it faces. Both the strengths and the challenges they identified were those also identified in the self-study.

Emerging strengths in neuroscience and environmental studies. The satellite campuses at Jupiter, Davie, and Harbor Branch have provided the university opportunities to grow world-class research and teaching centers in neuroscience and environmental science.

Scripps Research Institute and Max Planck Florida Institute at the Jupiter campus amplify the neuroscience research and teaching opportunities and the visibility of neuroscience at FAU. The group of accomplished FAU neuroscience faculty and students at Jupiter interact daily with Scripps and Max Planck neuroscientists. This interaction is invaluable to both research and instruction, and dramatically enhances the international visibility of the neuroscience program.

Environmental sciences has a strong core of faculty and students working at the Davie campus. They are engaged both in advancing the discipline and addressing the environmental challenges facing Florida.

The research productivity of the Biological Sciences faculty as a whole has increased markedly over the last decade, doubling the numbers of scientific presentations, publications, and grant applications submitted. This is quite remarkable, especially in the face of a simultaneous doubling of the number of FTE students to teach and a national tightening of research support.

Undergraduate and graduate research. Undergraduates are actively engaged in research in faculty laboratories across the disciplines and campuses. Both Masters and Ph.D. students are engaged in rigorous programs and active in research on the Boca, Davie and Jupiter campuses. MS and PhD support models co-exist in the Department, and faculty's desire to train preferentially one or the other is respected.

Transparency in governance. We were told that departmental decisions were reached after open discussion among all stake-holders. This transparency extended to the faculty discussions of tenure applications, where only the votes were confidential. This transparency enables junior faculty to see how the P&T guidelines are interpreted by senior faculty, and thereby to understand what is actually required by them for tenure. One recently promoted faculty member said that this process was "invaluable" in helping to plan well before the tenure year.

It seems to us that this could only occur among faculty who had high confidence in each other and in their leaders and were well-accustomed to interacting in a friendly and professional manner.

Energy, enthusiasm and ambition. All of the faculty and students we met were enthusiastic and ambitious for the university and its research and teaching programs. They (and we) were also impressed by how much the research programs, particularly the neuroscience program, had developed in the last few years. They stated that this growth was the result of energetic, far-sighted leadership in the Department, College, University, and the state.

Faculty expressed enthusiasm about building the research programs on the Jupiter and Davie campuses while retaining close ties between all three campuses.

Challenges and Opportunities

Departmental cohesion across separate campuses. An essential characteristic of a dynamic, growing university is a high frequency of interaction of students and faculty both within and between units. Both planned and chance encounters lead to new insights, new projects, and new discoveries. However the discipline-specific separation of research and teaching on different FAU campuses creates significant challenges for continued growth and departmental cohesion. These challenges are exacerbated by the lack of frequent, efficient, and predictable transportation between the campuses. It increases the time and the energy needed to participate in any activity not located at one's home campus, causing everyone to think twice when contemplating activities at another campus. This barrier reduces the opportunities for learning, teaching, and collaborative research available to students and faculty on their own campus and on the other campuses. It slows all of these activities while it erodes the sense of community within the department that is necessary for them to occur.

If timely and efficient transportation between the campuses is not available as the faculty and student populations at Jupiter and Davie grow, community feeling will erode across the Department and bring pressures to split the department along geographic and disciplinary lines. Faculty who originated on the Boca campus and moved to Davie or Jupiter will retire and be replaced by new faculty without that experience and sense of involvement with the Boca campus. As the numbers of new faculty grow on those campuses, so will a sense of self-sufficiency, especially as they share a sub-discipline of biology with their local colleagues (e.g. neuroscience on the Jupiter/Scripps campus, environmental science at Davie). This will reduce each group's interest and willingness to participate in research, instruction, and service with their Biology colleagues on the other campuses and it will promote the fission of the department.

The University should develop an effective shuttle bus system that runs between the campuses as soon as possible. Ideally, it would run on a fixed schedule several times a day, in both directions, from Dania Beach in the south to Harbor Branch in the north, and vice-versa. Equipped with a down-loadable app that tracks the bus locations, students and faculty could minimize their wait times at bus stops.

This transportation system would enable faculty and students to move quickly and reliably between campuses for round trips that might last only one-half day. This would facilitate class scheduling, teaching schedules, research collaborations, and spontaneous interactions between campuses. It would also enable all faculty to share more easily in the teaching burden located primarily on the Boca campus. Sharing the burden, and being seen to share the burden, will maintain the department collegiality we observed.

We heard some discussion about the possible use of the Tri-rail if there were an adequate shuttle between the Boca Raton and Jupiter campuses. The undergraduate

students we interviewed indicated that this was impractical as the train trips took up to two hours for what should be a 1-hour trip.

Increasing intercampus interactions. Even with rapid, reliable transportation, a sense of departmental community across campuses will be a challenge to maintain and grow as the numbers of Biology faculty, students and staff on each campus grow. At present, this community sense is promoted both by the low numbers of faculty and students on each satellite campus and the dynamic leadership of the department. While it is strong, however, this sense of community should be reinforced by cultivating institutional habits and expectations that support it. These could include a monthly "Biology Day" on the Boca campus that would include a face-to-face all-department meeting, followed by a scientific talk by a distinguished guest and a departmental party/scientific exchange, with poster presentations by graduate and undergraduate students and a spread of refreshments. Inter-campus teaching might be incentivized and structured to encourage interactions and make it seem cost-effective to students and faculty to spend a day away from home-base.

The challenge of 2600 Biology majors for 31 faculty. It is remarkable that the 28 tenure-track Biology faculty and 3 instructors are able to teach 2600 undergraduate majors effectively while maintaining a vigorous graduate program and their individual research programs. Their success results not just from hard work, but also from efficient organization and leadership. We were told that this organization enables the tenure-track faculty to have a one-one teaching load: one large and one smaller class per year. That schedule enables the faculty to focus time and energy on their research while fulfilling the teaching needs of the department. We were also told that non-tenure track faculty have personal laboratories in which they perform their own research, often with the help of undergraduates. This arrangement ensures that, like the tenure-track faculty, the non-tenure track faculty see themselves as scientists as well as teachers, a view that is shared by their colleagues and their students. The morale-boosting effect of this arrangement enables them to be effective in instructing their many large classes and to share their research with students.

Despite these efforts, the large student/faculty ratio means that many students in the large classes have little opportunity for direct interaction with their instructor, whose assessments of their accomplishments are often confined to exams graded by machine. The large classes may or may not be assisted by a teaching assistant (TA), but TAs do teach the laboratory courses that are associated with the large classes. The laboratory courses seem to be extremely well organized and efficient at teaching the very large number of students who take them. The TAs are graduate students who are closer in age and culture to the students, which may facilitate finding solutions to problems that arise for the students. Nonetheless, every effort should be made to reduce the student/faculty ratios, which appear to be higher than the FAU norm. This will require hiring additional faculty, but changes in the way courses are organized may also help. One such change may be to break one session per week of a large lecture class into smaller "recitation" sections of at most 30 students, each taught by a faculty member or a senior graduate student. A 3-credit course in this model would divide into two lecture hours per week and one recitation hour, in which the recitation section would emphasize student-teacher interaction and problem solving.

Retention rates. A primary challenge facing the Department is the failure to retain Biology majors until graduation. According to Fig. 4 in the self-study, the number of Biology majors in 2013 was lowest among the second year students, and greatest among the fourth-year class. If these numbers reflect the trend of each student class over time, the data show that the number of Biology majors who start at FAU as freshmen falls by 50% over three years, while transfer students account for the later rise. We were told that many of the students who drop the major also leave the university; the university is then penalized by the state for the lower retention rate.

Two reasons for the loss of students who begin their career at FAU were suggested to us: failure to progress in the major and personal plans to spend only a year or two at FAU before transferring elsewhere. The undergraduates we interviewed told us that many students begin their career at FAU already planning to transfer to the University of Florida or Florida State University. There are many possible reasons for these plans, including the family tradition, and differences in campus life, reputation, and education and research opportunities.

We were told that many students may fail to progress in the major because they are either not prepared for or simply not enthusiastic about the series of chemistry, physics and mathematics courses required early in the career of a biology major. A large fraction of Biology majors declare their pre-med status, and the Biology curriculum is arranged to accommodate them. Premedical students are asked to take a set of demanding courses in chemistry, physics, and mathematics at the outset of their education. However, we were told that only 15% of students are able to graduate in four years and less than 50% graduate in six years, and a very small percentage are eventually able to matriculate in medical school. This suggests that many students are misplaced as pre-medical students and as Biology majors. We learned from both students and faculty that several factors contribute to this. The first is that the students are poorly prepared at entry, both in their knowledge, learning skills, and work habits. It is practical to urge such applicants to seek remedial education elsewhere, perhaps at the local community colleges.

A second factor is that the incoming freshmen are ignorant of all the possible careers in healthcare and in life sciences generally, including business and finance, law, and public policy. We suggest that freshmen be required to learn about these in a first semester, 1 credit course that introduces them to careers in the life sciences, broadly construed. Such a course, which could feature a variety of outside speakers from across the life sciences, may help students and their parents consider the possibility of "my son the hospital CFO" instead of only "my son the doctor". If the students are to pursue these alternate life science career paths, their undergraduate training must support them. Majors or major/minor combinations that support biology/business, biology/pre-law, or biology/public policy should be developed to give students alternatives to the traditional hard-science path. Faculty from the Medical and Business Colleges may contribute to these courses, a step that should appeal to students while also helping Biological Sciences. This will enable students to make positive choices among attractive alternatives before they ship-wreck on the shoals of organic chemistry. Those of us in public higher education would do well to remember that memories of their own shipwrecks may linger in the minds of the state legislators who sit on the committees that decide university budgets.

Enticing Biology majors and avoiding shipwrecks. Many beginning students are likely to be tentative in the commitment to a Biology major, or they are much more enthusiastic about aspects of biology that don't require an initial immersion in the hard sciences. They should be able to take a course as first-term freshmen that excites them about biology and the major. It should also motivate them for the hard science courses by showing how chemistry, physics and math help explain developments in the life sciences.

It is also likely that the chemistry, physics and math courses focus on subjects that are appropriate for their own majors but are not needed by biology majors. These courses are often set up for chemistry, physics and math majors and are staffed by young people who, having faced the rigors of undergraduate and graduate training in their discipline, want to make sure that biology majors appreciate the finer points of the subject. However, by working with the chemistry, physics, and math faculty to design courses that are appropriate for the biology students, the biology faculty would help their students learn these subjects in a biological context and enhance retention. For instance, calculus might be taught in a "Calculus for Life Sciences" course where the examples and motivations are relevant to the students' interests. Moreover, the ready availability of software for numerical integration and differentiation reduces the need to memorize analytical procedures, and also provides opportunities for students to understand and appreciate how models of biological populations or chemical reactions work.

We heard from faculty and students that the centralized advising and registration processes often do not serve either the students or the Biology department well. Problems in advisement may arise because the advisors and Biology department are not in touch or because the advisors have independent views of the appropriate sequence of courses students should take. We were told that pre-med students were advised to take the series of hard-science courses regardless of their level of preparedness for them. We also learned that students were advised away from certain courses because they were "too hard", and not alerted to new courses that the Biology department had developed.

Questions about course scheduling and registration drew many complaints from students. We were told that students must go online immediately at the opening of registration to have a chance to get into desired or required courses. Classes are said to fill up quickly, even when they are required for the major, so that students who miss the opening of registration may have to defer taking them. One student we interviewed reported that she had to postpone graduation and register for an additional semester to take a required course that had not been available for her earlier. Another student reported that it was only through his personal contacts and research that he was able to plan a sequence of courses that would satisfy both graduation requirements and his interests and still allow him to graduate in 4 years. We strongly recommend that advisement, especially for sophomores and upperclassmen, be brought back into the department. It is important that students learn about the offerings and opportunities in Biology from the department faculty, and that the department faculty learn quickly what the students find frustrating in pursuing the major. We also recommend that the department interview a group of their most successful students shortly before their graduation to learn from them what is and is not working for Biology majors. Like the students we interviewed, such a group will contain articulate, keen observers who will be eager to report what did and did not work for them and their peers.

Support and interventions. Failing students can often be helped by interventions that help them face reality and seek specific help. While the university may have a general program, Biology can help its own students by creation of student-run structures that provide peer support for specific courses and more general problems. One of these might be an undergraduate Biology Club that might serve several functions: (i) to bring life science professionals to campus to discuss careers; (ii) to help manage a peer-to-peer tutoring service for individual courses; (iii) to organize outreach activities, like school visits and demonstrations for events like Brain Awareness Week or Earth Day.

Data-driven answers. It is difficult to know the truth on the ground, and therefore what to recommend, from our brief interviews with administrators, faculty, and students. However, data should be available to help determine why Biology loses majors. Answers may be available from advisement interviews, from course evaluations and from student grades. These data may be supplemented by surveys that ask specific questions.

Graduate programs and Graduate Student support. Many faculty members mentioned that it was very hard to recruit graduate students from a national market given the non-competitive stipends and the lack of health insurance support. This has serious implications for the research program that GTAs often support by working in faculty labs and doing their own doctoral research projects. We recommend the University invest in more competitive GTA stipends and health insurance.

Faculty mentoring program. Though their faculty colleagues are generous with their time, some junior faculty mentioned a lack of a formal mentoring program meant that they often do not have clear and timely guidance for issues regarding research support, promotion and tenure issues, and other topics a former mentor might provide. We recommend that the College or Department establish a mentoring program, especially if the University invests in the many new lines in the strategic plan areas that Biological Sciences will have. As the department and college grows, informal mentoring may not be enough to ensure junior faculty success and retention.

Enhancement of research. Research activity in Biological Sciences is growing at an impressive rate and the policies that have led to that growth, including the development of the Jupiter and Davie campuses, should continue. The primary way in which that growth could be spurred would be to offer nationally competitive graduate fellowships (above). Although these might be limited in number at first, the first-rate students they would help attract would have an immediate impact on research productivity. A second step would be to enhance links on all campuses to other scientific and engineering disciplines. Electrical and mechanical engineers, computer scientists, physicists, and mathematicians may find much of interest on the Jupiter and Davie campuses, while biologists on those campuses may find the others' knowledge of measuring technology, data analysis, and modelling to be invaluable. Interdisciplinary "translational" and "transformative" projects that arise from these links are likely to be welcomed at funding agencies.

RECOMMENDATIONS

1. Continue to build research and instruction on the Boca, Jupiter and Davie campuses along the lines already established.

2. As soon as possible, develop a reliable, efficient transportation system between the different campuses for students and faculty.

3. Support the sense of community in the Biology department by developing institutional habits and traditions that support it, such as a monthly departmental day on the Boca campus that all are expected to attend.

4. Do not offer admission to under-prepared students. Consider limiting future University growth in the largest undergraduate major to enable the faculty to plan for orderly instruction in this discipline.

5. Develop a first semester, 1 credit course that introduces first year students to exciting developments in the life sciences, explains the need for tools and concepts from the hard sciences and mathematics, and identifies careers pathways in the life sciences other than pre-medicine.

6. Create course sequences and major/minor combinations that lead to degrees in Biology/public policy, Biology/law, Biology/business and finance and non-profits.

7. Hire additional faculty or non-tenure-track instructors to reduce the student/faculty ratio. Create a formal faculty mentoring program.

8. Consider course structures that increase the interaction of students and instructors; the 'recitation section' is one possible model.

9. Bring advisement for sophomores and upper class students back to the department.

10. Engage the better students in peer-support activities by developing an undergraduate interest/service club.

11. Consult the better graduating seniors about what did and did not work for them, and how it can be improved.

12. Supplement the anecdotal accounts of students with data from the university to identify the roadblocks to timely graduation and how they might be cleared.

13. Strengthen research productivity by encouraging more interdisciplinary ties with other departments and colleges and by improving the graduate student support package offered to PhD and MA/MS students.

CONCLUSION

The Department of Biology accomplishes remarkable feats of instruction, research, and external funding across campus distances with limited resources and little control over the growth of the undergraduate major. Our recommendations for the future are to promote a sense of inclusion for Biology faculty, staff and students on all campuses by regularly exercising their common bonds. We further urge The University to enable Biology to create ownership practices for early undergraduate enrollment, advising, and course content that may improve freshman retention and graduation rates.

APPENDIX

List of faculty and students with whom review team met. (attached excel spreadsheet)

FLORIDA ATLANTIC UNIVERSITY

ENVIRONMENTAL SCIENCE PROGRAM

Academic Program Review
Self-Study Report

Program:	Environmental Science Program
Program Director/ Coordinator Name:	Dale Gawlik / Dianne Owen
Program Self-Study Contact:	Dale Gawlik / Dianne Owen
Self-Study Contact Email:	dgawlik@fau.edu / dowen@fau.edu
Self-Study Contact Phone Number:	561-297-0873 / 561-297-0873

A. Mission and Purpose of the Environmental Science Program

The mission of the Environmental Science (ES) Program at Florida Atlantic University is to educate and support students who are motivated to reach the highest level of professional achievement in environmental science, and to facilitate a robust research climate for faculty and students.

The undergraduate program promotes a broad, integrated understanding of the interdependencies of humans and their environment and prepares students for diverse career paths related to environmental science. At the graduate level, the ES Program fosters leadership and provides students with in-depth knowledge and training in the natural and social sciences, preparing them to develop and implement solutions to complex environmental problems.

Environmental Science Program Academic Goals

The ES Program will provide students a foundational understanding of the inter-related disciplines that pertain to environmental issues through an interdisciplinary core curriculum at both the undergraduate and graduate level. To meet this goal, the ES Program requires all students to complete core courses that emphasize the inter-connectedness of the natural and social sciences. Upon completion of coursework, students should be able to form and identify conceptual linkages across disciplinary boundaries, and utilize multiple perspectives of diverse disciplines in addressing environmental issues.

The ES Program will develop students' professional skills in Environmental Science, through a flexible curriculum that accommodates a broad range of student goals and interests. To meet this goal, courses

in the ES Program curriculum are organized around interdisciplinary focal areas in the natural and social sciences. Courses offered within this framework include: traditional lecture-style, e-learning lab, and field courses; special topics courses that introduce students to the latest theories, methods, and emerging issues; professional certifications; seminar series; experiential learning through thesis research, directed independent study (DIS), and internship programs. Through this framework, students will gain proficiency in the application of scientific principles such as, critical thinking, experimental design, synthesis, and quantitative analysis, as well as a sense of professional responsibility and integrity.

The ES Program will prepare students to meet the real-world challenges they will face as environmental professionals and citizens through experiential learning and faculty mentoring. To meet this goal, student education in the ES Program capitalizes on the research strengths and experience of the FAU faculty and the close connection to the diverse community of Environmental Scientists in South Florida. Students conduct and publish research in their field of interest under the guidance of experienced faculty. The ES Program supports both undergraduate and graduate student research that is relevant, novel and applicable to solving critical environmental problems. By fostering external partnerships (NGOs, local, state, federal agencies), the ES Program provides faculty and students access to sources of funding, specialized services and equipment, as well as the opportunity for direct engagement with the public, private organizations, and environmental decision-makers. By linking the practice and application of environmental science, The ES Program ensures students develop professional skills in: Communication of science to a variety of audiences; Development and maintenance of professional collaborations; Ethical obligations to the scientific community and society; Technical proficiency within the field.

The ES Program will produce students with the skills required for professional positions within the field of environmental sciences in the public or private sector and/or continued graduate education.

Undergraduate Student Goals

Undergraduate students will understand and be able to apply the following core concepts to the analysis of environmental issues; 1) Fundamental principles in the natural and social sciences; 2) Basic interactions between social and natural systems; 3) Processes and feedbacks that govern complex dynamic systems; 4) Major challenges in human-environment interactions. Using these core concepts, undergraduate students will be able to effectively communicate and apply critical thinking and analytic skills to problem solving in environmental science and demonstrate proficiency in practical skills related to environmental science.

Graduate Student Goals

Both thesis and non-thesis graduate students will demonstrate a broad understanding of the multidisciplinary field of environmental science and in-depth knowledge of their area of specialty. They will be able to use scientific research methods, perform analyses of scientific data and critically evaluate and communicate research findings. They will demonstrate professional skills in environmental science,

as evidenced by scholarly interactions with professionals in the field, including participation in professional organizations, workshop and conference participation.

Graduate students enrolled in the thesis option will be able to conduct original research and perform in-depth analysis, as demonstrated by successful completion of a Master's Thesis. Specifically, students will demonstrate: 1) current knowledge of their field of study and the ability to critically review and interpret scientific literature 2) the ability to develop a hypothesis, design and execute scientific experiments, and draw logical conclusions from data and 3) the ability to write scientific reports and communicate effectively in scholarly presentations.

Student Goals in the Environmental Science Program are linked to the following elements of FAU's Strategic Plan:

Goal 1: Enrich the Educational Experience

Goal 1, Objective 2: Strengthen and expand graduate programs

Goal 1, Objective 4: Support an organizational culture in which all units are dedicated to student success

Goal 2: Inspire Research, Scholarship and Creative Activity

Goal 2, Objective 1: Increase scholarship and creativity

Goal 2, Objective 3: Enhance the regard and visibility of our research, scholarship and creativity

Goal 2, Objective 4: Strengthen and support interdisciplinary research and its visibility in the University

Goal 2, Objective 5: Involve students at all levels in research, scholarship and creative activity

Goal 3: Increase FAU's Community Engagement

Goal 3, Objective 1: Enrich the educational and cultural experiences for students, faculty and the surrounding communities

Goal 3, Objective 2: Increase the number of community partnerships

Goal 3, Objective 3: Focus on the unique opportunities of FAU's stewardship of place

Goal 3, Objective 4: Focus resources on increasing FAU's support to the communities it serves

B. Previous External Reviews

The last self-study and review of the Environmental Science Program was done in Spring 2009. At that time a total of 13 students were enrolled in the ES Master's Program and the ES was entering a phase of rapid growth spurred by a broad range of important changes that had been recently implemented by Dr. Dale Gawlik, who became Director of the ES program in 2007. These changes included: significant revisions of the

graduate curriculum and the introduction of a non-thesis degree option; establishment of new partnerships and collaborations with outside organizations and agencies to provide support for student research, including a $500,000 Fellowship Initiative with the National Park Service; broadening faculty participation in governance through the formation of standing Admissions and Program committees; broadening the range of academic units from which faculty participating in the program are drawn, hosting of regular workshops and a seminar series; expanding and updating the ES web site to disseminate timely information and facilitate interaction of faculty and staff with prospective and current students.

Beginning in 2009, the ES Program took on the additional responsibility for oversight and assessment of the undergraduate Environmental Science Certificate Program. Annual reports from the Director to the Dean that summarize the year's progress in more detail are attached (Appendix E).

C. Instruction

Baccalaureate Programs: Undergraduate Certificate in Environmental Science

Prior to 2009, when the Environmental Science Program took on oversight of the Environmental Science Certificate, there were no student learning outcomes (SLOs). The Environmental Science Program Committee developed program goals, defined new student learning outcomes for the ES Certificate, and put in place a new assessment plan beginning in 2009-2010. Implementation of the new assessment plan proved problematic; the interdisciplinary nature of the Certificate program, and the procedures in place for awarding the ES Certificate, made it difficult to identify students until just before or after graduation, so reliable assessment results could not be obtained. In 2014 the ES Program Committee recommended major changes to the Certificate curriculum, adding a capstone course and introducing a core requirement in statistics. These changes, which will be effect for Fall 2015, will ensure that all ES Certificate students can meet the SLOs and facilitate the implementation of program assessment.

Student Learning Outcomes – Undergraduate Certificate Program

SLO 1: Critical Thinking and Communication

Students will be able to effectively communicate and apply critical thinking and analytic skills to problem-solving in environmental science, drawing on a broad understanding of the processes and feedbacks involved in the interaction of social systems and ecosystems.

Assessment Method

Students submit a paper that identifies a clear issue in environmental science, examines the relevant facts, and proposes a scientifically defensible solution. The paper is assessed using the attached rubric.

Implementing Strategy

All students must take a core course that emphasizes the interactions of social systems and ecosystems. As a requirement for the core course, students submit a written in-depth review and analysis, and propose a solution, to a problem related to the interaction between social systems and ecosystems. These written assignments are assessed by the instructor using a rubric to assess written communication, critical thinking, analysis and synthesis skills. The ES Program committee has also approved changes to the curriculum that include the introduction of a capstone course, beginning in Fall 2014, that will directly assess this outcome.

Criterion for Success

At least 75% of ES Certificate students will meet or exceed expectations for all communication and critical thinking/analysis skills, as specified in the assessment rubric.

SLO 2: Core Principles in Environmental Science

Students will understand and be able to apply the following core concepts to the analysis of environmental issues: 1) Fundamental principles in the natural and social sciences 2) Basic interactions between social systems and ecosystems 3) Processes and feedbacks that govern complex dynamic systems 4) Major problems and issues in human-environment interactions

Assessment Method

The map of assessment criteria addressed in individual courses offered in the ES Certificate curriculum will be compared with the actual courses chosen by ES Certificate students. Statistical analyses will be done to determine whether the courses taken by students are meeting outcome criteria.

Implementing Strategy

ES Program has created a course map that links these outcome criteria to the course learning objectives that are assessed by individual courses in ES Certificate curriculum. The ES Program committee has also approved changes to the curriculum that included the introduction of a capstone course, beginning in Fall 2014, that will directly assess this outcome.

Assessment Method

The map of assessment criteria addressed in individual courses offered in the ES Certificate curriculum will be compared with the actual courses chosen by ES Certificate students. Statistical analyses will be done to determine whether the courses taken by students are meeting outcome criteria.

Criterion for Success

All students earning the ES Certificate will take one or more courses in which the outcome criteria are covered and assessed

SLO 3: Practical Skills

Students will demonstrate proficiency in practical skills related to a field of environmental science.

Implementing Strategy

Students are given the opportunity, through their academic courses and programs within the ES Program, to participate in laboratory classes, internships, academic service learning projects, professional conferences or workshops, or Directed Independent Study research, in the field of environmental science. The ES Program committee has also approved changes to the curriculum that include the introduction of a capstone course, beginning in Fall 2014 that will directly assess this outcome.

Assessment Method

The ES Certificate curriculum requires students to demonstrate practical academic experience (laboratory classes, internships, academic service learning projects, professional conferences or workshops, Directed Independent Study) in the field of environmental science.

Criterion for Success

All students will successfully complete at least one laboratory class, internship, academic service learning project, professional conference or workshop, or Directed Independent Study project, in the field of environmental science.

Data Summary: Analysis and Evaluation

Assessment of this element of the Undergraduate ES Certificate Assessment Plan will begin in Spring, 2015, with the introduction of the new capstone course; results are not available for 2013-2014.

Program Improvement

As a result of the program review based on previous assessment results, a capstone course, that specifically addresses and assesses this outcome has been added to the ES Certificate curriculum to

ensure that all students in the ES Certificate Program achieve this outcome. This capstone course and the associated changes to the ES Certificate Program are expected to go into effect beginning Spring 2015.

***Assessment of SLOs and Program Improvement* – Undergraduate Certificate Program, 2013-2014**

SLO 1: Critical Thinking and Communication

Data Summary: Analysis and Evaluation, 2013-2014

This element of the Undergraduate ES Certificate Assessment Plan has been eliminated as part of a major revamping of the Undergraduate ES Certificate Program. The previous structure of the program did not allow the ES Program to identify ES Certificate students at the time they were enrolled in the core course. Because these core courses were large, multi-section courses, each taught in different departments, tracking the very small percentage of students who eventually applied for and earned the ES Certificate was not practicable, and results are not available for 2013-2014.

Program Improvement, 2013-2014

In recognition of the need to ensure that all students in the ES Certificate Program achieve this outcome, a capstone course, that specifically addresses and assesses this outcome, has been added to the ES Certificate curriculum. This capstone course and the associated changes to the ES Certificate Program are expected to go into effect beginning Spring 2015.

SLO 2: Core Principles in Environmental Science

Data Summary: Analysis and Evaluation, 2013-2014

The procedures for assessing this element of the Undergraduate ES Certificate Assessment Plan have been revised as part of a program review that led to a major revamping of the Undergraduate ES Certificate Program. The previous structure of the program did not allow the ES Program to identify many ES Certificate students until the semester they graduated, or in some cases, after graduation. This meant that the course mapping for recipients of the Certificate could not practically be kept up-to-date, and results are not available for 2013-2014.

Program Improvement, 2013-2014

As part of major revisions to the undergraduate ES Certificate program made as a result of the program review based on previous assessment results, a requirement for a capstone course has been added to the curriculum that will allow the ES to identify students prior to graduation. Revisions have also been made to the ES Certificate website and the ES Blackboard community, and the ES Program has worked with advisors in the College of Science to ensure that students understand the application and verification procedures.

SLO 3: Practical Skills

Data Summary: Analysis and Evaluation

Assessment of this element of the Undergraduate ES Certificate Assessment Plan will begin in Spring, 2015, with the introduction of the new capstone course; results are not available for 2013-2014.

Program Improvement

As a result of the program review based on previous assessment results, a capstone course, that specifically addresses and assesses this outcome has been added to the ES Certificate curriculum to ensure that all students in the ES Certificate Program achieve this outcome. This capstone course and the associated changes to the ES Certificate Program are expected to go into effect beginning Spring 2015.

i. State-approved prerequisites

The Environmental Science Certificate is designed to enhance a student's major program of study and does not qualify as a degree. Therefore, lower level pre-requisites are not enforced by the Environmental Science Program but are instead enforced by the University and/or the students' major program or department. All of FAU's baccalaureate programs require core curriculum courses as specified by the Florida State University System's Intellectual Foundations Program (IFP). All of FAU's IFP courses are thoroughly reviewed by the University's Core Curriculum Committee for compliance with the State University Systems' requirements per regulation 6.017. A list of FAU's core curriculum requirements can be found at http://www.fau.edu/uas/pdf/2014_2015/IFP-Curriculum.pdf.

ii. Limited access

The Environmental Science Certificate program is open to all students who have the necessary pre-requisites to progress through the course requirements for the certificate. Course pre-requisites are specified in the University catalog (http://www.fau.edu/academic/registrar/FAUcatalog/scienceDES.php).

iii. Admissions criteria

There are no admission requirements for the Environmental Science Certificate Program. Any FAU student is eligible to participate in the program. The ES Certificate is awarded only in conjunction with a Baccalaureate degree from FAU.

iv. Enrollment information

Since the Environmental Science Certificate Program is not housed within a department or program and is open to all FAU students, it is challenging to track detailed enrollment statistics. Enrollment in the courses that lead to the certificate is tracked by the departments and programs that administer those courses. However, there are no courses that are open only to students who are participating in the Certificate Program and historically there have not been any courses that all certificate students are required to take; therefore, course enrollment does not directly correlate to enrollment in the certificate program.

We have also recently made curriculum changes that we believe will be helpful in this regard. Effective Spring 2015 all new Environmental Science Certificate students will be required to take a senior-level capstone course, Critical Thinking in Environmental Science (EVS 4021). This will be the first time the Environmental Science Certificate Program has included a course that is required for all students. Having this required course will enable us to clearly identify and assess students who are working toward the certificate.

v. Average class size and faculty/student ratio

Class size and faculty/student ratio are tracked by the departments and programs that offer courses which are part of the Environmental Science Certificate Program. Historically, the only core requirement

for the Environmental Science Certificate was that students had to take either Environment and Society (EVR 2017) or Issues in Human Ecology (PCB3352). (As described below, beginning in Spring 2015 the core requirements for the certificate will change.) Between the spring of 2009 and the fall of 2014, the average enrollment for EVR 2017 was 43 students, and the average enrollment for PCB 3352 was 48 students.

vi. Curriculum

The Environmental Science Certificate curriculum draws from courses across multiple colleges and departments at FAU to ensure that students gain basic knowledge and skills in the interdisciplinary field of environmental science. The ES Certificate is awarded only in conjunction with a baccalaureate degree from FAU, and all students must complete a total of 18 credits from these areas:

<u>One course from each of three core areas</u>

1. Human Environmental Interactions
2. Statistics/Quantitative Methods
3. Environmental Science Capstone

<u>One course from three of five focus areas</u>

1. Biology
2. Chemistry,
3. Earth Science,
4. Human-Environmental Interactions,
5. Geographic Information Science.

This curriculum for the ES Certificate was approved for the 2015-2016 FAU Catalog. The full list of courses in the ES Certificate core areas and focus areas is in Appendix A.

Nationally, many universities offer an undergraduate certificate in Environmental Studies, but the undergraduate certificate in Environmental Science is much less common. The ES Certificate at FAU differs from a typical Environmental Studies Certificate in requiring a core course in quantitative methods and statistical analysis. Among state universities in Florida, only FAU offers an undergraduate Environmental Science Certificate. Florida International University offers an undergraduate certificate in Environmental Studies; other state universities in Florida, including FIU, offer baccalaureate degrees in Environmental Science or Environmental Studies but do not have an undergraduate certificate program. Nationally, several comparable and aspirational programs offer undergraduate certificates or minors in environmental science or environmental studies that are similar to the ES certificate; these programs also divide credit requirements between core and elective courses. The number of required core credits varies from 3-6, and total credits vary from 15-21.

Requirements for comparable and aspirational certificate programs listed below are shown in the table the following table.

- Ohio University, Environmental Studies Certificate
- University of Nevada, Las Vegas, Environmental Science Minor
- Florida International University; Environmental Studies Certificate
- University of Wisconsin, Madison; Environmental Studies Certificate

- University of Colorado, Boulder; Certificate in Environment, Policy and Society

	FAU	Ohio U	UNLV	FIU	UW Madison	U Colorado Boulder
Certificate Type	Env. Science	Env. Studies	Env. Sci Minor	Env. Studies	Env. Studies	Env., Policy and Society
Comparable/ Aspirational		comp	comp	comp	asp	asp
Total	18	18	21	18	15	18
Core	6	3	3	6	6	6
Electives	9	12	18	12	9	12
Senior Capstone	3	3				

vii. Internships, practicum, study abroad, field experiences

Many undergraduates in the ES Certificate Program are introduced to internship opportunities through interaction with ES faculty who offer Directed Independent Study courses that are tied to internships with community partners. These include unpaid internships with Broward County Environmental Protection and Growth Management, Florida Fish and Wildlife Conservation Commission, Jonathan Dickinson State Park, South Florida Water Management District, and the Palm Beach County Department of Environmental Resources Management. Since 2013, three ES Certificate students have won paid summer internships with the Arthur R. Marshall Foundation for the Everglades.

Most students in the upper division ES Certificate core course take advantage of the opportunity to gain field experience and Academic Service Learning credit through practical collaborative projects with community partners including Boca Raton Housing Authority, Broward County Environmental Protection and Growth Management, Florida Fish and Wildlife Conservation Commission, Gumbo Limbo Nature Center, Jonathan Dickinson State Park, Palm Beach County Department of Environmental Resources Management, and Pine Jog Environmental Education Center.

viii. Pedagogy/pedagogical innovations

With the exception of the new senior capstone course, which will first be offered in the spring of 2015, the pedagogical methods employed in the various classes that are part of the Environmental Science certificate are monitored by the programs and departments offering those courses. However, the Environmental Science Program Committee reviews the syllabi of courses to make sure that both the course content and instructional methods are in keeping with the mission of the Environmental Science program before approving them as optional courses for the certificate.

Although we do not specifically track pedagogy or pedagogical innovations, the Environmental Science Program and its faculty are committed to providing students opportunities to engage in critical thinking, observation, and data thinking and analysis. The following are a few examples of teaching excellence and innovation in some of the courses that are part of the Environmental Science certificate.

- The following courses include an enhanced undergraduate research project. The instructors of these courses have received internal grants to develop and assess the success of these undergraduate research projects.
    - Issues in Human Ecology, PCB 3352
    - Critical Thinking in Environmental Science, EVS 4021 (the new ES capstone course)
    - Biogeography, GEO 4300
    - Human-Environment Interactions in South Florida, GEA 4275
    - Hydrogeology, GLY 4822

- The following classes include an academic service learning project.
    - Issues in Human Ecology, PCB 3352
    - Critical Thinking in Environmental Science, EVS 4021
    - Human-Environment Interactions in South Florida, GEA 4275

- The Environmental Science Program, together with the Department of Geoscience and the Department of Biology, has established environmental monitoring stations on the ecological preserve on our Boca Raton campus (https://www.sites.google.com/site/drtararootshomepage/reach). These environmental monitoring sites serve as a field lab for the following courses.
    - Issues in Human Ecology, PCB 3352
    - Critical Thinking in Environmental Science, EVS 4021
    - Human-Environment Interactions in South Florida, GEA 4275
    - Hydrogeology, GLY 4822

- Water Resources (GEOC 4280), which became a fully online course in 2013, received Quality Matters (QM) certification after being peer reviewed to ensure the course meets the QM benchmarks for quality online instruction. (https://www.qualitymatters.org/)

ix. Scope of institutional contributions

As an interdisciplinary program that does not have direct oversight for any courses except the new senior capstone course, this section of the self-study has only limited relevance to the Environmental Science Certificate program. The new ES Certificate capstone course, Critical Thinking in Environmental Science, was created by the ES Program (in part as a means of identifying our students and assessing their progress) and is taught by ES faculty. The ES also provides research mentoring opportunities for undergraduates through its graduate-undergraduate mentoring program.

x. Student profile

The Environmental Science program does not track this information. Statistics about student diversity, age, gender, etc. are tracked by degree-offering departments and programs rather than interdisciplinary certificate programs.

xi. Advising procedures

It is challenging to advise students who are matriculated in a variety of departments throughout several colleges. Currently we rely heavily on the Environmental Science Program web page (http://www.science.fau.edu/biology/envirosci/undergraduate.html), the Program Coordinator and college-level academic advisers to advise students. Both the web page and college academic advisers encourage students to enroll in the Environmental Science Blackboard community, which we use to routinely to communicate with students. However, due largely to the interdisciplinary nature of the certificate program, a large proportion of students who are participating in the Environmental Science certificate program self-advise.

Currently the ES web page (http://www.science.fau.edu/biology/envirosci/undergraduate.html) and college-level academic advising are used to inform students that they must ask an advisor or the ES Program Coordinator to enroll them in the Environmental Science Blackboard community and submit an Application for the ES Certificate through the Blackboard site; this procedure was developed to allow the ES to track students who are pursuing the ES Certificate. However, we have found that students very frequently self-advise, complete all the courses required for the certificate, and submit the ES application during the semester they graduate; in some cases students who completed the required courses, but never submitted an application to the ES, are awarded the ES Certificate when they graduate. Thus many students earn the certificate without us being able to track their progress through the program. To improve communication with students and encourage students to participate in the Blackboard community and submit their application early, we plan to 1) work with the departments/instructors of core courses to announce these procedures every semester, and 2) in addition to the college-level academic advisors, ask department-level academic advisors to inform students of these procedures.

xii. Licensure rates (if applicable)

Not applicable.

xiii. Placement rates/employment profile

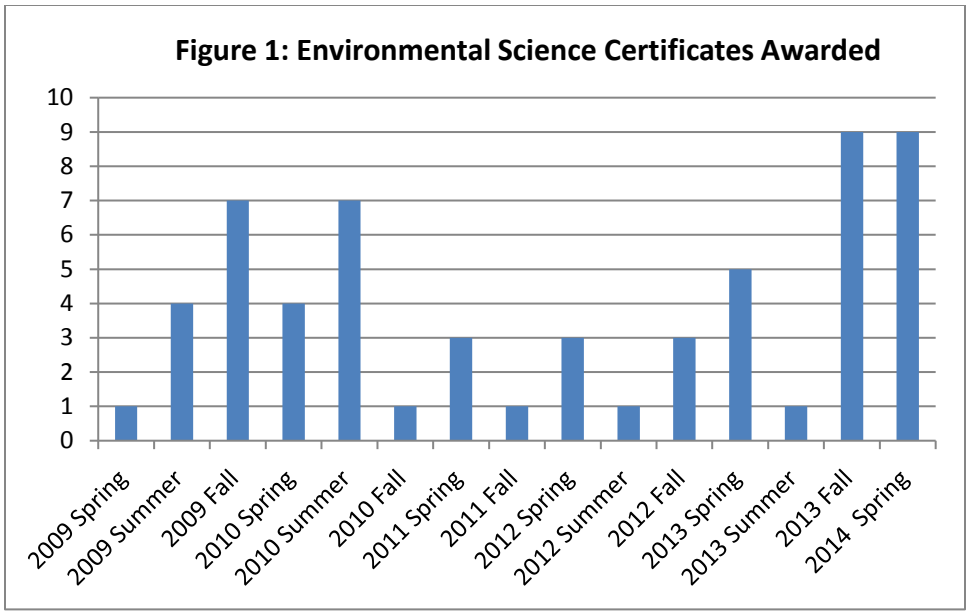
Not applicable: This information is tracked by degree-offering departments and programs rather than by the Environmental Science certificate program.

xiv. Retention rates

Not applicable; this information is tracked by degree-offering departments and programs rather than by the Environmental Science certificate program.

xv. Graduation rates

Figure 1 shows the number of students that have received the Environmental Science Certificate from Spring 2009 through Spring 2014.



xvi. Student recruitment

The Environmental Science website and college and department academic advisors are the primary means used to recruit students into the Environmental Science Certificate Program. Students in colleges and departments across the university enroll in ES Certificate courses to meet the requirements for their major, and many instructors in these courses advise and recruit students. In 2014 the ES also began hosting a weekly graduate-undergraduate round table in collaboration with the FAU chapter of SEEDS, the undergraduate organization of the Ecological Society of America; this informal gathering held at the Boca Raton campus helps to enhance interaction between undergraduates and ES graduates students and helps to recruit students interested students in the ES Certificate program.

Graduate Programs: Master of Science in Environmental Science

In 2010-2011 the Environmental Science Program Committee defined new student learning outcomes (SLOs) for ES graduate students that reflected the new program goals, particularly for non-thesis students, and developed a new assessment plan in the context of the new learning outcomes that used appropriate tools and methods and implemented sustainable practices. ES Program Committee reviews SLOs and assessment results annually and makes recommendations for program improvement.

Student Learning Outcomes – Master's Program

<u>SLO 1: Professional Activities</u>

Students will demonstrate substantial professional skills in environmental science, as evidenced by scholarly interactions with professionals in the field, including participation in professional organizations and activities such as scholarly presentations, workshop participation, and conference attendance.

Implementing Strategy
Information on student participation in professional societies and organizations, scholarly interaction with faculty, and participation in professional workshops and conferences, is collected by means of an online survey that is completed by students each academic year.
Assessment Method
The analyses and summary of the percentage of students reporting participation in specific professional activities is reviewed annually by the Environmental Sciences Program Committee, which makes specific recommendations for improving students' acquisition of professional skills.
Criterion for success
1) Participation in professional organizations:
90% of MS students will participate in one or more professional organizations
2) Interaction with faculty:
90% of students will interact with faculty weekly or more often.
3) Participation in workshops and conferences:
90% of students will present their thesis or DIS research at one or more workshops or conferences

SLO 2: Original Thesis Research

Students enrolled in the thesis option will be able to conduct original research and perform in-depth analysis, as demonstrated by successful completion of a Master's Thesis. Specifically, students will demonstrate:
1)current knowledge of their field of study and the ability to critically review and interpret scientific literature.
2) the ability to develop hypothesis, design and execute scientific experiments, and draw logical conclusions from data.
3) the ability to write scientific reports and communicate same effectively in oral presentations.

Implementing Strategy
Overall evaluation of student thesis work in the ES Program is performed by the thesis committee and departmental graduate coordinator in accordance with the guidelines of the academic department of the faculty advisor. A thesis committee reviews the thesis proposal and thesis defense presentations, which are open to all faculty. The advanced procedural and technical skills of the student are evaluated and reported by the thesis committee in accordance with the guidelines of the academic department of each student's faculty advisor.
Each member of the Thesis Committee will submit a written evaluation of the thesis proposal and defense to the ES Program Coordinator, utilizing the assessment forms downloaded from the Environmental Sciences website. The evaluations are reviewed by the ES Program Director and the standing Program Committee.
Assessment Method
Assessment of Thesis Proposal: During the first year, each student writes a thesis proposal and presents a proposal seminar that is open to all faculty. Each member of the Thesis Committee evaluates the proposal by a 3-pt scale (1=below expectation, 2= Meets expectation; and 3 = Exceeds expectation) for the following criteria:
1) Scientific Merit of Study
2) Adequacy of literature review
3) Ability to create testable hypothesis and define objectives
4) Soundness of research methods, including procedure for data analysis
5) Oral communication and seminar
Assessment of Thesis Defense: During the last semester of study, each student submits a final written

thesis and presents a thesis defense seminar. Each member of the Thesis Committee evaluates the thesis by a 3-pt scale (1=below expectation, 2= Meets expectation; and 3 = Exceeds expectation) for the following criteria:
1) Scientific Merit of Study
2) Critical analysis of literature in the field
3) Hypothesis and extent to which objectives are accomplished
4) Scope and quality of data collected and its presentation
5) Intellectual merit of data interpretation and analysis
5) Potential for journal publication from the work
Criterion for success
Success criterion for thesis proposal:
100% of all students will achieve a score of 2.5 or better on the thesis proposal evaluation.
Success criterion for thesis defense:
100% of all students will achieve a score of 2.5 or better on the thesis defense evaluation.

SLO 3: Employment after Graduation

Students will demonstrate the skills required to successfully compete for professional positions in the workforce by gaining employment in a field of environmental sciences-related field in the public or private sector.
Implementing Strategy
The ES Program maintains contact with students after graduation through faculty advisors and annual email surveys.
Assessment Method
A system for collection and tracking post-graduation placement data (career path after leaving FAU) through email surveys is maintained by Environmental Science faculty and staff
Criterion for success
At least 90% of students that seek employment in the discipline are able to obtain appropriate employment within one year.

SLO 4: Critical Thinking and Communication

Students will demonstrate a broad understanding of the multidisciplinary field of environmental science and in-depth knowledge of their area of interest. They will be able to perform analyses of scientific data and research methods, critically evaluate research findings, and communicate effectively with colleagues in their field.
Implementing Strategy
All students must take the Environmental Sciences Colloquium course during two fall semesters. As a requirement for this course, students submit weekly summaries of the scientific seminar presentations and provide in-depth critical reviews of three presentations. These written assignments are assessed by the instructor according to rubric approved by the Environmental Sciences Program Committee.
Assessment Method
Students' written reviews of the seminar presentations will be assessed using a rubric that evaluates communication, critical thinking, and synthesis skills.
Criterion for success
At least 80% of students will meet or exceed all expectations, as specified in the assessment rubric.

Assessment of SLOs and Program Improvement – Master's Program, 2013-2014

SLO 1: Professional Activities

Data Summary: Analysis and Evaluation

Of the 10 students responding to the annual assessment survey:

1) 70% participated in one or more professional organizations. 10% participated in a professional club at FAU and 60% participated in a professional club outside FAU.

2) 70% interacted with their advisor weekly or more often.

3) 90% of students attended a workshop or conference. at FAU. Only 70% attended a workshop or conference outside FAU.

The success criteria were not met for two components of this outcome, however, the level of student compliance with the requirement to complete the annual survey was extremely low (45%), making it difficult to draw valid conclusions from the results. Since failure to complete the survey is in itself indicative of low student engagement in the program, the level of success for this outcome is likely to be even lower among the students who did not take the survey.

Program Improvement

The ES has implemented three program improvements to increase student success for this outcome:

1) Increase engagement of first-year students in professional interactions. Beginning in 2014-2015, all ES students will be required to present a poster at the ES Retreat. The ES now holds its Annual Retreat in conjunction with the Graduate and Professional Student Association Research Day at FAU. In the past, only second-year thesis students were required to present a poster at the ES Retreat. In the future, first-year non-thesis students will present a poster of their proposed DIS project, second-year non-thesis students will present a poster of their Directed Independent Study (DIS) project results, and first-year thesis students will present a poster of their proposed thesis research. ES faculty judge the posters in the thesis and DIS categories, and winners receive funding for travel to a scientific conference or membership in a professional society.

2) Increase student completion of the assessment survey. The low level of student compliance with email requests to complete the assessment survey has been a perennial problem. Currently, the survey is conducted by an email request to students explaining the purpose of the survey and providing a link to SurveyMonkey. In the future, completion of the survey will be a requirement in the ES Colloquium course that all ES students must take during the fall semester. The survey results will remain anonymous, but students must complete the survey through Blackboard as part of their grade for the course. ES staff will do a short in-class presentation about the objectives of the survey and its role in program improvement and student success.

3) Increase student interaction with faculty. The introduction in Spring 2014 of the requirement that non-thesis ES students complete a DIS project under the direction of an ES faculty member is expected to increase the interaction of non-thesis students with faculty.

SLO 2: Original Thesis Research

Data Summary: Analysis and Evaluation

1) 100% of 8 students achieved a score of 2.5 or better on their thesis proposal evaluation.

2) 100% of 4 students achieved a score of 2.5 or better on their thesis proposal evaluation.

Program Improvement

No specific program improvements are planned for this outcome.

SLO 3: Employment after Graduation

Data Summary: Analysis and Evaluation
100% of 12 students who graduated from Fall 2012 through Summer 2013 found employment in the field or entered a PhD or professional program within one year after graduation.
Among 15 students graduating less than one year ago (from Fall 2013 through Summer 2014), 10 students had found employment in the field, 2 had entered Ph.D. programs, and 3 were seeking employment. Of the students who had found employment, 3 were employed part-time by choice.
Program Improvement
No program improvement related to this outcome is planned at this time.

SLO 4: Critical Thinking and Communication

Data Summary: Analysis and Evaluation
100% of students met or exceeded expectations for communication, critical thinking and synthesis.
First-year students scored significantly lower (p=0.045) than second-year students in communications skills (5.0±0.46 and 6.8±0.60, respectively).
First-year students also scored significantly lower (p=0.037) than second-year students in communications skills (4.9±0.58 and 6.7±0.52, respectively).
These results support the expectation that the ES Program will improve students' critical thinking and communication skills.
Program Improvement
The introduction of the requirement that first-year students participate actively in the Annual ES Retreat by presenting a poster of their thesis or research proposal is expected to improve student skills in communication and critical thinking.

i. Limited access

To be considered for admission to the master's degree program in Environmental Sciences, applicants must meet the following minimal requirements:

- Have an earned bachelor degree from a regionally accredited college or university or the international equivalent.
- Have a cumulative grade point average of 3.0 or greater over the past 60 credit hours. This could include graduate-level coursework.
- Have a Graduate Record Examination (GRE) score of at least 151 on the verbal test and 148 on the quantitative test from the past five years. The admissions committee evaluates the scores on each test individually, not cumulatively. Prior to the change in the GRE test in 2011 a cumulative score of 1000 was the benchmark minimum standard.

ii. Admissions criteria

The Environmental Science (MS) graduate program seeks to provide advanced education to highly qualified graduate students. Admission to the ES master's program is competitive and applicants are evaluated on several factors that collectively indicate their potential for scholarly and professional success. To be considered for full acceptance into the master's degree program in Environmental Sciences, applicants minimally must:

- Have an earned bachelor degree from a regionally accredited college or university or the international equivalent.
- Complete the Environmental Science graduate study application.
- Submit a 1-2 page typed personal statement of research/career objectives as they relate to environmental sciences.
- Have a cumulative grade point average of 3.0 or greater over the past 60 credit hours. This could include graduate-level coursework.
- Have a Graduate Record Examination (GRE) score of at least 151 on the verbal test and 148 on the quantitative test from the past five years. The admissions committee evaluates the scores on each test individually, not cumulatively. Prior to the change in the GRE test in 2011 a cumulative score of 1000 was the benchmark minimum standard.
- Have two letters of recommendation from previous professors, employers, or someone otherwise qualified to evaluate the applicant's potential for academic work in environmental science.
- Have a support letter from a sponsoring faculty member who is a member of the ES graduate faculty indicating his/her willingness to advise the applicant.

For applicants that are graduates of foreign colleges or universities they must provide an official certified transcript that indicates the nature/scope of his or her academic training.

For applicants with a native language other than English, they must submit a Test of English as a Foreign Language (TOEFL score of 500 or iBT score of 61).

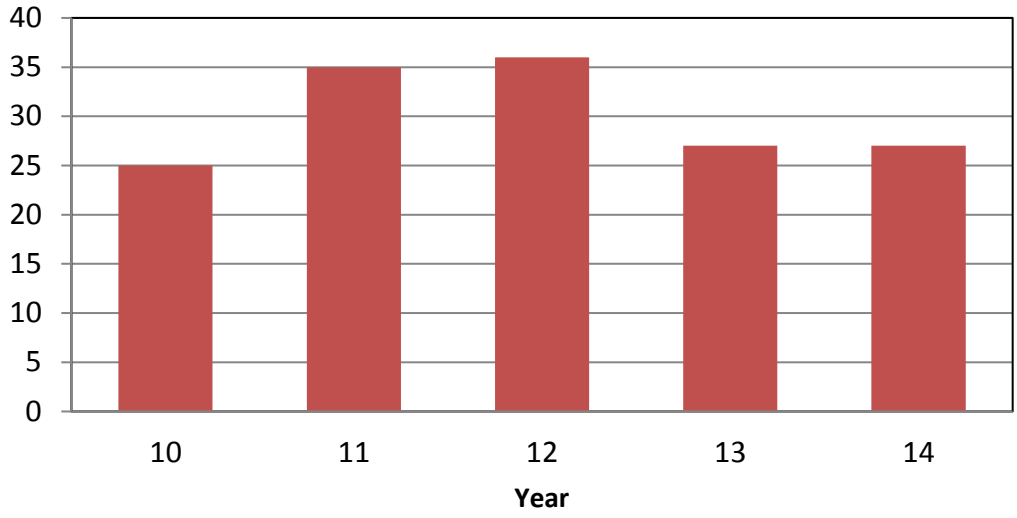
Applicants are accepted as either Thesis or Non-thesis option. The minimum standards for the two options are the same, but the offer of teaching assistantships and fellowships (see **Student Recruitment**) is limited to students in the Thesis option. This creates some competition, making higher scores and support of a sponsoring faculty member of greater import.

The requirement for a sponsor letter makes it necessary for most students to communicate with a faculty member beforehand and secure their support. This process represents a type of pre-selection before the ES admissions committee considers an application. For students applying for the Thesis Option, that faculty-level pre-selection generally requires a mutual research interest between the faculty sponsor and the applicant as well as sufficient resources to initiate the research.

iii. Enrollment information

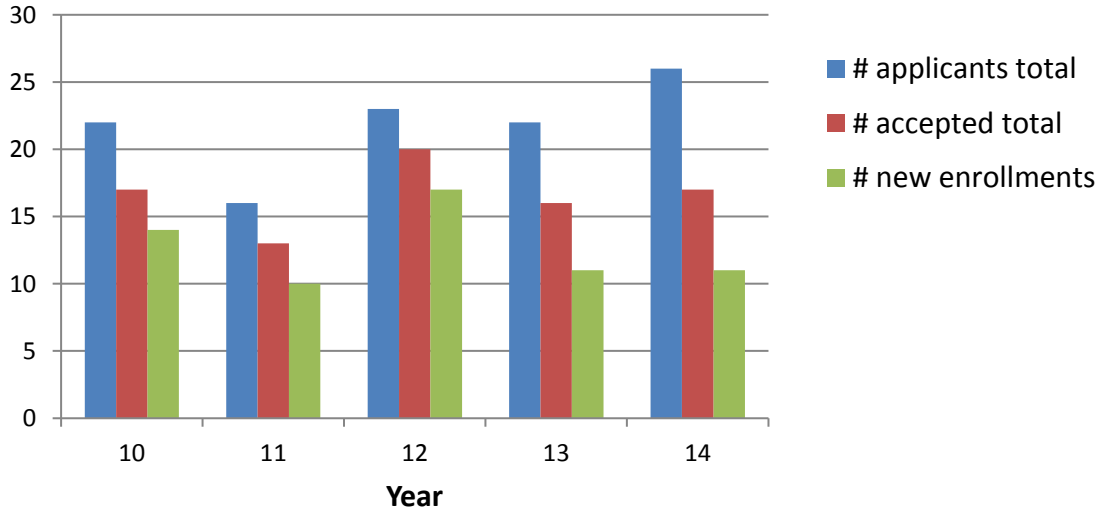
Enrollment in the graduate ES program increased from 2010 through to a peak of 36 students in 2012-2013. Enrollment has since declined to 26-27 students for the past two academic years (Figure 2).

Figure 2: Total Graduate Program Enrollment



This decline in enrollment is not due to a decrease in the number of applicants, nor to any decrease in applicant quality. Applicant number, in fact, has remained relatively steady over the past 5 years, with a mean of 22 applications per year and 17 accepted for a mean rate of 77% of applicants accepted into the program. Applicants in 2014 in fact were a record 26. The disparity lies in the **declining number of students accepted who then choose to enroll at FAU** (see Figure 3). Over the period 2010 – 2013, 64-74% of applicants accepted into the graduate program enrolled at FAU. In 2013 that fraction declined to 50% and was only 42% in 2014. Unfortunately, we are losing some of our top applicants, who are choosing other schools over FAU.

Figure 3: 5-yr trends in ES graduate applicants



Students have told their potential sponsors in the graduate program that teaching assistantships at other schools are more attractive, especially as the cost of living in Boca Raton is high. An investigation by the ES Program Committee into other state universities in Florida revealed that FAU is non-competitive in both stipends and benefits, and this shortcoming is considerably more pronounced for the MS stipends compared to College of Science PhDs.

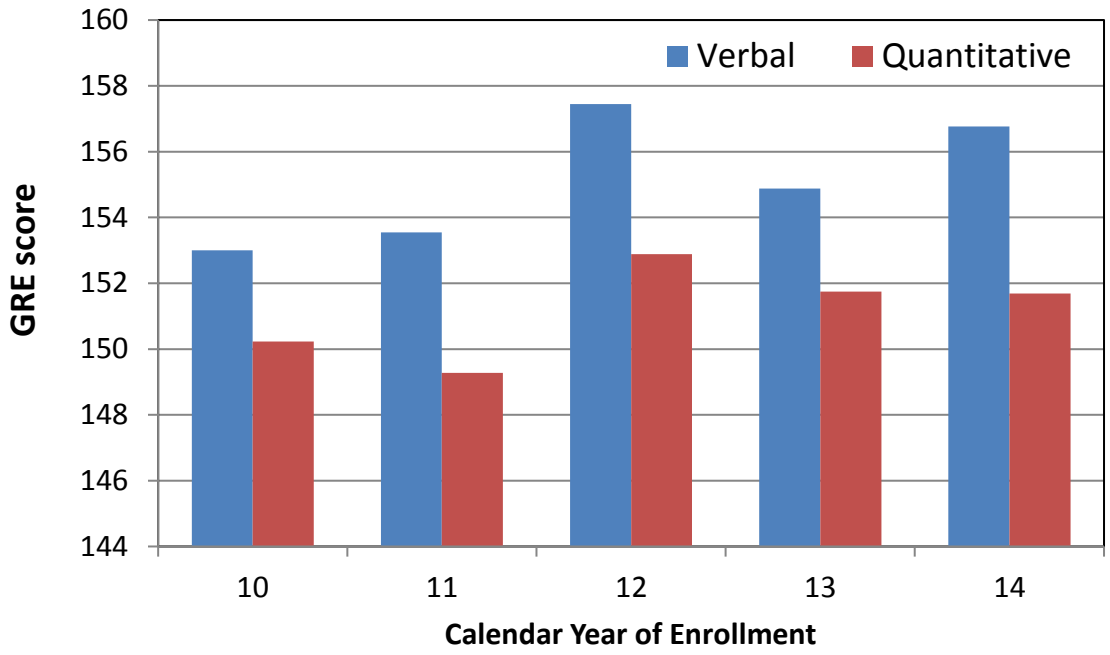
University	MS Stipend	months	Tuition waiver	Health insurance
FAU	**9,636**	9	100% (in-state)	**No**
FIU	15,000	12	9cr/sem.	75% of cost
USF	18,600	9	100%	100%
UF	18,000	9	100%	100%
FSU	20,000	12	100%	$900 supp.
UCF	10,000	9	100%	Yes

The Center for Environmental Studies gave the ES Program an additional $20K for this academic year to disburse as the Program Committee saw fit. The Committee approved the division of the additional funds to supplement the three top students, with the remainder going to student recruitment. This was a onetime benefit however, and there is no guarantee that additional monies will be forthcoming.

The test scores of graduate students enrolling in the program has increased over the past five years demonstrated by the average GRE scores of accepted and enrolled graduate students from 2010-2014 (Figure 4), all scores expressed on the newer GRE scale, 2014 concordance table). Over the past 5 years the average GRE scores were 155 on the verbal test (67th percentile) and 151 on the quantitative test (44th percentile). The average undergraduate GPAs of accepted/enrolled cohorts for the 5 years ranged from 3.3-3.4. The faculty involved in the program have discussed raising the admission standards a bit further, but without commensurate support we doubt that the program can continue to improve and

sustain or increase enrollment number

Figure 4: Average GRE scores of incoming graduate students

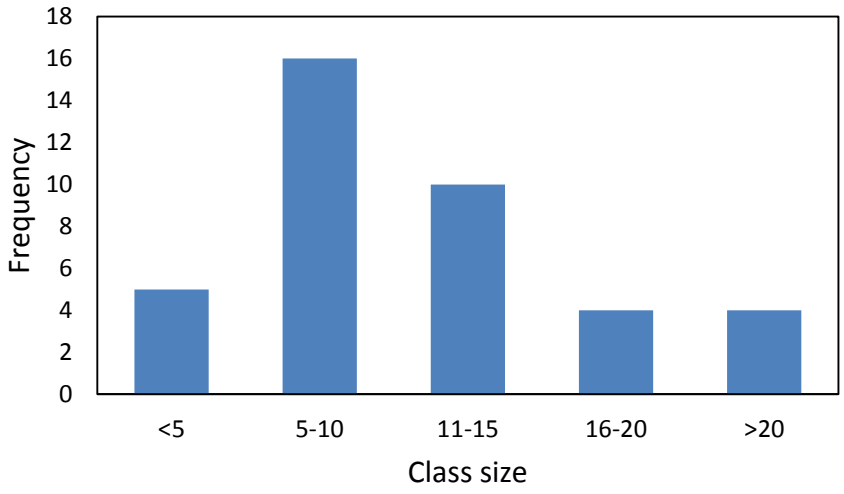


s.

iv. Average class size and faculty/student ratio

Graduate classes at FAU are generally small, allowing for extensive interactions with students and enhancing discussion and student-faculty interactions. While Dashboard indicators for the ES program class size and student/faculty ratio are not available, we obtained enrollment data for courses in the six core areas of the ES Program (Figure 5). Although class size ranges up to 27, most have 10-15 students, with an average of 11 students. The ES Colloquium, which is required of all students in the program, typically has 20-25 students.

Figure 5: Graduate course class sizes



v. Curriculum

The curriculum draws from courses across multiple colleges to ensure students receive broad training in the environmental sciences. The MS degree requires a minimum of 36 credits, with at least 22 from a set of core courses in six subject areas: Chemistry, Geographic Information Science, Modeling, Conservation and Ecology, and Policy and Planning. Students must take one course from at least four of these core subject areas. The detailed curriculum can be found in Appendix B. The expected duration of the program is two years.

Students must also take at least two semesters of Environmental Science Colloquium (EVS 6920, 1 credit per semester). The broad goals of the ES Colloquium are to develop critical thinking and communication skills in the context of a variety of topics in environmental research and management fields.

The MS Thesis program requires 6-12 thesis research credits (EVS 6971) in addition to presentation of a thesis proposal and defense. The non-thesis program requires the same minimum of 22 credits from core courses, and only 6 elective credits may be taken outside the core subject areas. Non-thesis students must also complete 3 directed independent study credits (EVS 6905).

Credit requirements for similar programs are listed in the table below. The specific degree programs are

- George Mason University, MS in Environmental Science & Policy
- University of Nevada Las Vegas, MS in Environmental Science
- Florida A&M University, MS in Environmental Sciences
- Florida Gulf Coast University, MS in Environmental Science
- University of Florida, MS in Interdisciplinary Ecology
- Louisiana State University, MS in Environmental Sciences

Comparable programs also divide credit requirements between core and elective courses; however, the number of required core courses varies widely (9-31 credits). FAU sits approximately in the middle of this distribution and is similar to our aspirational programs. Some programs (e.g., George Mason, UF) require all students to take a small number of specific courses in research methods and statistics. Like FAU, four of the six similar programs require at least one seminar/colloquium course.

Minimum credit requirements for FAU and comparable Environmental Science Masters programs.

	FAU	George Mason	UNLV	FAMU	FGCU	UF	Louisiana State
Comparable/ Aspirational		comp	comp	comp	comp	asp	asp
Total	36	33	33	36	36	36	36
Core	22	21	9	31	16	18	24
Thesis/Research	6	3	6	6	0	0	6
Seminar/Colloquium	2	1	1	0	0	2	1

vi. Internships, practicum, study abroad, field experiences

The Environmental Science Program promotes internships for its students because internships are a form of experiential learning where students learn by doing. South Florida is rich in institutions involved in resource management and research so it is an ideal place to have students engaged in experiential learning as part of their academic studies. Since 2010, ES students have interned at private consulting companies, state agencies (the South Florida Water Management District and the FL DEP), national agencies (FWS, EPA), county resource management agencies (Palm Beach, Broward County) and nearby parks and wildlife reserves (Everglades, Big Cypress, state, local).

A new (summer 2014) study-abroad program will now be available to ES students. FAU recently concluded arrangements, originated by 2 members of the ES Graduate faculty, in which the Tropical Forestry Research Institute (TFRI) in Guangzhou, China will provide funds for students to conduct a portion of their research at the TFRI. This collaboration will benefit students at FAU who are interested in mangrove ecology.

Field experiences are an important part of the ES curriculum. The courses take advantage of the varied environment around South Florida, from the Everglades to the ocean, and from estuaries to urban areas and most are in the Conservation and Ecology core subject area (e.g. Flora of South Florida, Marine Ecology, Marine Invertebrate Zoology, Natural History of the Indian River Lagoon).

vii. Pedagogy/pedagogical innovations

The Environmental Science Program combines traditional classroom learning with experiential learning in the form of field trips to the highly varied South Florida ecosystems and urban landscapes, field work and research experience for both thesis and non-thesis students, and internships. South Florida is rich in

institutions involved in resource management and environmental research so it is an ideal place to have students engaged in experiential learning as part of their academic studies; internships may also lead to future employment.

The Environmental Sciences Colloquium (seminar series), in turn, brings experts from both the surrounding areas and outside of South Florida to FAU, broadening students perspectives beyond that of the FAU faculty. For example, in the last two years the ES Colloquium has hosted speakers from various agencies with presentations on wildlife management (US Fish & Wildlife Service), science communication (Patricia & Philip Frost Museum of Science), and climate change impacts (Smithsonian Environmental Research Center). The ES Colloquium also sponsors academic research seminars by faculty from universities in Florida and out of state.

Several of our most highly attended core courses, including the ES Colloquium, must be taught by video conference due to the distributed campus environment at FAU. These courses are broadcast from the originating campus to the Davie, Boca, Jupiter, and Harbor Branch campuses, as needed and include both seminars and lecture format classes. Broadcasting courses allow students in the ES Program (and others) to schedule necessary courses despite the distances between campuses. The video conference system also provides an important link between students and faculty throughout the program. Recent updates to the system have made this more effective, though distance teaching still occasionally poses challenges. For example, sound quality and dropped connections are problems on the technology side; student reticence with microphones and lack of the instructor's physical presence are pedagogical challenges.

Special courses and workshops are also designed for ES students, though students, faculty, and professionals outside of FAU also may benefit. For example, in 2012, about 17 FAU ES and Biology students, most of whom are studying avian ecology, were trained on how to capture invasive Burmese pythons, common to the southern regions of the Everglades. Because many of the students conduct research in the Everglades, it's not unusual for them to encounter the non-venomous pythons; learning to safely remove these reptiles benefits both the students and the environment.

In an academic setting, the ES program has run four, multi-day statistics and modelling workshops for researchers and students from throughout South Florida (2009-2013, another is currently in the planning stages). These workshops bring in outside experts to present an intensive workshop on a particular topic. In 2013 the ES workshop was presented by Dr. Robert M. Dorazio, US Geological Survey on the use of Bayesian statistical methodologies in analyses of biological data using the R statistical program.

Where appropriate, e-learning is also a part of the ES curriculum; as the Geographic Information Systems courses are computer-intensive rather than field-oriented, they are taught exclusively on-line. Other courses, while not e-learning, provide practical instruction and experience in relevant computer programs and computer modeling, including statistics and hydrology courses.

At the end of each academic year, the ES Program sponsors an Annual Environmental Science Retreat. This is intended to develop a sense of collegiality among ES students, who are scattered across multiple

campuses and thus rarely meet as a cohesive group. All ES students present posters of their work, and both an outside speaker and an alumnus are selected to present talks, thus allowing students to get additional perspectives on the professional world to which many ES graduates aspire.

viii. Scope of institutional contributions

The six core subject areas in the Environmental Science Program include courses from multiple schools/colleges/departments, including Biology, Chemistry, Geosciences, Urban and Regional Planning, Women's Studies, and Philosophy. Although most of these courses were not in general created by the ES Program, ES graduate students interact extensively across these departments. The Environmental Science Colloquium was created by the ES Program (in part as a means of assessing our students' progress); however, this course also serves to fulfil seminar requirements for students in the Biological Sciences MS Program and the Integrative Biology PhD Program.

Two certificate programs are available to graduate students in the Environmental Science Program. The ES Program offers the **Environmental Restoration** certificate for graduate students who wish to pursue an environmental restoration position upon graduation or for professionals looking to increase their knowledge base, advance professionally or change careers. The certificate is interdisciplinary, drawing on courses from environmental science, geosciences, biology, urban and regional planning and civil engineering. The certificate also includes considerable opportunity for experiential learning in the form of course field trips to actual restoration projects; internship opportunities with local, state and federal agencies conducting restoration; and primary research experiences with future, ongoing and recent environmental restoration projects in South Florida. These opportunities also provide the prospect of meeting, networking and interacting with professionals from public and private environmental restoration organizations.

The certificate consists of a minimum of 21 credits, including three core courses, one internship or DIS resulting in the completion of a restoration-related project, completion of a manuscript of publishable quality and colloquium presentation based on the internship/DIS project, and three electives chosen from the two elective foci (both elective foci: Ecology, and Planning and Engineering, must be represented). The three core courses include Environmental Restoration, Restoration Implementation and Management and Conservation Biology. All courses must be completed with a grade of "C" or better to be counted toward the certificate.

As Geographic Information Science is one core subject area available to ES students, students in that core area may obtain the **Geographic Information Systems Certificate**. The Geographic Information Systems (GIS) certificate for graduate students is not an ES specific certificate, but is offered jointly by the Department of Geosciences and the School of Urban and Regional Planning in the College for Design and Social Inquiry. Graduate students who complete the program with a grade of "B" or better in each course are entitled to receive the certificate. Nine credits (3 courses) of core material are required plus an additional 6 credits (2 of 3 possible courses) of the student's choosing. The GIS courses are taught exclusively on-line.

ix. Student profile

Demographics:

FAU has long ranked as the most racially, ethnically and culturally diverse institution in Florida's State University System. In 2014, minority students make up 47 percent of the 30,000-member student body. FAU ranks 93rd in the nation for conferring graduate degrees to all minorities combined, who represent 35 percent of the total number of graduates; FAU ranks 90th in the nation for conferring graduate degrees to African-American students and 57th in the nation for conferring graduate degrees to Hispanic students, who account for 14 percent of the total number of graduates. Students in the ES program are less ethnically diverse, with white students making up 80% and 83% of the ES graduate population in 2011 and 2012, respectively, the only years for which FAU provided Dashboard Indicators. Hispanic students comprised 17% and 14% of the student body in those years, with African-American and Asian/Pacific Islanders making up 3% each. The ES program is thus comparable to or better than the overall graduate program in the College of Science, where 3% of the overall graduate student body was African-American and 6% Hispanic in 2012-2013 (the only year for which Dashboard Indicators were available). While this is positive in that it shows the ES program is attractive on a national scale, it does suggest that more effort could be made to recruit from the highly diverse local student body, both from FAU and the surrounding urban areas.

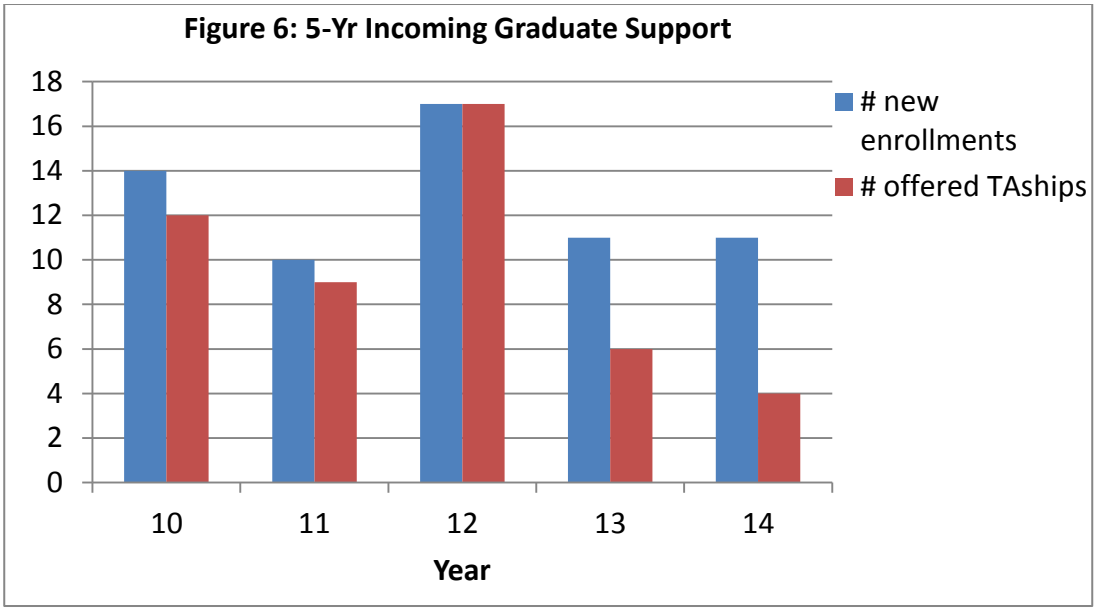
The male/female ratio for the COS in 2012-2013 was 50/50 overall. The ES graduate program is weighted slightly towards women; the graduate student body was 56% and 58% female in 2011 and 2012, respectively.

Support:

These students are supported primarily by way of graduate Teaching Assistantships (TAs); some ES students may also be supported by a Research Assistantship through their advisor. Two incoming students were supported by RAships in 2012, for example, while 4 of 15 incoming students in the fall of 2014 are on RAs. Not all incoming students request TA support, and students in the Thesis track are given priority for TAships while students admitted "conditionally" are also not offered guaranteed TA support initially (though if successful in the program they will be considered for future TA positions). The ES Program is now granted 11.5 positions per academic year and 4-5 each summer, this represents an increase from 9 that were available through most of the time prior to the 2010 academic year. Support has been augmented over the last few years by scrambling to find TA positions in Chemistry or Biology.

Teaching assignments are generally in the department of which the student's advisor is a member. Since FAU has multiple campuses with varying undergraduate populations (and thus differing numbers of TA opportunities), efforts are made to match the graduate student's primary campus with TA opportunities. To accommodate students at Harbor Branch Oceanographic Institution (HBOI), arrangements were made for teaching positions at the nearby Indian River State College (IRSC), where students are considered affiliate faculty and receive the same pay for a semester of teaching as they

would at FAU. FAU has generally approved tuition waivers for those students in our program with support from IRSC.



Recent efforts by the ES Program Director have resulted in additional RAships being made available through the Everglade Fellowships funded by the National Park Service. The first round of funding was $500,000 and established in 2009. A second round of funding was $100,000 and initiated in 2014. The FAU Environmental Science Everglades Fellowship Initiative is funded by the National Park Service to facilitate restoration of the Everglades ecosystem with the objectives of:

1. Producing high quality publishable scientific papers that provide guidance for the restoration of the Everglades ecosystem.
2. Provide support and training for outstanding fellows to conduct research that is pertinent to the science, management, or policy needs of National Park Service or other U.S. Department of Interior agencies in South Florida.
3. Fostering synergistic collaborations among faculty and students in the FAU Environmental Science Program and staff at the National Park Service.

While the work must be relevant to the restoration of the greater Everglades ecosystem, it can be done on any Department of Interior lands in South Florida including Everglades National Park, Big Cypress National Preserve, Biscayne National Park, Dry Tortugas National Park, and the A.R.M. Loxahatchee National Wildlife Refuge. The initial fellowship program offered a significant boost to the ES Program in terms of the quality of students that it attracted and the breadth of faculty that began their participation in the Program. The former College of Science Dean helped the Director secure the initial fellowship grant by meeting with National Park Service administrators and signaling that FAU was ready to invest in training and research for Everglades science. Surprisingly, within a year the upper university administration publically announced a shift in its environmental research emphasis to a climate science initiative, effectively ending the considerable momentum that had been achieved in making FAU known for developing a science initiative that closely matched the research needs of the $8 billion Everglades

restoration effort. An attempt to regain this momentum has only recently emerged through efforts by the current Dean of the College of Science to signal a renewed interest by FAU in training students and conducting research that meets the needs of the Park Service and other agencies involved in the management and restoration of South Florida's aquatic ecosystems.

Scholarly Activity:

Over the past 5 years, the ES Program has worked to increase student scholarly activity and in particular to increase interactions with ES professionals. To track scholarly activities, a Blackboard survey was developed that all students now take annually during the fall semester ES graduate colloquium. The analyses and summary of the percentage of students reporting participation in specific professional activities is reviewed annually by the Environmental Sciences Program Committee.

The ES Program Committee established the following criteria for success 1) Participation in professional organizations by at least 90% of MS students 2) 90% of students will interact with faculty weekly or more often. 3) Participation in workshops and conferences: 90% of students will present their thesis or DIS research at one or more workshops or conferences.

Originally, the criteria were not met successfully for two components, however, the level of student compliance with the requirement to complete the annual survey was extremely low (45%), making it difficult to draw valid conclusions from the results. Since failure to complete the survey is in itself indicative of low student engagement in the program, the level of success for this outcome may have been even lower among the students who did not take the survey.

Of the 10 students responding to the initial annual assessment survey:

1) 70% participated in one or more professional organizations. 10% participated in a professional club at FAU and 60% participated in a professional club outside FAU.
2) 70% interacted with their advisor weekly or more often.
3) 90% of students attended a workshop or conference at FAU. 70% attended a workshop or conference outside FAU.

Seven ES thesis students published their work in peer-reviewed journals during 2010-2014, and several more have submitted manuscripts currently under review. ES students have presented locally at the Florida Chapter of the Wildlife Society, Arthur R. Marshall National Wildlife Refuge Symposia and Greater Everglades Ecosystem Restoration conferences. Students attend national and international meetings as well, including the International Sea Turtle Symposium, the Ecological Society of America annual meeting, Wildlife Society Annual meeting, Society for Freshwater Science annual meeting, and the Society of Wetland Scientists annual meeting.

The ES has implemented three program improvements to increase student scholarly activity and engagement:

1) Increase engagement of first-year students in professional interactions. Beginning in 2014-2015, all ES students will be required to present a poster at the Annual ES Retreat. The ES now holds its Annual Retreat in conjunction with the Graduate and Professional Student Association Research Day at FAU. In the past, only second-year thesis students were required to present a poster at the ES Retreat. In the future, first-year non-thesis students will present a poster of their proposed DIS project, second-year non-thesis students will present a poster of their Directed Independent Study (DIS) project results, and first-year thesis students will present a poster of their proposed thesis research. ES faculty judge the posters in the thesis and DIS categories, and winners receive funding for travel to a scientific conference or membership in a professional society.

2) Increase student completion of the assessment survey. The low level of student compliance with email requests to complete the assessment survey has been a perennial problem. Previously, the survey was conducted by an email request to students explaining the purpose of the survey and providing a link to SurveyMonkey. Currently, completion of the survey will be a requirement in the ES Colloquium course that all ES students must take during the fall semester. The survey results will remain anonymous, but students must complete the survey through Blackboard as part of their grade for the course. ES staff do a short in-class presentation about the objectives of the survey and its role in program improvement and student success.

x. Advising procedures

Applicants who receive acceptance letters must sign and return offer letters indicating their acceptance of the offer to the ES program and the Graduate College.
Throughout their degree students are expected to meet with their ES faculty advisor regularly, but also at the start of each semester to review the expectations for progress towards the degree. Specific semester-by-semester expectations and documentation requirements can be found online through the FAU Blackboard system.

All graduate students must develop and submit a Plan of Study by the end of their second semester. Students admitted to the Thesis Option are expected to form a thesis committee by the end of their first semester. In consultation with their major advisor the student is expected to submit and defend a Thesis Proposal by the end of their second academic semester. Students in the Non-Thesis Option must meet with their faculty sponsor and develop a plan for their independent research project by the end of the second semester.

Students are expected to maintain a GPA of 3.0 or higher throughout their course of study. Students falling below 3.0 will require evaluation by the ESP Director and their major advisor. Students may be required to complete an Academic Progression Plan to clarify the expectations given the deficiency. If sufficient improvement is not made the student may be dismissed from the program.

In the semester of intended graduation (the fourth academic semester), students must submit an application for degree and, when needed, a revision to the Plan of Study.

xi. Licensure rates (if applicable)

Not Applicable

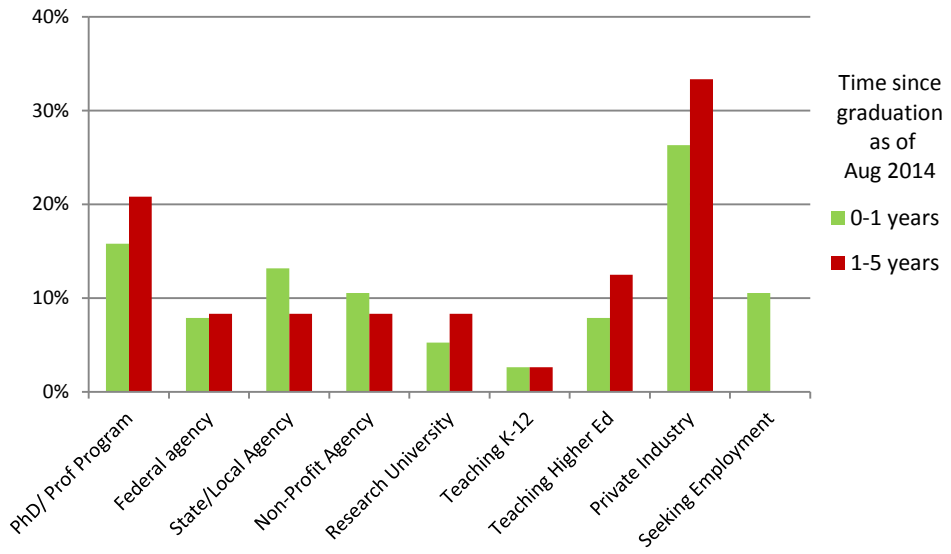
xii. Placement rates/employment profile

The ES Graduate Program currently consists of thesis and non-thesis Masters degrees (an Environmental Science track as part of FAU's Integrative Biology PhD program is currently under consideration by the administration). Non-thesis students completing the program are qualified for positions in the environmental sciences related to permitting, regulation, monitoring, policy formulation or other duties that do not require experience in scientific research. Students who plan to pursue a career in research choose the thesis option, which qualifies them for research positions at various governmental and non-governmental agencies or for additional training in a doctoral program.

The 2009 assessment and program review identified student tracking as an area where improvement was needed in the ES Program, and the Program Committee has implemented a policy to enhance the tracking of students post-graduation. The ES Program Assistant and Coordinator collect Information on student employment after graduation by multiple means: direct communication with alumni who provide the ES with their email addresses, online sources (LinkedIn and Facebook), and student advisors who remain in contact with their former students. Information is maintained for five years after graduation and is compiled in a spreadsheet. Beginning in 2015, an alumni page will be maintained on the ES website.

Over the past 5 years, students have been employed in federal, state, and local agencies, as teachers in primary and secondary schools, with private companies in related fields, and have gone on to doctoral or professional programs. The placement rates and employment profile are detailed in Figure 7.

Figure 7: ES MS Program Post-Graduation Employment



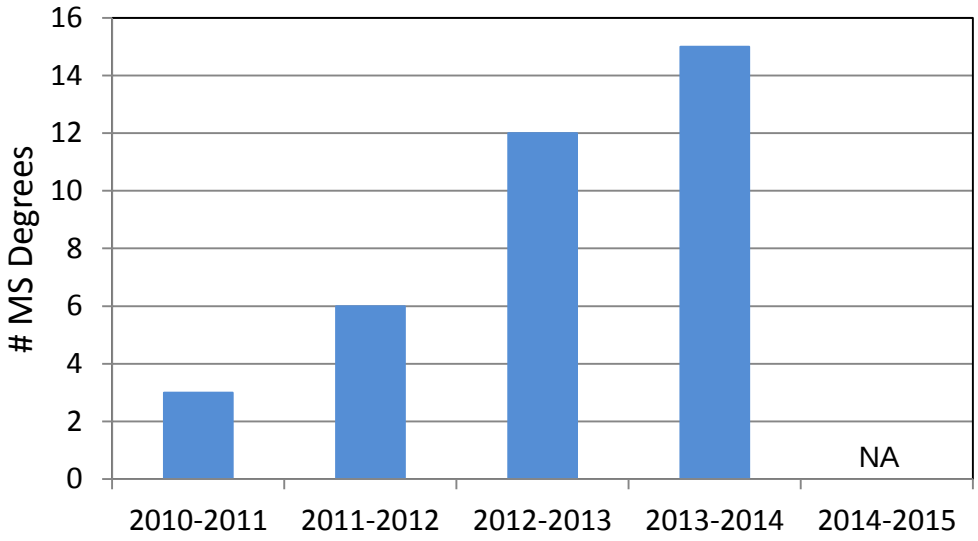
xiii. Retention rates

Forty-five graduate students were enrolled in the ES MS program that could have realistically graduated with MS degrees during this review period (i.e., enrollment from 2008-2012). Of the forty-five (45) students three (4) left the program for personal or medical reasons. The five year retention rate in the graduate program for the period was 91%.

xiv. Graduation rates

As of this review the ES program offers two-year thesis or non-thesis Master of Science degrees. Of the 41 students enrolled and remained from '08-'12, 37 were awarded MS degrees, of which 28 were MS thesis degrees and 9 were MS non-thesis degrees. Students can graduate in fall, spring or summer semesters. The number of degrees awarded has increased for four consecutive years (Figure 8) but the graduation data for the current academic year 2014-2015 is not yet available. The 37 graduates were advised by 20 different major professors housed in Biological Sciences (Boca, Davie, and Harbor Branch faculty), Geosciences, the Honors College, Chemistry and the Center for Environmental Studies.

Figure 8: MS degrees awarded by year



xv. Student recruitment

Passive recruitment of graduate students arises by use of the Environmental Science Program website, advertisement to FAU undergraduates through coursework/research in allied fields and the websites of individual faculty.

Active recruitment occurs as members of the faculty with active research programs search for graduate students (Thesis option) nationally or internationally through discipline-specific channels. The ES program has a limited number of teaching assistantships (11.5 academic year stipends with tuition waivers) to offer to the top applicants. Applicants must meet or exceed the minimum GRE and GPA standards and be deemed good prospects in other respects (letters, experience, personal statement) to receive committed support for two years.
Additional sources of support have been used to recruit top students, including Fellowship Programs from the U.S. National Park Service, internships with the South Florida Water Management District, a new Fellowship Program in partnership with the Center for Environmental Studies (FAU) and Research Assistantships offered by participating ES graduate faculty with their own grants. In addition, a Provost Fellowship consisting of a one-time offer of $2500 is offered to the top recruit each year when the fellowship is available.

A limited number of the top applicants that are not local are provided travel reimbursements for campus/lab visits with recruitment fellowship funds provided by the Provost's Office.

Faculty

i. Administrative structure

The administrative structure of the Environmental Science Program consists of a Program Director and a Program Coordinator with faculty appointments in the CES College of Science, and a part-time Program Assistant with a staff position in the CES College of Science

ii. Faculty profile

The Environmental Science Program is an interdisciplinary program. It is currently comprised of 42 faculty members representing approximately 12 different departments throughout FAU and other affiliate faculty. A central institutional database for ES faculty does not currently exist. Therefore, to the extent possible, ES staff track this information independently.
Faculty summary:
Biology: (18) 42%, Geosciences: (11) 25%, Harbor Branch: (3) 7%, Honors College: (3) 7%,
Others (1) 2.3% each: Chemistry, Anthropology, Mathematics, URP, CMS, CEGE, CES
30 Male: 70%
13 Female: 30%

Faculty in the Environmental Science Program

Last Name	**First Name**	**Diversity**	**Rank**	**Department**	**Academic Specialties**	**Full-time /Part-time**
Baldwin	**John**	M	Full	Biology	Conservation Biology	Full-time
Benscoter	**Brian**	M	Assistant	Biology	Plant ecology	Full-time
Brooks	Randy	M	Full	Biology	Behavioral/physiological ecology of marine organisms	Full-time
Comas	Xavier	M	Associate	Geosciences	Peatland Geophysics	Full-time
Dawson-Scully	Kenneth	M	Associate	Biology	Neurobiology of cellular stress and neuroprotection	Full-time
Detwiler	**Kate**	F	Assistant	Anthropology	Primate hybridization and speciation	Full-time
Devlin	**Donna**	F	Assistant Research Professor	Biology	Plant-invertebrate interactions	Full-time
Dorn	**Nathan**	M	Associate	Biology	Freshwater ecology	Full-time

Esiobu	Nwadiuto	F	Full	Biology	Environmental microbiology	Full-time
Fadiman	**Maria**	F	Associate	Geosciences	Ethnobotany	Full-time
Frazier	**Evelyn**	F	Instructor	Biology	Terrestrial Ecology, Conservation Biology	Full-time
Gawlik	**Dale**	M	Full & Program Director	Biology	Avian Ecology, Wetland ecosystems & restoration ecology	Full-time
Haky	Jerry	M	Associate	Chemistry	Chemical education research	Full-time
Hanisak	Dennis	M	Research Professor	Harbor Branch	Ecology and physiology of marine plants	Full-time
Hanson	**Howard**	M	Full	Geosciences	Atmosphere-ocean interaction	Full-time
Hindle	**Tobin**	M	Associate Scientist	Geosciences	Ecological Regeneration	Full-time
Hughes	Colin	M	Associate	Biology	Evolutionary Genetics and its relationship to conservation	Full-time
Ivy	Russ	M	Full	Geosciences	Transport Network Analysis	Full-time
Kajiura	Stephen	M	Associate	Biology	Functional morphology & sensory biology of fishes	Full-time
Koch	Margueri te	F	Full	Biology	Marine botany	Full-time
Lapointe	**Brian**	M	Research Professor	Harbor Branch	Algal physiology and biochemistry	Full-time
Markwith	**Scott**	M	Associate	Geosciences	Biogeography,	Full-time

Meerhoff	Daniel	M	Full	CEGE	Solid Waste Management, Water Chemistry	Full-time
Milton	**Sarah**	F	Associate	Biology	Physiological responses to environmental stress	Full-time
Mitsova	**Diana**	F	Associate	URP	Environmental modeling, climate change,	Full-time
Moore	**Jon**	M	Full	Honors College	Ecology, evolution, and distribution of fishes	Full-time
Noonburg	**Erik**	M	Associate	Biology	Ecological modeling	Full-time
O'Corry-Crowe	**Greg**	M	Associate Research	Harbor Branch	Marine mammal population genetics	Full-time
Oleinik	Anton	M	Associate	Geosciences	Cenozoic stratigraphy	Full-time
Owen	**Virginia**	F	Scientist and Program Coordinator	Biology	Landscape & Community Ecology, Invasion Biology	Full-time
Petuch	Ed	M	Full	Geosciences	The geology, biostratigraphy, and invertebrate paleontology of the Floridian Peninsula	Full-time
Polsky	Colin	M	Director CES Full	CES Geosciences	Human Dimensions of Global Environmental Change	Full-time
Proffitt	**Ed**	M	Associate	Biology	Ecology of marine & estuarine	Full-time

					macrophytes & invertebrates	
Qian	Lianfen	F	Full	Mathematics	time series analysis and regression modeling, survival analysis, environmental statistics	Full-time
Roberts	Charles	M	Associate	Geosciences	Extracting thematic information from remotely sensed imagery	Full-time
Root	**Tara**	F	Associate	Geosciences	Ground water chemistry,water-rock interaction, groundwater sustainability	Full-time
Santaniello	Neil	M	Instructor	CMS	Environmental Journalism	Full-time
Warburton	David	M	Associate	Honors Col	Environmental geochemistry	Full-time
Wetterer	James	M	Full	Honors Col	Biogeography, ecology, and environmental impact of ants,	Full-time
Wyneken	**Jeanette**	F	Associate	Biology	Integrative biology	Full-time
Xie	Zhixiao	M	Full	Geosciences	spatial temporal GIS analysis, environment health, invasive species	Full-time

Zhang	Xing-Hai	M	Associate	Biology	Plant molecular biology and biotechnology	Full-time

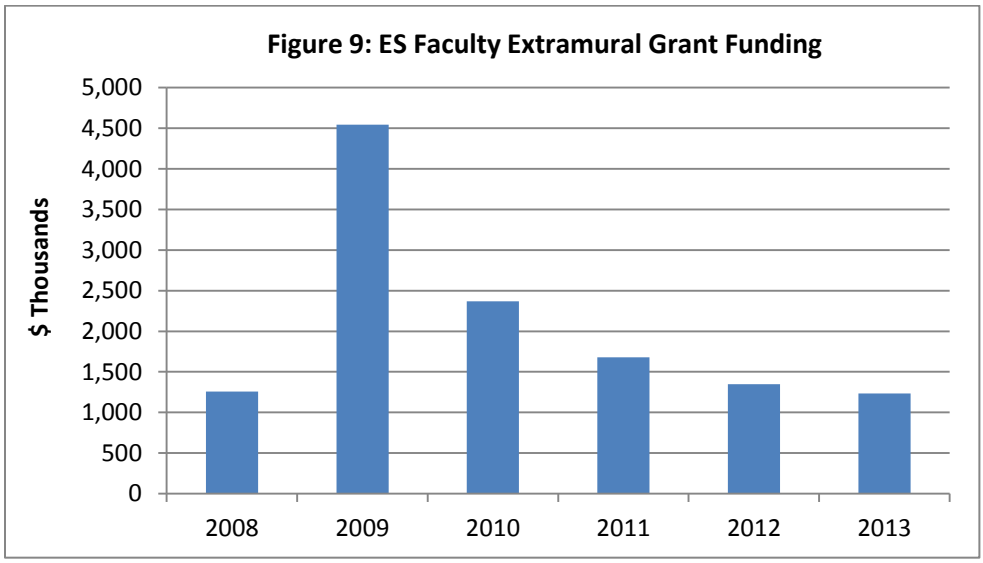
Bold type indicates faculty who have sponsored one or more ES MS students since 2009.

iii. Faculty teaching load

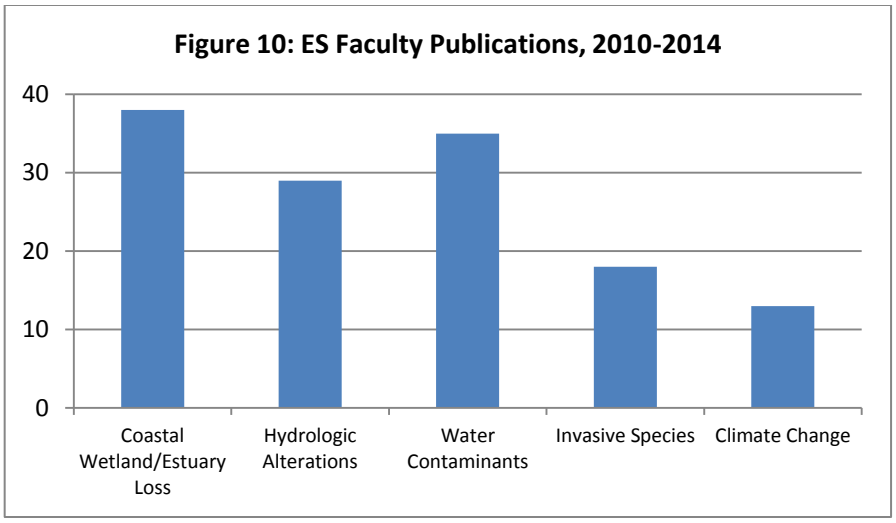
Not applicable; courses in the ES Program curricular are taught by faculty in the departments that offer these courses.

iv. Summary of faculty research productivity

The ES does not have faculty lines and there is no institutional-level tracking of grant funding awarded to ES faculty. ES staff independently tracks grant funding received by ES faculty (Figure 9) to understand their level of research activity and to identify research strengths that will shape the future directions of the program.



ES faculty publications are heavily focused on research questions related to wetlands and estuaries. This area of strength was the basis for focusing research in the ES Program on the big questions related to restoration and management of wetland and estuarine ecosystems that closely match government funding mechanisms; wetland loss, hydrologic alterations, invasive species, contaminants including nutrients, and climate change. In 2010, the ES Program established the Greater Everglades Research Initiative based on an interdisciplinary framework that is now widely recognized as the most effective way to conduct research for ecosystem restoration and management. GERI brings together FAU faculty and collaborators based on their relevance to a problem at hand, not by the subject of their academic training. GERI offers one of the few tangible mechanisms for reaching across disciplines, agencies, and ecosystems to solve human-caused problems. The ecosystems addressed by GERI fall roughly along an elevation gradient from the human-wetland interface to freshwater wetlands, estuaries, coastal waters, and coral reefs.



v. Strategic planning for hires

Not applicable; the ES Program does not have faculty lines and does not influence hires.

vi. Abbreviated faculty CVs

Abbreviated CVs for ES faculty are in Appendix C.

D. Research

i. Review of Part II of the Department Dashboard Indicators

Not applicable; the ES Program does not have faculty lines.

ii. Interdisciplinary efforts and community engagement efforts

Environmental Science is an archetype of an interdisciplinary field, comprised of 42 FAU faculty from nine departments across six colleges, with the Davie campus as the core. Additionally, ESP faculty actively collaborate with local, state and federal agencies and governments, and NGOs addressing critical environmental issues (listed below). External agency personnel also actively participate in the ESP as affiliate faculty in supervising and participating on graduate student committees.

External Organizations Affiliated with FAU Environmental Science

International

Universidade Federal de Mato Grosso do Sul (Brazil)

National

A.R.M. Loxahatchee National Wildlife Refuge
Everglades National Park
Big Cypress National Preserve
US Environmental Protection Agency
US Fish & Wildlife Service

US National Park Service
US Geological Survey
US Army Corp of Engineers
US Department of Energy
US Bureau of Land Management
US Bureau of Indian Affairs
National Science Foundation
NOAA
NASA
SeaGrant

State

South Florida Water Management District
St. Johns River Water Management District
Florida Fish and Wildlife Conservation Commission
Florida Department of Environmental Protection
Jonathan Dickinson State Park

Regional & Non-Profit

Palm Beach County Department of Environmental Resources Management
Broward County Environmental Protection and Growth Management
Broward County Climate Change Task Force
Lee County Natural Resources Division
Loxahatchee River District
Martin County Utilities Department
Monroe County Department of Environmental Resources Management
Miami-Dade County Environmental Resources Management
South Plantation High School Everglades Magnet Program
Arthur R. Marshall Foundation
Everglades Foundation
The Nature Conservancy

Academic Institutions

Nova Southeast Oceanographic Center
University of Florida
University of South Florida
Florida International University
University of Central Florida
University of Miami
University of North Carolina Wilmington
University of Georgia (Odum School of Ecology)

Corporate

Coastal Education and Research Foundation, Inc.
Ecology and Environment, Inc.
Tetra Tech, Inc.
Ram Realty
Keith and Schnars, PA
CDM Smith, Inc.

iii. Establishment of goals for research

- Increase ES faculty external grant funding and support of ES students with RAs
- Better incorporate the marine researchers and marine topics into research focused on wetlands and estuaries, and coral reefs.
- Develop the Davie campus as an Everglades Research hub with a focus on restoration and management of coastal and wetland ecosystems and the coupled natural-human systems research.

To that end it is necessary to strengthen the depth of program expertise through targeted cluster hires, which will enhance the ES Program's value to external partners, research productivity, and academic programs.

iv. Assessment of how well goals are being met

The enhancement of research conducted by ES faculty is assessed by the levels of scientific publication, funding of external awards, and collaborative relationships with external partners.

E. Service/Community Engagement for Department/School

i. Community engagement

The Environmental Science (ES) Program is strongly committed to community service and outreach. Its primary goals in this area include knowledge dissemination and public service through internships, outreach, academic service learning, and mentoring. Over the years, the program has developed active and mutually beneficial relationships with government agencies and local and regional organizations providing FAU students with opportunities to gain hands-on learning and working experience. Service activities have also contributed to addressing various environment-related problems and needs in local communities and broader regions.

ii. Review of Part III of the Departmental Dashboard indicators for Department/School

Not applicable

iii. Establishment of goals for service

The ES program has established the following goals for service.

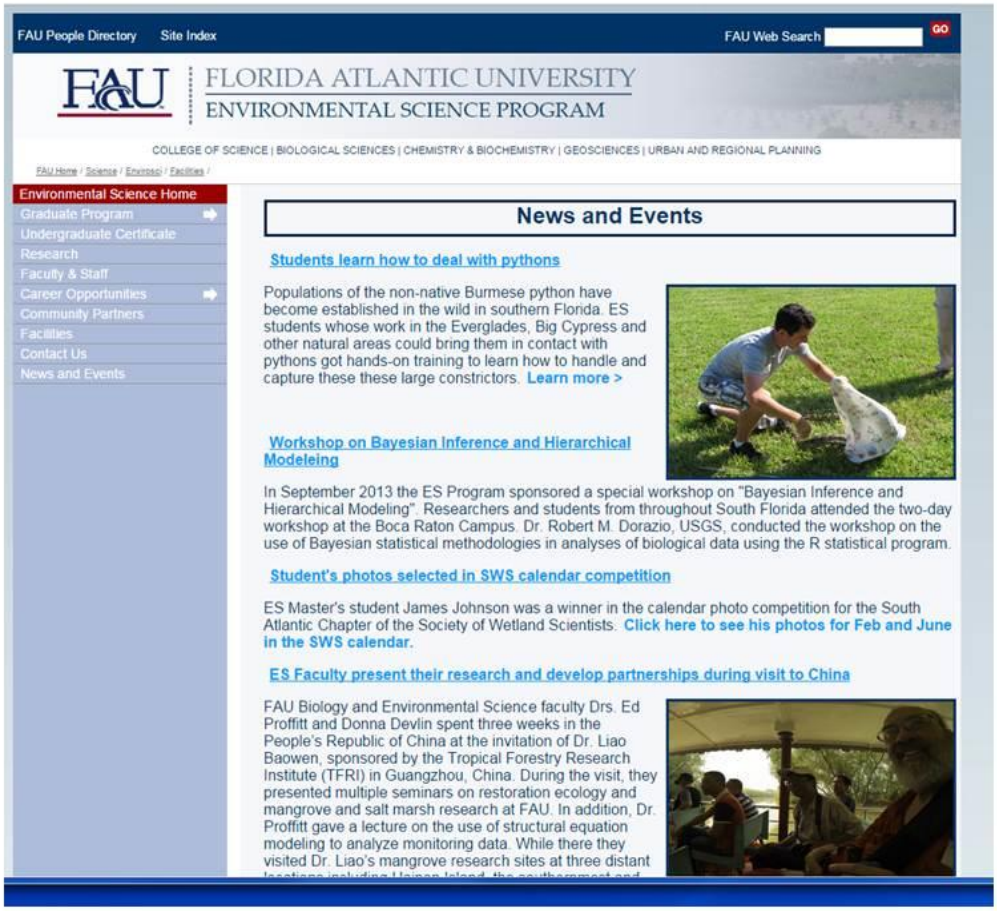
- Dissemination of research outcomes and activities to the public and decision-makers is a core component of the ES Program efforts in community service. The program has already established a strong record of organizing and hosting workshops and technical meetings on a variety of environmental topics including the restoration of the Everglades National Park. As part of these efforts, the program has built strong institutional relationships with local governments, regional authorities and federal agencies.
- The ES Program has a strong commitment to providing public service through student internships with federal, state and local agencies and organizations. The internships offer opportunities for FAU students to collect data, participate in research and monitoring efforts,

learn new skills, obtain experience, and provide various type of support to environment-related institutions and projects. Thus, the ES Program, its faculty and students have become a resource for local communities, government agencies, and local businesses in their efforts to find innovative environmental solutions.

- The ES Program also engages in community outreach efforts through volunteering of student and faculty time to meeting with the public and participating in community events.
- Academic service learning and community-based research
- Mentoring (K-12)
- Strong website presence

iv. Assessment of how well goals are being met

Faculty in the ES Program contribute to an extensive list of community engagement and service activities, including participation in community lecture series, serving on community advisory boards, mentoring K-12 students in environmental education programs, judging at science fairs, organizing



community workshops, engaging K-12 and undergraduate students in Citizen Science Programs, contributing to the annual High School Science Olympiad at FAU, serving as officers and board members of professional societies. This culture of service is communicated in turn to ES students, who actively seek volunteer opportunities in government agencies and non-profit community organizations.

F. Other Program Goals for School or College

- Facilitate multi- and interdisciplinary environmental initiatives across the university and with external agencies to increase extramural funding for FAU faculty.
- Establish FAU as an institution of academic excellence in environmental research and outreach to engage stakeholders from local to international scales
- Provide a cohesive message and branding to increase the visibility of FAU environmental activities and attract high-caliber students and faculty that will advance the role of FAU in South Florida.
- Improve educational programs and learning outcomes that prepare our students for more advanced study and/or an increased rate of placement in environmental professions.
- Facilitate the growth of FAU's capacity for environmental initiatives by pooling intellectual and educational resources as well as facilities that can easily be shared, rather than duplicated, across multiple programs.
- Create a broader range of opportunities for undergraduate ES students to build research and inquiry skills through sustainable strategies tied to integration with a culture of community service:
  - develop a peer mentoring program for undergraduate ES research that engages graduate and advanced undergraduates
  - create long-term Community-Based Research Academic Service Learning (ASL) courses in Environmental Science
  - include a community-based research component in the ES Certificate capstone course
  - create standard requirements for Directed Independent Study (DIS) research for the ES Certificate curriculum that are directly linked to Distinction Through Discovery Student Learning Outcomes for undergraduate research

  Initial progress toward achieving this goal was enabled by an internal Distinction Through Discovery grant that funded stipends for graduate and advanced undergraduate peer mentors for 2013-2015. This grant enabled more than 80 undergraduate students in ES core courses to participate in community-based research with six community organizations during 2013-2014. Funding for laboratory and field supplies from the C.E.S. College of Science also increased the ability of ES faculty to offer undergraduates the opportunity to engage in experiential learning and conduct meaningful research in academic courses and through directed independent study, attracting undergraduates with an interest in Environmental Science at an early stage of their studies.

G. Strengths and Opportunities That Support Achievement of Program Goals

The Environmental Sciences program has a variety of strengths and opportunities to achieve program goals. These include:

Strengths:

- Faculty has considerable academic and research experience with the aquatic ecosystems in the Greater Everglades region, including Florida Bay, Calooshahatchee Estuary, Indian River Lagoon, the freshwater Everglades and the human interactions with these ecosystems
- A close connection to agencies involved in the restoration and management of the Greater Everglades ecosystem, including the estuaries and water quality issues
- Growing interest of undergraduate and graduate students in environmental issues
- Large and diverse urban population with interest in environmental issues
- Interdisciplinary curriculum of core courses at both undergraduate and graduate level
- Participation of faculty from a broad range of academic units (currently 11 colleges, centers, and institutes).
- Flexible curriculum allows for broad range of backgrounds and interests in natural and social sciences
- Wide variety of courses, including traditional, e-learning, and distance learning classroom and lab; seminar series, and courses with extensive field components.
- Experiential learning through MS thesis research and directed independent study (DIS), including an emphasis on undergraduate research (Office of Undergraduate Research and Inquiry, FAU-OURI)
- Already established relationships with local, state, and national governing bodies, including Water Management Districts, National and State Parks, and the US Geological Society
- Well-developed infrastructural support for research and education in environmental science at FAU facilities:
    - Davie Everglades Research Center
    - Harbor Branch Oceanographic Institute
    - Boca and Davie Campus Research Greenhouses
    - Pine Jog Environmental Education Center
    - Riverwoods Field Laboratory
    - DuPuis Environmental Management Area
    - Gumbo Limbo Environmental Complex

Opportunities:

- FAU strategic plan to increase research in environmental and coastal science
- FAU is reaching a critical mass of environmental activities in many academic units that could be reorganized to more effectively market its considerable, but currently diffuse, environmental research and education capabilities (see analysis of national environmental programs; Appendix F).
- Desire by federal and state agencies involved in restoration and management of wetlands and estuaries in the greater Everglades ecosystem for local universities to increase research expertise and workforce development that meets their needs.
- Expanding human population in South Florida generating need for more environmental professionals

- Unique opportunities for the study of coupled natural-human systems research in South Florida's extensive wetland, estuary and coral reef ecosystems.
- Opportunities to study aspects of restoration and management of aquatic ecosystems, including oceanography, water quality, hydrology, biogeochemical cycling, invasive species, harmful algal blooms, GIS, environmental chemistry, hydrology, urban and regional planning
- Cooperation with local, state and federal agencies and NGOs in addressing environmental issues and policy development
- Education and outreach to public through various media in South Florida
- Collaboration with researchers at other universities and institutions in South Florida, e.g. University of Miami, Florida International University, University of South Florida, Nova, Smithsonian Institution, as well as the wider Caribbean region (Bonaire, Bahamas, Bermuda, Martinique)
- Developing global collaborations including the Tropical Forestry Research Institute (TFRI) in Guangzhou, China, which will provide funds for students to conduct a portion of their research at the TFRI and a recently developed agreement with the Universidade Federal de Mato Grosso do Sul, Brazil.
- Approval of IBES track for doctoral students to emphasize environmental sciences within the FAU IB program will allow us to conduct more in depth, longer term research as well as attract high caliber students

H. Weaknesses and threats that impede program progress for School or College

- Small graduate stipends and lack of benefits (weak support) relative to the south Florida cost of living and compared to other Universities in the region make it difficult to attract and matriculate top graduate students.
- The relatively small number of ES faculty and breadth of expertise is a limitation to further growth and the ability of the program to build and maintain research relationships with non-university partners.
- The lack of input/authority over faculty hires in participating departments (e.g., Biology, Geosciences) limits the growth and research capacities of the ES program; faculty are awarded to, and chosen by, departments rather than interdisciplinary programs.
- The dispersed campus structure and the dispersion of ES students from Fort Pierce to Davie limit interactions among students and do not allow for effective peer to peer mentoring.
- Upper division courses with labs (i.e., research/field experiences) for undergraduates interested in environmental science are lacking. Courses are often limited to summer sessions because the primarily tenure-track research faculty members offering the courses are teaching larger required lectures for their home department during their 9-month appointment. As a result, these course offerings are often unpredictable and fluctuate depending on faculty research obligations during the summer session.
- Insufficient number of administrative, research, and teaching support personnel. These limited positions are often shared among multiple departments with individual job descriptions that would more appropriately be allocated to multiple personnel.

- Excessive administrative burden placed on faculty.
- No administrative support or physical presence at central Boca campus
- Lack of understanding in Sponsored Research of funding modes and agencies other than major federal funding programs (e.g., NSF and NIH)
- The lack of proximate research facilities (especially experimental) limits the breadth of research avenues.
- Limited research facilities and faculty restricts availability and range of advanced course offerings, limiting opportunities for hands-on coursework for graduate and undergraduate students (*especially in Davie*).
- Lack of program-specific recurring funds to support preliminary studies in the development of larger research projects or programs.
- Lack of integration at the level of the University with other regional universities, research agencies, or educational venues.
- Lack of marketing of FAU as a destination for students interested in a career in environmental science at the BS, MS, and PhD levels, as well as the expertise at FAU as a resource for regional and national stakeholders.
- No undergraduate degree in Environmental Science that would meet the growing demand and could provide a conduit of top students into the ES graduate Program.

Other Potential threats

In the past there has been a lack of coordination and shared focus between ES program faculty and other environment-themed programs at FAU. Several satellite campuses, such as Davie and Harbor Branch Oceanographic Institute at FAU (HBOI), are becoming known primarily for their environmental emphasis; however, few of these units have cross connections and there is no core environmental unit around which all others are organized to project an accurate representation of the depth and diversity of environmental activities at FAU. As a result, outside agencies, which fund a great deal of FAU's environmental research, tend to underestimate the collective environmental capabilities of FAU.

There appears to be a bias against graduate education at the level of the Master program in favor of PhD programs, both in general among Universities nationally and specifically at FAU. While this may be unintentional and driven more by the proximate return on investment of time and resources on the part of the advisor and the metrics used for various institutional rankings and evaluations, it nonetheless has an ultimate detrimental effect on the potential for student success and its reflection on FAU. The labor market in environmental fields is oversaturated by an abundance of PhDs and a dearth of long-term employment opportunities for PhD level applicants. However, there is increasing demand for applicants with advanced training in the field without the need for a PhD. Masters degree programs produce these technically savvy personnel and provide both student and supervisor the opportunity to assess interest and potential success in future doctoral study. FAU should embrace the opportunity to produce this highly-sought workforce, which will benefit the University's reputation and facilitate greater future advancement.

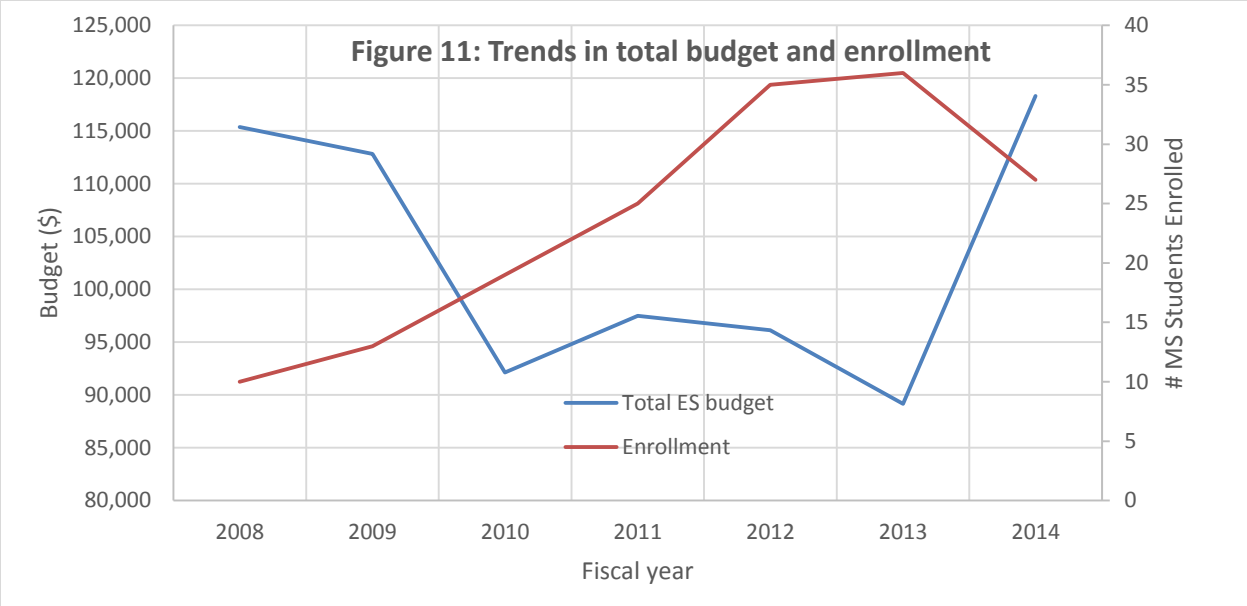
Our society is increasingly environmentally conscious (and active!), but not more scientific. This produces pressure to become more of a general environmental studies program. Institutional movement towards a general education program in environmental issues would *weaken* our focus on practical and conceptual scientific training, placing our graduates at a disadvantage as they enter the workforce and diminish the value of the degree programs to the labor market and research partners.

I. Resource analysis for School or College

The ES Program budget includes a half-time (12 month) for a Program Assistant at the Davie campus, and 11 months of support for a Director, and 9 months of support for a Program Coordinator at the Boca Raton campus. In addition there are funds for Teaching assistantships (9-11.5) and general operating funds. The latter go toward an annual retreat to bring all ES students and faculty together in one place for one day per year, a statistics workshop, recruitment activities such as paying for student visitation of campus, and for Director travel to market the program locally and nationally.

In 2010 the university faced a budget shortfall (Fig. 11), which the Dean of the College of Science directed disproportionately toward Research Centers and Academic Programs, including ES. By 2014 the funding for student teaching stipends was restored to pre-2010 levels but operational funds have continued to slide, despite the increase in student enrollment and need to offer increased student services. As the budget was reduced, the ES program continued to grow to its current level as the second largest MS program in the College of Science and reportedly the largest interdisciplinary program at FAU. This has occurred with remarkably few direct resources to the ES Program because it is "value added" to faculty and administration in other departments. If FAU is interested in following its strategic plan and enhancing interdisciplinary research, then the ES Program may offer a cost-effective way to launch that effort.

Currently the size of the ES Program is limited by the number of faculty who can take on additional graduate students. The quality of the program is also becoming limited by the operational funds that have not kept up with enrollment and do not allow for activities that can provide ES students dispersed across multiple campuses with a sense of belonging to a cohort. Enriching the special events and providing offerings beyond courses and thesis research will help to alleviate that weakness.



Fiscal year	2008	2009	2010	2011	2012	2013	2014
$ Greenhouse	19,242	17,170	2,000	2,000	2,000	250	500
$ Operating	10,000	9,520	4,000	9,377	8,000	7,000	7,000
$ MS TAs Spr/Fall*	86,130	86,130	86,130	86,130	86,130	81,906	110,814
Total ES budget	115,372	112,820	92,130	97,507	96,130	89,156	118,314
# MS TAs Spr/Fall**	9	9	9	9	9	8.5	11.5
# MS TAs Summer	0	0	0	4	4	4	6
ProgDir	11 mo	11 mo	11 mo	11 mo	11 mo	11 mo	11 mo
ProgCoord	12 mo	12 mo	12 mo	12 mo	12 mo	9 mo	9 mo
ProgAsst	12 mo @ 0.5	12 mo @ 0.5	12 mo @ 0.5	12 mo @ 0.5	12 mo @ 0.5	12 mo @ 0.5	12 mo @ 0.5
Enrollment	10	13	19	25	35	36	27

*Summer TA support is not included in regular budget but funded by Dean depending on summer budget
**Support for a number of MS, PhD, Post-docs and interns was provided by a $500,000 grant to DEG from Nat. Park Service for Everglades Fellowship Program 2009-2011.
***The majority of students at HBOI are supported by TAs through Indian River State College.

J. Future directions for School or College

- ***Cross-list departmental courses contributing to the Environmental Science Program graduate and undergraduate degree/certificate programs be cross-listed?*** By providing a parallel 'EVS' course distinction, the contribution of existing environmental program students to course enrollment can be tracked and quantified to indicate targets for inclusion and the University-

wide FTE impact of environmental programs without impacting performance metrics of the course host department.

- ***Work with the FAU Development Office to increase the visibility of the Environmental Science Program and FAU capabilities and achievements*** Showcasing FAU environmental programs on the FAU homepage, and at meetings, workshops, and conference exhibits will increase the recognition of FAU locally and nationally. Development of existing and new contacts with regional stakeholders with shared values will establish FAU as an option for future collaboration, providing opportunity for external research funding, involvement of FAU faculty, staff and students with regional partners.
- ***Create incentives to increase faculty involvement in environmental initiatives*** Internal funding programs for pilot research projects or professional development would spur collaboration among FAU participants, improve chances of external support, and improve the quality of educational opportunities at FAU. Continuing education or other fee-based activities by participating faculty can be developed to generate funds for these initiatives. Return of a portion of indirect costs from external funds secured through proposals initiated by ES and CES participants can also be a source for initiative funding, providing an incentivized, positive feedback between program participation and internal support.

Questions for Reviewers

- ***Should incentives be created for departments to include interdisciplinary program needs when making strategic faculty hires?*** A mechanism for interdisciplinary programs like the ES to influence departmental faculty hires could provide a way to strategically build a faculty that meets the needs of a broader FAU environmental community.
- ***What are the most effective strategies for building deeper faculty expertise on wetland and estuary restoration and management?***
    - Align expertise of new faculty hires to research opportunities
    - Establish Visiting Fellows program
    - Seek cluster hires
    - Fund an Endowed Chair in Environmental Science
- ***What are the best strategies for attracting top-tier graduate students?***
    - Increase graduate stipends
    - Fund prestigious Student Fellowships
- ***Should the ES Increase administrative help and establish a physical administrative presence on the Boca campus?***
- ***Should the ES evaluate the feasibility of a BS in Environmental Science?***
- ***Should the ES evaluate the feasibility of a PhD in Environmental Science, using the PhD in Integrative Biology with emphasis in Environmental Science as a model?***
-

K. Student Feedback

The Environmental Science Program places a high value on student feedback for program improvement, and the Assessment Plan for student learning developed by the ES in 2010 for the graduate program

explicitly seeks student feedback (Appendix D). Overall, ES graduate students who completed the survey have indicated that they are very satisfied or satisfied with their experience in the program. However, student surveys have helped to identify areas were improvement was needed. Since 2010 a number of program improvements have been initiated in response to student feedback:

Availability of Courses
Limited course offerings was a common student complaint. Since the ES does not have faculty lines, and does not determine course schedules, our ability to directly address this problem was limited. However, the Program Committee added a large number of regularly offered courses after 2010, and removed courses that were offered infrequently or irregularly in their departments. In addition, the ES website now offers a list of expected course availability for future semesters that students can use as a planning tool.

Multiple Campuses
In response to student concerns about the extensive commuting required to attend courses, the ES curriculum now includes a wide variety of courses, in addition to the ES Colloquium course, that are video-conferenced to all three campuses.

Oral Communication and Professional Networking
Many ES students indicated that they felt poorly prepared for oral communication and professional networking in their field. To address this shortcoming, the ES created the ES Colloquium course that brings together all ES students in a seminar setting where they have an opportunity to practice their oral communication skills and interact with their peers and guest speakers. An Annual ES Retreat, attended by ES faculty and students and invited speakers, was also established as a venue for students to present their own work and interact with faculty in an informal setting.

In the ES Certificate Program, obtaining student feedback was not possible in the past. However, this will be addressed as part of the assessment for the new ES Certificate Capstone course through a survey similar to the survey used for graduate student assessment.

CURRICULUM VITAE

JOHN D. BALDWIN PH.D.

Professor
Department of Biological Sciences
Charles E. Schmidt College of Science
Florida Atlantic University – Davie Campus
3200 College Ave, Davie, FL 33314
Phone: (954) 236-1151 Email: jbaldwin@fau.edu
Webpage: www.science.fau.edu/biology/faculty/baldwin

Professional Preparation

B.S., Zoology, 1988. Department of Zoology, University of Maryland, College Park
Post-Graduate Researcher, 1989 – 1992, Marine Toxicology, Bodega Marine Laboratory, University of California, Bodega Bay, California
Ph.D., Cell and Developmental Biology, 1997. Div. Biological Sciences, University of California, Davis
Post-Doctoral Researcher, 1997 – 1998, Dept. Fisheries and Aquatic Sciences, School Forest Resources and Conservation, University of Florida, Gainesville, Florida

Appointments

2014 – Present	*Professor*, Department of Biological Sciences, Charles E. Schmidt College of Science, Florida Atlantic University
2014 – Present	*Associate Director*, Center for Environmental Studies, Charles E. Schmidt College of Science, Florida Atlantic University
2004 – 2014	*Associate Professor*, Department of Biological Sciences, Charles E. Schmidt College of Science, Florida Atlantic University
2011– 2012	*Interim-Director,* Environmental Sciences Program, Charles E. Schmidt College of Science, Florida Atlantic University
2009 – 2010	*Research Fellow*, (Sabbatical), South Florida Natural Resource Center, Everglades and Dry Tortugas National Park, NPS, DOI, Homestead, FL
1998 – 2004	*Assistant Professor*, Department of Biological Sciences, Charles E. Schmidt College of Science, Florida Atlantic University

Select Publications

Hanson, M.R. and **J.D. Baldwin**. *(In Press).* Adjusted Diets of Bald Eagles, *Haliaeetus leucocephalus*, Breeding in an Altered Estuary. *Journal of Raptor Research*.

Denton, M.J., K.M. Hart, A.W.J. Demopoulos, A. Oelinik, and **J.D. Baldwin**. 2016. Diet of Diamondback Terrapins (*Malaclemys terrapin*) in subtropical mangrove habitats of South Florida. *Chelonian Conservation Biology*.

Denton, M.J., Hart, K.M., Oleinik , A., Wood, R., and **Baldwin, J.D**. 2015. *Malaclemys terrapin rhizophorarum* (Mangrove Diamondback terrapin). Herpetological Review. 46(3): 426-427

Green. M.L., D.L. Herzing, and **J.D. Baldwin**. 2015. Molecular assessment of mating strategies in a population of Atlantic spotted dolphins. *PloS one*, 10(2): e0118227, 10.1371/journal.pone.0118227

Ogden, J.C., **J.D. Baldwin**, O. Bass, J. Browder, M. Cook, S. Davis, P. Fletcher, P. Fredrick, P.E. Frezza, R. Galvez, A. Hodgson, K. Meyer, L. Oberhofer, A. Paul, and J. Lorenz. 2014. Waterbirds as Indicators of Ecosystem Health in the Coastal Marine Habitats of Southern Florida: 1. Selection and Justification for a Suite of Indicator Species. *Ecological Indicators* 44, 128-147.

Ogden, J.C., **J.D. Baldwin**, O. Bass, J. Browder, M. Cook, S. Davis, P. Fletcher, P. Fredrick, P.E. Frezza, R. Galvez, A. Hodgson, K. Meyer, L. Oberhofer, A. Paul, and J. Lorenz. 2014. Waterbirds as Indicators of Ecosystem Health in the Coastal Marine Habitats of Southern Florida: 2. Conceptual Ecological Models. *Ecological Indicators* 44, 148-163.

Theisen, T. and **J.D. Baldwin**. 2012. Movements and depth/temperature distribution of the ectothermic Scombrid *Acanthocybium solandri* (wahoo) in the western North Atlantic. *Marine Biology* 159 (10) 2249-2258.

Baldwin, J.D., J.W. Bosley, L. Oberhofer, and O.L. Bass. 2012. Long-Term Changes, 1958–2010, In the Reproduction of Bald Eagles of Florida Bay, Southern Coastal Everglades. *Journal of Raptor Research* 46(4) 336-348.

Green. M.L., D.L. Herzing, and J.D. Baldwin. 2011. Reproductive success of male Atlantic spotted dolphins (*Stenella frontalis*) revealed by noninvasive genetic analysis of paternity. *Canadian Journal of Zoology* 89 (3) 239-253.

Theisen, T.C., B.W. Bowen, W. Lanier, and **J.D. Baldwin**. 2008. Lack of global population structure in the pelagic wahoo, *Acanthocybium solandri* (tuna family Scombridae). *Molecular Ecology* 17 (19) 4233-4247.

Professional Service, Collaborators and Other Affiliations

2014 – pres. Board of Directors, Environmental Science Magnet Program, South Plantation H.S.
2010 – pres. Technical Science Rep., South Florida-Caribbean Cooperative Ecosystem Studies Unit
2007 – pres. Science Coordination Group, South Florida Ecosystem Restoration Federal Task Force
2000 – pres. Courtesy Assoc. Professor, Dept. Fisheries and Aquatic Sciences, Univ. of Florida
2009– 2010 Research Fellow, Dry Tortugas and Everglades National Park, NPS, Dept. of Interior
2007 – 2014 Conservation and Research Advisory Board, The Florida Aquarium, Tampa Florida
2007 – 2008 Chair, University Faculty Senate Research Committee, Div. Sponsored Research
2005 – 2008 Integrative Biology Ph.D. Graduate Program Committee
2003 – 2009 University Faculty Senate Research Committee, C.E.S. College Science Representative
2004 – 2006 Chair, Biology Graduate Studies

Selected Grants

Baldwin, J.D. 2015. Broward Undergraduate Student Research Awards for $3,000. Project entitled "Assessing Genetic Population Structure of Wahoo, *Acanthocybium solandri*, on a Global Scale: Molecular Insight for Fisheries Management." (*Principle Investigator*)

Baldwin, J.D. and C.R. Hughes July 2007 – July 2014. Institute of Wildlife Sciences for $15,000. Project entitled "Conservation of Bald Eagles." (*Principle Investigator*)

Baldwin, J.D. May 2009 – May 2011. Everglades National Park/Environmental Sciences Everglades Fellowship Program for $134,247. Project entitled "Evaluation of Bald Eagle Population Dynamics and Foraging Ecology: Current and Historical Trends in Florida Bay and the Southern Estuaries of Everglades National Park." (*Principle Investigator*)

Cody, R.P, A.J. Poholek, and J.D. Baldwin. Aug. 2009 – July 2011. Unallied Management Program, National Marine Fisheries Service, NOAA, DOC for $195,500. Project entitled "Reproductive Biology and Ecology of Important Shallow-water Snapper Species in South Florida and the Florida Keys." (*Co-Principle Investigator*)

Berzins, I., C. Watson, R. Yanong, K. Kilgore, M. Breitbart, C. Daniels, C. Hughes, J. Baldwin. Jul. 2007 – Oct. 2009. Florida's State Wildlife Grants Program, Florida Fish and Wildlife Conservation Commission for $83,621. Project entitled "Continuation of Studies Evaluating Aquacultured Coral for Restoration Activities." (*Co-Principle Investigator*)

Baldwin, J.D. and B.W. Bowen. Oct. 2002 – Sept. 2005. MARFIN program National Marine Fisheries Service, NOAA, DOC for $166,775. Project entitled "Genetic Analysis of Wahoo, *Acanthocybium solandri*, Stock Structure in the Western Atlantic and Gulf of Mexico." (*Principle Investigator*)

Baldwin, J.D. March 2002 – August 2003. Research funded by Florida Sea Grant College Program, Marine Aquaculture, NOAA, DOC for $36,576. Project entitled "Reproductive development of Blood Ark, *Anadara ovalis*, and Ponserous Ark, *Noetia ponderosa*." (*Principle Investigator*)

TIFFANY ROBERTS BRIGGS, PH.D.

A. Professional Preparation
University of South Florida Environmental Science B.S. (*cum laude),* 2006
Honors College
University of South Florida Geology M.S., 2008
University of South Florida Geology Ph.D., 2012

B. Appointments
1. Assistant Professor, Department of Geosciences, Florida Atlantic University, 2014-present
2. Instructor & Course Coordinator, Department of Geology & Geophysics, Louisiana State University, 2012-2014
3. Adjunct Professor, Polk State College, 2011-2014
4. Coastal Coordinator Internship, Pinellas County, Florida Department of Environmental Management, 2011-2012
5. Corporate Secretary, Coastal Sediments Conferences, Inc., 2009-present
6. Research Associate, University of South Florida, 2008-2012
7. Graduate Research Associate, Coastal Research Lab, University of South Florida, 2006-2012
8. Graduate Teaching Assistant, Department of Geology, University of South Florida, 2006-2009
9. Undergraduate Research Assistant, Coastal Research Lab, University of South Florida 2005-2006

C. Selected Peer-Reviewed Publications
1. Wang, P. and **Roberts Briggs, T.M.**, 2014. Storm-Induced Morphology Changes along Barrier Islands and Post Storm Recovery. In: Ellis J. and Sherman, D. (Eds.), Sea & Ocean Hazards, Risks and Disasters, Elsevier, *in press*.
2. **Roberts, T.M.,** Wang, P., and Puleo, J., 2013. Storm-Driven Cyclic Beach Morphodynamics of a Mixed Sand and Gravel Beach along the Mid-Atlantic Coast, USA. *Marine Geology* 346, 403-421.
3. Wang, P., and **Roberts, T.M.,** 2013. Distribution of Surficial and Buried Oil Contaminants Across Sandy Beaches Along Northwest Florida and Alabama Coasts Following the Deepwater Horizon Oil Spill in 2010. *Journal of Coastal Research* 29(6A), 144-155. Coconut Creek (Florida), ISSN 0749-0208.
4. **Roberts, T.M.** and Wang, P., 2012. Four Year Performance and Associated Controlling Factors of Several Beach Nourishment Projects along Three Adjacent Barrier Islands in West-Central Florida, USA. *Coastal Engineering* 70, 29-39.
5. **Roberts, T.M.,** Rosati, J.D., and Wang, P. **(eds.)** 2011. *Proceedings, Symposium to Honor Dr. Nicholas C. Kraus,* Journal of Coastal Research, Special Issue 59. West Palm Beach (Florida), 290 p., ISSN 0749-0208.2

Tiffany Roberts Briggs*, Ph.D., Assistant Professor, Department of Geosciences, Florida Atlantic University Geosciences SE470, 777 Glades Road Boca Raton, FL 33431, (561) 297-4669, briggst@fau.edu *Roberts – maiden name

D. Selected Other Publications
1. **Roberts, T.M.,** 2012. Natural and Anthropogenic Influences on the Morphodynamics of Sandy and Mixed Sand and Gravel Beaches. Doctorate Dissertation, University of South Florida, Tampa, FL.
2. Wang, P., Rosati, J.D., and **Roberts, T.M. (eds.)** 2011. *Proceedings, Coastal Sediments 2011 International Conference,* World Scientific Publishing, Singapore. 2639 p.
3. **Roberts, T.M.** and Wang, P., 2011. Profile Change and Post-Storm Recovery of Delaware Beaches Resulting from Three Consecutive Storms in 2009. *Proceedings, Coastal Sediments 2011 International Conference,* World Scientific Publishing, Singapore. 1304-1317.

4. Wang, P., **Roberts, T.M.,** Dabees, M., and Horwitz, M.H., 2011. Beach Changes Associated with Active 2009-2010 El Nino Winter Along the West-Central Florida Barrier Islands. *Proceedings, Coastal Sediments 2011 International Conference,* World Scientific Publishing, Singapore. 1229-1242.
5. Wang, P. and **Roberts, T.M.,** 2010. Ongoing Beach Cleanup of the BP Oil Spill – A Superficial Job, Literally. National Science Foundation RAPID Response Grant Progress Report.

E. Synergistic Activities
1. Student Short Course Organizer, Professional Preparation, American Shore & Beach Preservation Association National Coastal Conference, 2014, Virginia Beach, Virginia
2. Invited Speaker, Mythbusters: 5 Reasons Active Learning Won't Work in Large Courses at LSU, 2014 Center for Academic Success Faculty Focus Workshop, Louisiana State University
3. Workshop Attendee, Future of Undergraduate Geoscience Education Summit, 2014, University of Texas at Austin, Texas
4. National Academies Fellow, Gulf Coast Summer Institute on Undergraduate Education, Howard Hughes Medical Institute and National Academies, 2013, Baton Rouge, Louisiana
5. Workshop Attendee, Communication Across the Curriculum (CxC) Summer Institute, Louisiana State University Office of Academic Affairs, 2013, Baton Rouge, Louisiana

F. Collaborators and Other Affiliations
1. Jack Puleo, Ph.D., Coastal Engineering, University of Delaware
2. Julie Dean Rosati, Ph.D., Engineering Research & Development Center, Army Corps of Engineers
3. Ping Wang, Ph.D., School of Geosciences, University of South Florida

G. Courses Taught
1. Coastal and Marine Science, GLY3730
2. Graduate Research, GLY6918

H. Community Engagement or Outreach
1. Chair, Student & New Professional Involvement Committee, American Shore & Beach Preservation Association

Curriculum Vitae – RANDY BROOKS, PhD

A. Professional Preparation

Southwestern College, Winfield, Kansas	B.S. 1979	Biology
Florida State University, Tallahassee, Florida	M.S. 1981	Marine Biology
Florida State University, Tallahassee, Florida	PhD 1984	Marine Biology

B. Appointments

1984-1987	Assistant Professor Biology, Auburn University at Montomgery, Alabama
1987-1991	Assistant Professor of Biology, Florida Atlantic University
1991-1996	Associate Professor of Biology, Florida Atlantic University
1992-2000t	Adjunct Professor Biology, Broward County Community College
1993-1995	Visiting Researcher, Duke University Marine Laboratory, NC
1996-present	Professor of Biology, Florida Atlantic University

C. Research Interests

My research emphasis has been in the area of behavioral/physiological ecology of marine organisms, with a particular interest in symbiotic associations. These associations represent tremendous potential in demonstrating alternatives to competition as major selective agents. The significance of coevolutionary adaptations by associated organisms is just recently being acknowledged as a major evolutionary force (e.g., endosymbiotic hypothesis for development of eukaryotes). Specifically, I have usually studied associations involving organisms that live with cnidarians, including dinoflagellates, fishes, hermit crabs, and shrimp. Recently, I have also been involved in the long-term monitoring of coral reef conditions using video transects. Some recent projects involving graduate students involve: 1) temperature-induced bleaching response of zooxanthellae living in cnidarians; 2) behavioral interactions among echinoderms and symbiotic crabs; 3) predator/prey interactions within the sargassum community. My research has been extramurally funded.

D. Select Publications

S. Perez, C. Cook and W.R. Brooks. The role of symbiotic dinoflagellates in the temperature-induced bleaching response of *Aiptasia pallida.*, J. Exp. Mar. Biol. Ecol., 2001, 256, 1-14.

M.N. Reeves and W.R. Brooks. Host selection, chemical detection, and protection of the symbiotic pinnotherid crabs *Dissodactylus crintichelis* and *Clypeasterophilus rugatus* associated with echinoderms. Symbiosis, 2001, 300, 239-256

D.W. Kemp, C.B. Cook, T.C. LaJeunesse and W.R. Brooks. A comparison of the thermal bleaching responses of the zoanthid *Palythoa caribaeorum* from three geographically different regions in south Florida. J. Exp. Mar. Biol. Ecol., 2006, 335, 266-276.

W.R. Brooks, K.A. Hutchinson, and M.G. Tolbert. Pelagic Sargassum mediates predation among symbiotic fishes and shrimps. Gulf of Mexico Sci., 2007, 2: 144-152.

C.F Jobe, and W.R. Brooks Habitat Selection and Host Location by Symbiotic Shrimps Associated with *Sargassum* Communities: The Role of Chemical and Visual Cues, *Symbiosis*, 2009, 49, 77-85, C.F Jobe, and W.R. Brooks

L.J. Ambrosio and W.R. Brooks. Recognition and use of ascidian hosts, and mate acquisition by the symbiotic pea crab *Tunicotheres moseri* (Rathbun, 1918): the role of chemical, visual and tactile cues. *Symbiosis*, 2011, 53, 53-61.

A.M. McCammon & W.R. Brooks. Protection of Host Anemones by Snapping Shrimps: A Case for Symbiotic Mutualism? Symbiosis. doi:10.1007/s13199-014-0289-8. 2014.

C.O. Bennice and W.R.Brooks. Habitat Selection Among Fishes and Shrimp in the Pelagic Sargassum Community: The Role of Habitat Architecture. Gulf of Mexico Science. In Press.

E. Books/Study Guide Publications

Barcharts: Marine Biology – 2000; Botany – 2001; Zoology – 2001; Microbiology – 2004; Biology 2 – 2004; Ecology – 2005; Becoming a Doctor – 2005; Biology Booklet – 2006; Genetics – 2007; Physiology – 2008; Bio Lab Basics, 2008; Environmental Science, 2010; Biology- 2012; Molecular Biology – 2012; Biology Terminology – 2013; Science Terminology – 2013;

Biodiversity: The Diversity of Life, Pearson Custom Publishing, 2000, 2005.

Biological Principles: The Way Life Works, Pearson Custom Publishing, 2000, 2005.

G. Select Grants

2001-02	National Science Foundation, $130,000 project entitled, "Exploring IDEAS: An Integrated Design Enhancing Academic Success in Science, Reading and Mathematics" (with N. Romance, D. Lowell, J. Haky and D. Ploger).
2002-03	National Science Foundation, $74,999 project entitled, "Success by Design: Building Faculty Capacity to Improve Curriculum and Instruction" (with D. Lowell, J. Haky, and R. Jordan).
1997-04	National Oceanic & Atmospheric Administration, $26,000 per-year project entitled, "Coral Reef Monitoring off the Southeastern Florida Coast: Establishing Techniques and Baseline Data for Both Video and Fixed-Transect Monitoring".

Laurent M. Chérubin

Florida Atlantic University, Harbor Branch Oceanographic Institute
5600 US 1 North, Florida 34946

PROFESSIONNAL PREPARATION

Université Bordeaux I, France	Mechanics	BS 1993
Université de la Méditerranée, France	Coastal Oceanography	MS 1995
Université de la Méditerranée, France	Physical Oceanography	PhD 2000
Universidade de Lisboa, Portugal, Post-doc	Physical Oceanography	2000-2001
University of Miami, USA, Post-doc	Physical Oceanography	2002-2003

APPOINTMENTS

Research Associate Professor, Florida Atlantic University	present
Adjunct Faculty, Miami-Dade College, USA	2013
Associate Scientist, University of Miami, USA	2011 - 2013
Visiting Scientist at University of the Virgin Island	2011
Adjunct Faculty at SUNY Oswego, USA	2007 - 2009
Assistant Scientist, University of Miami, USA	2004 - 2010

PRODUCTS

L'Hegaret, P., X. Carton, I. Ambar, C. Menesguen, L. Hua, **L.M. Chérubin**, B. Le Cann, Y. Morel, N. Daniault, N. Serra, and A. Serpette, 2014. Evidence of Mediterranean Water dipole collision in the Gulf of Cadiz. *J. Geophys. Res*, **119**(8), 5337-5359. DOI: 10.1002/2014JC009972

Chérubin, L.M., R.S. Nemeth, N. Idrisi, 2011. Flow and transport characteristics from an *Epinephelus Guttatus* (red hind grouper) spawning aggregation site in St. Thomas (US Virgin Islands). *Ecological Modelling,* **222,** 3132–3148.

Duarte, R., X. Carton, X. Capet, L.M. **Chérubin**, 2011. Trapped instability and vortex formation by an unstable coastal current. *Regular and Chaotic Dynamics*, **16**(6), 577-601.

Carton, X., N. Daniault, J. Alves, L.M. **Chérubin**, and I. Ambar, 2010. Meddy dynamics and interaction with neighboring eddies southwest of Portugal: Observations and modeling. *J. Geophys. Res*., 115, C06017, doi:10.1029/2009JC005646.

Chérubin L.M., D.G. Dritschel and X. Carton, 2007. Baroclinic instability of boundary currents over a bottom slope in a quasigeostrophic model. *J. Phys. Oceanogr*., (6)**37**, 1661-1677

OTHER SIGNIFICANT PRODUCTS

Criales, M. M., **L. M. Cherubin**, J. A. Browder. Modeling larval transport and settlement of the pink shrimp in south Florida: dynamics of behavior and tides. *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science*, **7**, 148-176.

Karnauskas, M., L.M. **Chérubin**, B.E. Hutington, and E.A. Babcock (2012). Physical forces influence the trophic structure of reef fish communities on a remote atoll. *Limnology and Oceanography*, **57**(5), 1403-1414.

Chérubin, L.M., C. Kuchinke, and C.B. Paris, 2008. Ocean circulation and terrestrial

runoff dynamics in the Mesoamerican region from spectral optimization of SeaWiFS data and a high resolution simulation. *Coral Reefs*, **27**, 503-519. DOI: 10.1007/s00338-007-0348-1

Capet, X., L. **Chérubin**, Y. Morel, 2002. Influence of the transport on the instability of a boundary current. *J. Phys. Oceanogr*., **32**, 2806-2815.

SYNERGISTIC ACTIVITIES

- Contributor to open source code for the development of bio-physical models: BiOphysical Larval Tracking System (BOLTS) and Connectivity Modeling System (CSM).
- Mentor undergraduate and graduate interns supported by the Link Foundation at HBOI as well as intern from Universidad del Mar (Mexico), from Université de la Méditerranée (France), from Université de Bretagne Occidental (France).
- I lead the set-up of a high performance computing center at HBOI
- Affiliate Scientist at the Smithsonian Institute
- Member at large of the South Atlantic Fishery Management Council Advisory Panel

BIOGRAPHICAL SKETCH - Anni K. Vuorenkoski Dalgleish

PROFESSIONAL PREPARATION

Helsinki Institute of Technology, Finland	Engineering	B.S.	1998
Cranfield University, Cranfield, England	Engineering	M.S.	2002
Cranfield University, Cranfield, England	Engineering	Ph.D.	2005

ACADEMIC AND PROFESSIONAL APPOINTMENTS

2013- present	Assistant Research Professor, Harbor Branch Oceanographic Institute at Florida Atlantic University
2009- 2013	Research Associate, Harbor Branch Oceanographic Institute at FAU
2006-2008	Staff Scientist, Advanced Technologies Group, Inc.
2001-2004	Research Associate, Cranfield University
1999-2001	Project Engineer, SAAB Automobile/Valmet Automotive, Inc.

PRODUCTS

Peer-reviewed publications

Ouyang B., Hou W, Caimi FM, Dalgleish FR, Vuorenkoski AK, Gong C.(2015) Distributed Compressive Sensing vs. Dynamic Compressive Sensing: Improving the Compressive Line Sensing Imaging System through Their Integration. Proc. SPIE 9459, Ocean Sensing and Monitoring VII, 945914 (May 19, 2015).

Vuorenkoski AK, Dalgleish FR, Twardowski MS, Ouyang B, Trees CC. (2015) Semi-empirical inversion technique for retrieval of quantitative attenuation profiles with underwater scanning LIDAR systems. Proc. SPIE 9459, Ocean Sensing and Monitoring VII, 945915 (May 19, 2015).

Ouyang B, Hou W, Caimi FM, Dalgleish FR, Vuorenkoski AK, Gong C, Britton W. (2015). Near-Infrared Compressive Line Sensing Imaging System Using Individually Addressable Laser Diode Array. Proc. SPIE 9484, Compressive Sensing IV, 948401 (May 14, 2015).

Dalgleish, F.R., Shirron, J.J., Rashkin D., Giddings T.E., Vuorenkoski A.K., Cardei I., Ouyang B., Caimi F.M. and Cardei M. (2014) 'Physical layer simulator for undersea free-space laser communications', Opt. Eng. 53 (5), 051410 (April 25, 2014); doi: 10.1117/1. OE.53.5.051410

Ouyang B., Dalgleish F.R., Caimi, F.M., Giddings T.E., Britton W.B., Vuorenkoski, A.K., and Nootz G.A. (2014) 'Compressive line sensing underwater imaging system', Opt. Eng. 53 (5), 051409 (April 22, 2014); doi: 10.1117/1.OE.53.5.051409

Dalgleish, F. R., Vuorenkoski, A. K. , and Ouyang, B., (2013) 'Extended-Range Undersea Laser Imaging: Current Research Status and a Glimpse at Future Technologies', Marine Technology Society Journal, 47:5. 128-147.

Dalgleish, F.R., Vuorenkoski, A.K., Nootz, G.A., Ouyang, B. and Caimi, F.M., (2013) 'Experimental Study into the Performance Impact of Environmental Noise on Undersea Pulsed Laser Serial Imagers', Journal of Underwater Acoustics (USN), Volume 61, Issue 4.

Ouyang B., Dalgleish F. R., Caimi F. M., Giddings T. E., Shirron J. J., Vuorenkoski A. K., Nootz G., Britton W. and Ramos B., (2013) 'Compressive Sensing Underwater Laser Serial Imaging System', SPIE Journal of Electronic Imaging, special edition on Compressive Sensing, Vol. 22, Issue 2, 2013.

Ouyang B., Dalgleish F. R., Vuorenkoski A., Britton W., Ramos B. and Metzger B., (2013) 'Visualization for multi-static underwater LLS system using Image based Rendering', IEEE Journal of Oceanic Engineering, Vol. 38, pp. 566 – 580, 2013.

Vuorenkoski, A. K., Dalgleish F. R., and Ouyang B. (2013) 'Real-Time Natural Seep Detection and Characterization Using Autonomous Persistent Presence Surface Vehicles', Accepted. Marine Technology Society Journal.

Dalgleish, F. R., Ouyang, B., Vuorenkoski, A. K., Thomas, J. C. and Carragher, P. D., (2013) 'Towards Persistent Real-Time Autonomous Surveillance and Mapping of Surface Hydrocarbons.', Offshore Technology Conference, Houston, TX, USA. May 5-8, 2013.

Patents

Vuorenkoski, A., Dalgleish, F and Ouyang, B.: "Underwater Sensing System." Full United States patent application filed with the United States Patent and Trademark Office ("USPTO"). Filed: February 17, 2016. Application No.: 15/045,980. NDQ Ref. No.: 59100-00228 (6818-244-1). **Pending.**

Ouyang B., Dalgleish F., Dalgleish (Vuorenkoski) A. 2015. "MEMS microdisplay optical imaging and sensor systems for underwater and other scattering environments", US Patent 9019503 (Apr 28, 2015).

Dalgleish F., Dalgleish (Vuorenkoski) A., Ouyang, B. 2014. "MEMS microdisplay optical imaging and sensor systems for underwater scattering environments", US Patent 8917395 (Dec 23, 2014).

SYNERGISTIC ACTIVITIES

Editor, Marine Technology Society Journal (Nov 2014 – present)

Reviewer, FAU College of Science Seed proposals

Co-chair, Faculty Assembly Steering Committee (Harbor Branch Oceanographic Institute, Nov 2013 – March 2015)

Member, various Standing and Ad-hoc Committees (Harbor Branch Oceanographic Institute and Florida Atlantic University, Nov 2014 – present)

Co-author, Strategic and Implementation Plans, Sections on Innovative Technology and Ocean Exploration (Harbor Branch Oceanographic Institute, 2013 – 2014)

COLLABORATORS AND OTHER AFFILIATIONS

Collaborators

Walter Britton (HBOI-FAU), Frank Caimi (HBOI-FAU), Ionut Cardei (FAU), Mihaela Cardei (FAU), Fraser Dalgleish (HBOI-FAU), Thomas Giddings (Metron Inc), Sue Gong (TCU), Weilin Hou (NRL-Stennis), Bing Ouyang (HBOI-FAU), Christian Meinig (NOAA PMEL), Martin Montes (UQAR), Gero Nootz (NRL – Stennis), James Osse (NOAA PMEL), David Rashkin (FAU), Joseph Shirron (Metron Inc), Michael Twardowski (HBOI-FAU), Charles Trees (NATO CMRE).

Graduate Advisors

Mark Jermy, graduate advisor, University of Canterbury, New Zealand
Matthew Harrison, graduate advisor, Royal Academy of Engineering, London, England

FRASER R. DALGLEISH

Professional Preparation

University of Edinburgh	Electrical and Electronic Engineering	B.Eng. (Hons) 1995
Cranfield University, UK	Ocean Engineering	M.Sc. 2001
Cranfield University, UK	Ocean Engineering	Ph.D. 2004
Harbor Branch Oceanographic Inst.	Ocean Engineering	Postdoc 2004 - 2005

Appointments

2013 – present	Associate Research Professor, Harbor Branch Oceanographic Institute at Florida Atlantic University
2007 - 2013	Assistant Research Professor, Harbor Branch Oceanographic Institute at Florida Atlantic University
2005 - 2007	Ocean Engineering Project Manager, Harbor Branch Oceanographic Institution
2004-2005	Postdoctoral Fellow, Harbor Branch Oceanographic Institution
2001-2004	Research Assistant, Cranfield University, UK.

5 products most closely related to the proposed project

Dalgleish, F. R., Vuorenkoski, A. K. , and Ouyang, B., (2013). Extended-Range Undersea Laser Imaging: Current Research Status and a Glimpse at Future Technologies. *Marine Technology Society Journal, 47:5. 128-147.*

Dalgleish, F.R., Vuorenkoski, A.K., Nootz, G.A., Ouyang, B. and Caimi, F.M., (2013) Experimental Study into the Performance Impact of Environmental Noise on Undersea Pulsed Laser Serial Imagers, *Journal of Underwater Acoustics (USN), Volume 61, Issue 4.*

Dalgleish, F. R., Shirron, J. J., Rashkin D., Giddings T. E.; Vuorenkoski A.K.; Cardei I., Ouyang B., Caimi F. M. Cardei M. (2014) Physical layer simulator for undersea free-space laser communications. *Opt. Eng. 53 (5)* doi: 10.1117/1.OE.53.5.051410

Dalgleish, F. R., Ouyang, B., Vuorenkoski, A. K., Thomas, J. C. and Carragher, P. D., Towards Persistent Real-Time Autonomous Surveillance and Mapping of Surface Hydrocarbons., Proc. *Offshore Technology Conference*, Houston, TX, USA. May 5-8, 2013.

Dalgleish, F., J. Reed, and T. Frank. Glider observations support plankton population characterization. *Sea Technology*, September 2012: 39-42 (2012).

Synergistic Activities

Visiting Scientist at NATO-CMRE, Environmental Knowledge and Operational Effectiveness (EKOE), La Spezia, Italy, from July 7th to September 19th 2014.

Underwater Imaging committee chair for the Marine Technology Society (2009-present).

Program Evaluator at NSF LASER-TEC ATE at Indian River State College (2014-present).

HBOI technical representative for SECOORA (2013-present)

Organized and Chaired Special Sessions on Extended Range Underwater Laser Imaging at MTS/IEEE Oceans 2009, October 28th 2009, Biloxi, MS. & MTS/IEEE Oceans 2015, October 20th 2015, Washington, DC.

James Gammack-Clark

FAU Geosciences, 777 Glades Rd., Boca Raton, FL. 33431
Phone: 561-2970314, Email: jgammack@fau.edu

A. Professional Preparation

Master of Arts, Geography, Geographical Information Sciences emphasis, Florida Atlantic University, Boca Raton, Florida. 2001. Thesis: Image Rectification/Registration from a Project Manager's Perspective: A Review of Various Software. Advisor: Dr. Charles Roberts.

B. Appointments

Instructor, Florida Atlantic University Geosciences Department, Boca Raton, Florida. August 2006 to Present. This is primarily a teaching, rather than research, position. Specifically, classes taught include introductory and intermediate GIS/Cartography, introductory Geography and introductory Meteorology. Each of these classes is partially taught via the World Wide Web. In addition, the position calls for instruction in the field as part of an annual Geology Field Camp. Other duties include serving upon various committees and performing Academic Advising.
Adjunct Professor, Florida Atlantic University Geosciences Department, Boca Raton, Florida. January 2002 to May 2006. Commissioned to instruct FAU's Geosciences department's "Introduction to Mapping & GIS" course. The course is the cornerstone of the department's GIS sequence. This course is designed to introduce students to basic map design, map interpretation and appreciation, and an introduction to the art and science of GIS.
Senior Planner, Palm Beach County Planning Division, West Palm Beach, Florida, February 2004 to August 2006. This is considered an intermediate level professional and supervisory planning position in the Intergovernmental Section. The position involved the daily over sight of Planner I's and II's, a Planning Technician, Student Interns and a Secretary. Further responsibilities include: coordinating with Commissioners' offices to address specific intergovernmental projects; liaising with municipalities in coordination of both Future Land Use Amendments and Annexations; the design and management of GIS databases; in-depth analysis of spatial data from multiple sources (imagery, GIS, CAD, MDB, Shapefile, etc) for the development and maintenance of various data products and maps; leading and/or conducting data gathering; manipulation of remotely sensed data to detect change in the urban environment; and the interpretation of municipal comprehensive plans and elements. Also prepares technical and non-technical reports, and makes oral and written public presentations
Planner II, Palm Beach County Planning Division, West Palm Beach, Florida, July 2003 to February 2004. This is an intermediate level professional planning position in the Intergovernmental Section. Responsibilities included: managing GIS databases; 2
performing analysis of spatial data from multiple sources for the development and maintenance of various GIS products and maps; preparing, updating, and managing databases based on various sources of information using complex software programs; develops and maintains a listing of all approved developments on a countywide scale; and interprets municipal comprehensive plans and elements. Also prepares technical and non-technical reports, and makes oral and written public presentations. Supervises professional and technical staff in the conduct of assigned duties.
Planner I, Palm Beach County Planning Division, West Palm Beach, Florida, June 2002 to July 2003. This entry-level position involves the application of planning principals and methodology in the formulation of various planning studies and projects.

C. Selected Peer-Reviewed Publications

N/A. Research is not part of the Instructor's assignment.

D. Selected Other Publications or Products/Grants

N/A. Research is not part of the Instructor's assignment.

E. Synergistic Activities

Production Editor of ***The Florida Geographer***, 2008 - 2013
CEL1001R: eLearning Designer/Facilitator and Quality Matters Certification
GIS Expo, 2012

F. Collaborators and Other Affiliations

The Florida Society of Geographers
FAU Geosciences GIS Center

G. Courses Taught

GEA 2000: World Geography
MET 2010: Weather & Climate
GISC 3015: Introduction to Mapping & GIS
GISC 4043: Principles of GIS
GIS 4138: Geovisualization & GIS
GIS 4048C: Applications in GIS

H. Community Engagement or Out-reach

Instructed various professional development GIS classes
GIS/Redistricting consultant to local municipalities
Science Olympiad judge
Co–coordinator/presenter: S. Broward High School GIS field trip to FAU February, 2007

BIOGRAPHICAL SKETCH

Dale E. Gawlik

Professional Preparation

University of Wisconsin Stevens Point	B.S.	1984
Winthrop College	M.S.	1988
Texas A&M University	Ph.D.	1994

Appointments

2007-present	Director, Environmental Science Program, Florida Atlantic University
2013-present	Professor, Department of Biological Sciences, Florida Atlantic University
2011-2012	Senior Visiting Fellow, Australian Wetlands and River Centre, University of New South Wales.
2008-2013	Associate Professor, Department of Biological Sciences, Florida Atlantic University
2003-2008	Assistant Professor, Department of Biological Sciences, Florida Atlantic University
1994-2003	Senior Environmental Scientist, Everglades Division, South Florida Water Management District
1994	Postdoctoral Research Associate, Texas A&M University
1993-1994	Tom Slick Senior Graduate Fellow, Texas A&M University

Selected Peer-Reviewed Publications (five recent)

- Klassen, Jessica A., **D. E. Gawlik**, and P. C. Frederick. 2016. Linking Wading Bird Prey Selection to Number of Nests. Journal of Wildlife Management DOI: 10.1002/jwmg.21141.
- Botson, Bryan A., **D. E. Gawlik**, and J. C. Trexler. 2016. Mechanisms that generate resource pulses in a fluctuating wetland. PLoS ONE 11: e0158864.
- Calle, L., **D. E. Gawlik**, Z. Xie, L. Green, B. Lapointe, and A. Strong. 2016. Effects of tidal periodicities and diurnal foraging constraints on the density of foraging wading birds. Auk 133: 378-396
- Green, L., B. E. Lapointe, and D. E. Gawlik. 2015. Winter pulse and seagrass epiphyte bloom: evidence of anthropogenic enrichment or natural nutrient conditions in the Great White Heron National Wildlife Refuge, Lower Florida Keys? Estuaries and Coasts 38: 1854-1971.
- Green, L., D. E. Gawlik, L. Calle, and B. E. Lapointe. 2015. Relative effects of physical and small-scale nutrient factors on the distribution of tropical seagrasses in the Great White Heron National Wildlife Refuge, Lower Florida Keys. Aquatic Botany 124: 45-53.

Other selected publications or grants (five recent)

- Habitat selection models for wading birds in coastal South Florida. D. E. Gawlik, funded $231,461 by U.S. Geological Survey, 2015-2016.
- Dry season prey concentrations. D. E. Gawlik, funded $820,921 by U.S. Army Engineer Corp of Engineers Research and Development Center, 2012-2016.
- Wood stork use of roadway corridor features in South Florida. D. E. Gawlik, funded $462,855 by Florida Department of Transportation, 2013-2016
- Feasibility of modeling impacts of sea level rise on foraging habitat of the Little Blue Heron in the Great White Heron National Wildlife Refuge, Phase II: factors affecting habitat D. E. Gawlik and B. Lapointe, funded $50,000 by U.S. Fish and Wildlife Service, 2012-2013.
- Postdoctoral investigator program in marine science, engineering and technology: effects of nutrient enrichment on wading bird habitat in the Great White Heron National Wildlife Refuge, lower Florida Keys. B. Lapointe and D. E. Gawlik, funded $112,640 by Harbor Branch Oceanographic Institute at Florida Atlantic University, 2012-2014.

Synergistic Activities

- Steering Committee, IUCN Heron Specialist Group, 2015-present
- Research Advisory Council, Rookery Bay National Estuarine Research Reserve, 2015-present.
- Councilor, Wilson Ornithological Society, 2015-present.
- Co-organized symposium entitled System-wide science: translating a trophic hypothesis foundation for restoration. Greater Everglades Ecosystem Restoration Conference, Coral Springs, FL, 2015.
- Co-organized symposium entitled Biology of the Great Egret. Waterbird Society Conference, La Paz, Mexico, 2015.
- Panelist for evaluation of Society of Ecological Restoration International Primer on Ecological Restoration. Conference on Ecological and Ecosystem Restoration, New Orleans, 2014.
- Councilor, Association of Field Ornithologists, 2013-2016.
- Science Advisory Committee, Gulf Coast Bird Observatory, Lake Jackson, Texas, 2012 – present.
- Science Advisory Committee for the Whooping Crane Eastern Partnership, U.S. Fish and Wildlife Service, 2011-present.
- President, Florida Chapter of The Wildlife Society, 2011 – 2013.
- Reviewer, Biological Status Review of Florida's Threatened Species Program, Florida Fish and Wildlife Conservation Commission, 2010.
- Dissertation Reviewer, University of New South Wales, Sydney, Australia, 2010.
- Dissertation Reviewer, University of New England, Armidale, Australia, 2010.

Collaborators and other affiliations

- Peter Frederick, University of Florida, Gainesville, FL
- Frank Mazzotti, University of Florida, Davie, FL
- Arnold van der Valk, Iowa State University, Ames, IA
- Joel Trexler, Florida International University, Miami, FL

Courses Taught

- Conservation Biology (PCB 6045) Developed new graduate course on the principles of Conservation Biology. Format is lecture, team projects, guest speakers, paper discussions, and a field trip.
- Seminar in Emerging Topics in Avian Ecology (Zoo 6544C) Developed new graduate course focusing on recent topics in the literature. Format is student-led discussion with introductory and synthesis lectures by the instructor.
- Principles of Ecology (PCB 4043). Taught this existing large enrollment undergraduate course required for biology majors. Format is lecture with three simulation model exercises done in teams.

Outreach

- Gawlik, D. E. 2015. Wading birds in a changing Everglades. Audubon Society of the Everglades, West Palm Beach, FL.
- Gawlik, D. E. 2015. Herons on the flats: contrasting the habitat of two wading bird species. Delicate Balance of Nature Series, Dagny Johnson Key Largo Hammock Botanical State Park, Key Largo, FL.
- Gawlik, D. E. 2014. Everything Everglades: water, fish, and wading birds. Artist in Residence in Everglades (AIRIE) Program, College of Arts and Letters, Florida Atlantic University.
- Gawlik, D.E. 2014. Wading birds in the Everglades: graduate student research shaping the restoration of a global treasure. Jupiter High School Environmental Academy.
- Gawlik, D.E. 2013. Wading birds in Florida: cream skimmers and crumb pickers. Coastal Lecture Series, Florida Oceanographic Society, Fort Pierce, FL

M. DENNIS HANISAK
Harbor Branch Oceanographic Institute at Florida Atlantic University
5600 US 1 North, Fort Pierce, FL 34946
Phone: (772) 242-2306; E-mail: dhanisak@hboi.fau.edu

Professional Preparation: Rutgers University, Biological Sciences, A.B., 1971; University of Rhode Island, Botany, M.S., 1973; University of Rhode Island, Biological Sciences, Ph.D., 1977; Postdoctoral Fellow, Harbor Branch Foundation, Seaweed Aquaculture, 1977-1979

Appointments

2007-	Research Professor & Director of Education, Harbor Branch Oceanographic Institute at Florida Atlantic University, Fort Pierce, FL
2002-	Affiliated Professor, Florida Atlantic University, Boca Raton, FL
1991-2007	Graduate Faculty Member, Florida Institute of Technology, Melbourne, FL
1983-2007	Assistant/Associate/Senior Scientist, Harbor Branch Oceanographic Institution, Fort Pierce, FL (in addition, 1994-2006: Director, Division of Marine Science; 2000-2007, Director, Division of Marine Education)
1982-	Assistant Research Scientist, University of Florida, Gainesville, FL (stationed at Harbor Branch Foundation, Fort Pierce, FL)
1980-1982	Assistant Research Professor, Marine Sciences Research Center, State University of New York, Stony Brook, NY
1977-1980	Postdoctoral Fellow (2 years), Assistant Research Scientist (1 year), Harbor Branch Foundation, Fort Pierce, FL
1976-1977	Research Aquatic Biologist, United States Environmental Protection Agency, Narragansett, RI
1972-1976	Teaching Assistant, University of Rhode Island, Kingston, RI

Research Interests: Physiological Ecology of Marine Plants (Macroalgae and Seagrasses), Nutrient Dynamics, Coral Reef Ecology, Biology of Deep-water Macroalgae, Aquaculture (particularly Marine Plant Cultivation)

10 Selected Publications (that demonstrate range of career interests); Total: 81, 1977-2015:

Zechman, F.W., H. Verbruggen, F. Leliaert, M. Ashworth, M.A. Buchheim, M.W. Fawley, H. Spalding, C.M. Pueschel, J.A. Buchheim, B. Verghese, and M.D. Hanisak. 2010. The deep-water marine palmelloid algae *Palmophyllum* and *Verdigellas* represent a distinct lineage of green plants, J. Phycol. 46:1288-1295.

Littler, D.S., M.M. Littler, and M.D. Hanisak. 2008. Submersed Plants of the Indian River Lagoon. OffShore Graphics, Inc. 286 pages, ISBN 0-9678901-2-8.

Hall, L.M., M.D. Hanisak, and R.W. Virnstein. 2006. Fragments of the seagrasses *Halodule wrightii* and *Halophila johnsonii* as potential recruits in Indian River Lagoon, Florida. Mar. Ecol. Prog. Ser. 310: 109-117.

Hanisak, M.D. 2001. Photosynthetically Active Radiation, Water Quality, and Submerged Aquatic Vegetation in Indian River Lagoon. St. Johns River Water Management District, Palatka, Florida. 502 pp.

Littler, M.M., D.S. Littler, and M.D. Hanisak. 1991. Deep-water rhodolith distribution, productivity, and growth history at sites of formation and subsequent degradation. J. Exp. Mar. Biol. Ecol. 150:163-182.

Hanisak, M. D. and S. M. Blair. 1988. The deep-water macroalgal community off the east Florida Continental Shelf. Helgolander Meeresunters. 42: 133-163.

Hanisak, M.D., M.M. Littler, and D.S. Littler. 1988. Significance of macroalgal polymorphism: intraspecific tests of the functional-form model. Mar. Biol. 99: 157-165.

Hanisak, M.D. 1987. Cultivation of *Gracilaria* and other macroalgae in Florida for energy production. Pp. 191-218 in K.T. Bird and P. H. Benson (eds.), Seaweed Cultivation for Renewable Resources, Elsevier, New York.

Hanisak, M.D. 1983. The nitrogen relationships of marine macroalgae. Pp. 699-730, in E.J. Carpenter and D.G. Capone (eds.), Nitrogen in the Marine Environment. Academic Press, New York.

Hanisak, M.D. 1979. Growth patterns of *Codium fragil*e ssp. *tomentosoides* in response to temperature, irradiance, salinity, and nitrogen source. Mar. Biol. 50: 319-332.

Synergistic Activities

Frequently an invited participant at national and international meetings and workshops

Director education programs at Harbor Branch, including university courses, summer internship program, public lecture series, high school programs, and informal K-12 programs

Current teaching (FAU): Graduate course – Natural History of Indian River Lagoon (lead); Undergraduate courses – Marine Biodiversity (lead), Ocean Discovery (lead); Marine Science Field Studies (lead), Marine Science (co-instructor), Aquaculture and the Environment (co-instructor)

Previous major service to professional societies: Convenor, 10th International Phycological Congress (2013),; President, International Phycological Society (2004-2005); Chairman, Board of Trustees, Phycological Society of America (1994-2004); President, Phycological Society of America (1992-1993)

Collaborators and Other Affiliations

External Collaborators (last 5 years)

Robert Chamberlain, St. Johns River Water Management District; Robert Cowen, Oregon State University; Peter Etnoyer, NOAA; Julie Harrington, Florida State University; Paula Keener, NOAA; Chris Kelley, University of Hawaii, Manoa; Villy Kourafalou, University of Miami; Lori Morris, St. Johns River Water Management District; Peter Oertner, University of Miami; Ryan Smith, University of Miami; Robert Virnstein, Seagrass Ecosystems Analysts; Ming Ye, Florida State University

Graduate and Postdoctoral Advisors

M.S.: Richard Wood (deceased), Ph.D.; Marilyn Harlin (retired); Postdoc: John Ryther (deceased)

Thesis Advisor and Postgraduate Scholar Sponsor (last 5 years)

Currently: Kristen Davis (M.S., Biological Sciences, FAU)

Last Five Years: Postdoctoral Supervisor: Dr. Nikki Dix (2011-2013), GTM Research Reserve; Graduate Students: Karen Holloway-Adkins (Ph.D., Integrative Biology, FAU, 2014); Jacob Berninger (M.S., Biological Sciences, FAU, 2015)

Previously: Thesis Advisor of 6 other M.S. students (Florida Institute of Technology - 5, FAU - 1), Sponsor for 9 Postdoctoral Fellows/Scientists (HBOI), Mentor for 15 HBOI Summer Interns, 2 COSEE summer interns

Mingshun Jiang
Harbor Branch Oceanographic Institute
Florida Atlantic University
5600 US 1 N, Ft. Pierce, FL 34946
Phone: 772-242-2254, email: jiangm@fau.edu

a. PROFESSIONAL PREPARATION

09/89-07/94 PhD, Ocean University of Qingdao, Qingdao, P.R. China
09/82-07/86 BS, Peking University, Beijing, P.R. China

b. PROFESSIONAL EXPERIENCE

2013-present Associate Research Professor, HBOI, Florida Atlantic University
2002-2013 Research Associate, University of Massachusetts Boston
1999-2002 Postdoctoral Research Associate, University of Maine
1996-1998 Assistant Scientist, Institute of Atmospheric Physics, Chinese Academy of Sciences
1994-1996 Postdoctoral Research Associate, Peking University

c. 5 CLOSELY RELATED PRODUCTS

- **Jiang, M.S.** et al., 2014, Nutrient input and the competition between *Phaeocystis pouchetii* and diatoms in Massachusetts Bay spring bloom, Journal of Marine Systems, 134: 29-44.
- **Jiang, M.S.**, K. Barbeau, F. Azam, K. Buck, C. I. Measures, G. Mitchell, K. Selph, and M. Zhou, 2013, The role of Fe ligands in controlling Fe cycle and phytoplankton productivity in the Antarctic Peninsula, *Deep-Sea Research II*, 10.1016/j.dsr2.2013.01.029.
- **Jiang, M.S.**, G.T. Wallace, M. Zhou, S. Libby, and C. Hunt, 2007, Summer formation of a high nutrient low oxygen pool in Cape Cod Bay, USA. *J. Geophys. Res.-Oceans*, 112 (C5), C05006, 10.1029/2006JC003889.
- **Jiang**, **M.S.,** M. Zhou, S. Libby and C. Hunt, 2007, Influences of GOM intrusion on the Massachusetts Bay spring bloom, Continental Shelf Research, 27: 2465–2485.
- **Jiang**, **M.S.,** M.W. Brown, J.T. Turner, R.D. Kenney, C.A. Mayo, Z. Zhang, M. Zhou, 2007, Springtime transport and retention of *Calanus finmarchicus* in Cape Cod Bay and implications to North Atlantic right whale foraging, Marine Ecology Progress Series, 349: 183-197, doi: 10.3354/meps07088.

5 OTHER SIGNIFICANT PRODUCTS

- **Jiang, M.S.**, M.A. Charette, C.I. Measures, Yiwu Zhu, and M. Zhou, 2013, Seasonal cycle of circulation in the Antarctic Peninsula and the off-shelf transport of shelf waters into Southern Drake Passage and Scotia Sea, *Deep-Sea Research II,* DOI.10.1016/j.dsr2.2013.02.029.
- **Jiang, M.S**. et al., 2011, Dynamics of a meso-scale eddy off Cape Ann, Massachusetts in May 2005. *Deep-Sea Research I*, 58, 1130-1146.
- **Jiang, M.S**., and F. Chai, 2005, Physical and biological controls on the asymmetry of surface nutrients and pCO_2 in the central and eastern equatorial Pacific, *J. Geophys. Res*., *110*, C06007, doi:10.1029/2004JC002715.
- Chai, F., **M. S. Jiang**, et al., 2003, Interdecadal Variation of the Transition Zone Chlorophyll Front, A Physical-Biological Model Simulation between 1960 and 1990. *Journal of Oceanography,* **59**, 461-475.

- **Jiang, M.S**., et al., 2003, A nitrate and silicate budget in the Eastern Equatorial Pacific Ocean. *Deep-Sea Research II*, **50**, 2971-2996.

d. SYNERGISTIC ACTIVITIES

- Model development: biogeochemical model for Massachusetts Bay, ecosystem-iron-ligand model for Southern Ocean, ecosystem model for Lake Michigan
- Model development: Coupled physical-biogeochemical models for Antarctic Peninsula and Drake Passage, Boston Harbor and Massachusetts Bay, Gulf of Maine, Indian River Lagoon, Southwest Florida shelf and Florida Straits, Lake Michigan
- Model development: An operational forecast model for Boston Harbor and Massachusetts Bay
- Model development: Assimilating data from underwater mobile platform and sensors with numerical models to better predict ocean movements
- Reviewers for NSF, NASA and NOAA proposals and a number of scientific journals
- Serve on NOAA CPO proposal review panel

e. COLLABORATORS & OTHER AFFILIATIONS

COLLABORATORS: K. Barbeau (SIO), D. Borkman (URI), M. Brown (New Eaq), K. Buck (USF), R.F. Chen (UMB), E. Douglas (UMB), F. Chai (UMaine), M. A. Charette (WHOI), C. Detweiler (U. Nebraska-Lincoln), C. Dong (UCLA), M. Kahru (SIO), Z.P. Lee (UMB), S. Libby (Battelle), S. Mayo (PCCS), C. Measures (U. Hawaii), P. Orton (SIT), K. E. Selph (U. Hawaii), Z.A. Wang (WHOI), H. Xue (UMaine), M. Zhou (UMass Boston)
ADVISORS: X.H. Fang (Ph.D., retired), S.Z. Feng (Ph.D, retired), F. Chai (PostDoc, UMaine).
STUDENTS AND POSTDOCS: Chudong Pan (advisor, PostDoc), Ahsan Habib (MS graduate)

Stephen M. Kajiura

Biological Sciences, Florida Atlantic University, Boca Raton, FL 33431 USA

www.science.fau.edu/sharklab

A. Professional preparation

University of California at Irvine	*Ecology & Evolution*	Postdoc, 2002-2003
University of Hawaii at Manoa	*Zoology*	PhD, 2001
Florida Institute of Technology	*Marine Biology*	MS, 1994
University of Guelph	*Marine Biology*	Honours BSc, 1991

B. Appointments

2015-present	Professor, Biological Sciences, Florida Atlantic University
2010-2015	Associate professor, Biological Sciences, Florida Atlantic University
2003-2010	Assistant professor, Biological Sciences, Florida Atlantic University

C. Selected Peer-Reviewed Publications (5 most recent)

Kajiura, SM & SL Tellman. 2016. Quantification of Massive Seasonal Aggregations of Blacktip Sharks (*Carcharhinus limbatus*) in Southeast Florida. **PLoS ONE** 11(3): e0150911. doi:10.1371/journal.pone. 0150911

Bedore CN, SM Kajiura & S Johnsen. 2015. Freezing behaviour facilitates bioelectric crypsis in cuttlefish faced with predation risk. **Proceedings of the Royal Society B** 282: 20151886.

Harris, LL, CN Bedore, & SM Kajiura. 2015. Electroreception in the obligate freshwater stingray, *Potamotrygon motoro*. **Marine & Freshwater Research** 66: 1027-1036.

Berquist, RM, VL Galinsky, SM Kajiura, & LR Frank. 2015. The coelacanth rostral organ is a unique low-resolution electro-detector that facilitates the feeding strike. **Scientific Reports,** 5: 8962.

Bedore, CN, LL Harris & SM Kajiura. 2014. Behavioral responses of batoid elasmobranchs to prey-simulating electric fields are correlated to peripheral sensory morphology and ecology. **Zoology** 117: 95-103. (with cover)

D. Selected Other Relevant Publications (5 graduate student publications)

Macesic, LJ & SM Kajiura. 2014. Pelvic girdle shape predicts locomotion and phylogeny in batoids. **Journal of Morphology**, 275: 100-110.

McCutcheon, SM & SM Kajiura. 2013. Electrochemical properties of lanthanide metals in relation to their application as shark repellents. **Fisheries Research** 147: 47-54.

Meredith, TL, & SM Kajiura. 2010. Olfactory morphology and physiology of elasmobranchs. **Journal of Experimental Biology** 213: 3449-3456.

McComb, DM, TC Tricas & SM Kajiura. 2009. Enhanced visual fields in hammerhead sharks. **Journal of**

Experimental Biology 212: 4010-4018.

McGowan, DW & SM Kajiura. 2009. Electroreception in the euryhaline stingray, *Dasyatis sabina*. **Journal of Experimental Biology** 212: 1544-1552.

E. Synergistic Activities (past 5 years)

Supervised 6 PhD students, 5 MS thesis students, 3 non-thesis MS students, 2 post-doctoral researchers, 10 undergraduate DIS students. Served on 10 MS committees, 5 PhD committees. Presented 22 invited seminars, 9 conference presentations, 26 co-authored conference presentations. Peer-reviewed 61 journal manuscripts, invited to participate in 4 scientific workshops, have 1 patent pending

F. External Grants Awarded (past 5 years)

Florida Sea Grant $199,998 2016-2018
Novel application of galvanic fields to reduce shark bycatch in various fisheries

Colgan Family Foundation $144,000 2014-2017
Quantification of massive seasonal shark aggregations in Palm Beach county

Florida Institute of Oceanography $10,300 2014
A survey of Florida elasmobranch fishes

Florida Institute of Oceanography $20,600 2013
A survey of Florida elasmobranch fishes

Stratus Consulting $153,788 2012-2015
Impact of oil-laden water on marine apex predators

Southeast National Marine Renewable Energy Center $39,995 2012-2013
Seasonal abundance of coastal marine vertebrates in Palm Beach county waters

NMFS Bycatch Reduction Consortium $10,000 2011-2012
Supplement to: Efficacy of electropositive metals to reduce shark bycatch in longline fisheries

Petroleum Geo-Services $291,695 2010-2012
Assessment of shark attraction to underwater towed arrays

H. Community Engagement or Out-reach (past 5 years)

Provided on-camera appearances or technical consultation for 11 television documentaries. Provided interviews for numerous print and online media outlets locally, nationally, and internationally.

CURRICULUM VITA MARGUERITE KOCH-ROSE
Florida Atlantic University; Department of Biological Sciences
Aquatic Plant Ecology Laboratory (APEL)
777 Glades Road, Boca Raton, FL 33431-0991
Phone: (561) 297-3325; Fax: (561) 297-2749; email: mkoch@fau.edu
http://www.science.fau.edu/biology/koch/
https://www.facebook.com/FauAquaticPlantEcologyLab

A. Professional Preparation

Ph. D., Marine Biology and Fisheries, 1996. Rosenstiel School of Marine and Atmospheric Sciences, University of Miami, Miami, Florida.
Graduate Exchange Scholar, 1988-1989. Geography Department, University of Exeter, Exeter, England.
M.S., Marine Sciences, 1988. Marine Sciences Department, Center for Wetland Resources, Louisiana State University, Baton Rouge, Louisiana.
Marine/Estuarine Ecology and Fisheries, 1985. University of Washington, Seattle, WA.
Coral reef ecology, 1983. West Indies Laboratory, Fairleigh Dickinson University, St. Croix, West Indies.
B.S., Biology, 1981. Biology Department, Tulane University, New Orleans, LA.

B. Appointments

C. 2008-present **Professor:** Biological Sciences Department, Florida Atlantic University, Boca Raton, FL.
D. 2001-2008 **Associate Professor:** Biological Sciences Department, Florida Atlantic University, Boca Raton, FL.
E. 1996-2000 **Assistant Professor:** Biological Sciences Department, Florida Atlantic University, Boca Raton, FL.
F. 1993-1996 **Research Associate:** Rosenstiel School of Marine and Atmospheric Sciences (RSMAS), University of Miami, Miami, FL.
G. 1989-1992 **Senior Research Scientist:** Everglades Systems Research Division, Research Department, South Florida Water Management District, West Palm Beach, FL.
H. 1988-1989 **Research Associate:** University of Exeter, England.
I. 1985-1988 **Research Assistant:** Center for Wetland Resources, Louisiana State University, Baton Rouge, LA.
J. 1985 **Research Assistant:** University of Washington, Seattle, WA.
K. 1984 **Biologist:** National Marine Fisheries Service, Bering Sea, AK.

C. Selected Peer-Reviewed Publications

Strazisar, T., **Koch**, M., Madden, C. (2016) The importance of recurrent reproductive events for *Ruppia maritima* seed bank viability in a highly variable estuary: the Everglades-Florida Bay ecotone. Journal of Aquatic Botany. DOI: 10.1016/j.aquabot.2016.07.005

Hofmann, L.C., **Koch**, M.S., de Beer, D. (2016) Evidence for biotic control of diffusive boundary layer pH and active Ca^{2+} flux mechanisms in a tropical crustose coralline alga. PLOS ONE. DOI: 10.1371/journal.pone.0159057

Bedwell, H., Joles, L., **Koch**, M.S., Peach, K., Dutra, E., Manfrino, C. (2016) The role of in hospite zooxanthellae photophysiology and reef chemistry on elevated pCO_2 effects in two

branching Caribbean corals: *Acropora cervicornis* and *Porites divaricata*. ICES Journal of Marine Science. DOI: 10.1093/icesjms/fsw026

Peach, K.E., **Koch**, M.S., Blackwelder, P. (2016) Effects of elevated pCO_2 and irradiance on growth, photosynthesis and calcification in *Halimeda discoidea* Marine Ecology Progress Series 01/2016; DOI: 10.3354/meps11591.

Dutra, E., **Koch**, M., Peach, K., Manfrino, C. (2015) Tropical crustose coralline algal individual and community responses to elevated pCO_2 under high and low irradiance. ICES Journal of Marine Science; doi:10.1093/icesjms/fsv213.

Koch, M.S., C. Coronado, M.W. Miller, D.T. Rudnick, E. Stabenau, R.B. Halley, F.H. Sklar (2014) Climate Change Projected Effects on Coastal Foundation Communities of the Greater Everglades using a 2060 Scenario: Need for a New Management Paradigm. Journal of Environmental Management. DOI: 10.1007/s00267-014-0375-y

Strazisar, T., **Koch**, M., Madden, C. Seagrass (*Ruppia maritima* L.) (2014) Life history transitions in response to salinity dynamics along the Everglades-Florida Bay ecotone Estuaries and Coasts DOI: 10.1007/s12237-014-9807-4.

Koch, M., Bowes, G., Ross, C., Zhang, Xing-Hai. (2013 electronic; 2014 print) Climate change and ocean acidification effects on seagrasses and marine macroalgae. Review paper: Global Change Biology 19, 103–132, DOI: 10.1111/j.1365-2486.2012.02791.x

Koch, M.S., Kletou, D.C., Tursi, R. (2009) Alkaline phosphatase activity of water column fractions and seagrass in a tropical carbonate estuary, Florida Bay. *Coastal Estuarine and Shelf Science*. 83: 403-413.

Koch, M.S., Schopmeyer, S.A., Nielsen, O.I., Kyhn-Hansen, C., Madden, C.J (2007) Conceptual model of seagrass die-off in Florida Bay: Links to biogeochemical processes. 350:73-88. *Journal of Experimental Marine Biology and Ecology*.

D. Synergistic Activities

Establishing Marine Botany Microsensor Lab at FAU to investigate boundary layer conditions of tropical macroalgae for Ocean Acidification research and Seagrass die-off from sulfide intrusion into meristem region of dominant tropical seagrass (*Thalassia*). Developing seagrass ecosystem model with colleagues at South Florida Water Management District to define water regulation schedules to Florida Bay.

F. Collaborators and Other Affiliations

Collaborating with the Central Caribbean Research Center (CCMI) to develop their global change and ocean acidification coral reef research program.

G. Courses Taught

Undergraduate: Ecology, Marine Botany *Graduate*: Climate Change, Marine Ecosystem Management, Coastal Plant Ecology

H. Community Engagement or Out-reach

Actively giving oral presentations and seminars to local community organizations and educational institutions on Climate Change and Ocean Acidification to promote a greater awareness of this topic. Developed strong outreach and education program on Ocean Acidification at local Nature Center as part of broader impacts on current NSF-OA research program.

Susan E. Laramore

Harbor Branch Oceanographic Institute at Florida Atlantic University, Fort Pierce, FL
phone: (772)-242-2252 email: slaramo1@.fau.edu

Education:

Ph.D.	2006	Marine and Molecular Biology, Florida Tech
M.S.	1994	Cell Biology, Southern Illinois University
B.A.	1980	Biology, Southern Illinois University
A.S.	1978	Liberal Arts, Southwestern Illinois Community College

Professional Experience: Dates, Organization, Position

1/1/08-present	Florida Atlantic University	Asst. Research Prof.
1/1/06-1/1/08	Harbor Branch Oceanographic Inst.	Senior Research Assoc.
1/1/03-1/1/06	Harbor Branch Oceanographic Inst.	Research Assoc.
9/1/97-1/1/03	Harbor Branch Oceanographic Inst.	Research Asst. II & III
8/15/94 - 9/1/97	West Washington Co. School Dist.	Biology Instructor
6/1990 - 8/1992	Jewish Hospital	Research Asst.

Select Research, Teaching and Related Activities:

RESEARCH (past 5 years):

1 – Application of triploidy to an emergent oyster aquaculture industry on the west coast of Florida. UF-Fed Flow Thru (NOAA Sea Grant). 2/1/2016-1/31/2018. L. Sturmer, S. Laramore, C. Adams & C. Sims. $58.5 K (FAU total) of ~$200,000.

2 - Prototype Integrated Multi-Trophic Aquaculture System for Land-Based aquaculture: Fed component – sea urchins and other echinoderms, FL State License Plate (FL SLP), 7/1/15-6/30/16, S. Laramore & M. Riche. $33,333.

3 – Supplement: Comparative benchmarking of growth, survival & feed conversion efficiencies of *Litopenaeus vannamei* fed diets of varying nutritional composition in individual & group clear water culture systems. Private Industry. 1/1/2016-12/31/2017. S. Laramore. $98 K.

4 – Supplement: The Development of Controlled Individual Disease Challenge Systems for the Evaluation of the Relative Susceptibility of Shrimp to Viral & Bacterial Pathogens. Private Industry. 9/28/2015-9/27/2016. S. Laramore & P. McCarthy. $22K.

5 – The Development of Controlled Individual Disease Challenge Systems for the Evaluation of the Relative Susceptibility of Shrimp to Viral & Bacterial Pathogens. Private Industry. 2/1/2015-1/31/2016. S. Laramore & P. McCarthy. $52K

6- Reproductive patterns of cultured and wild SRV clams (*Macrocallista nimbosa)* in FL west coast waters, FL Aquaculture Research Council (FL ARC), 7/1/15-6/30/16. S. Laramore & L. Sturmer $43,465;

7 – Comparative benchmarking of growth, survival & feed conversion efficiencies of *Litopenaeus vannamei* fed diets of varying nutritional composition in individual & group clear water culture systems. Private Industry. 2/1/2015-1/31/2016. S. Laramore. $63K.

8 – Reproductive patterns & nutritional status of cultured & wild sunray venus clams. FL AQUA specialty License Plate Fund. 10/2014-6/2015. S. Laramore & L. Sturmer. $35K.

9 - An Initiative to Design and Demonstrate a Prototype Integrated Multi-Trophic Aquaculture System for Sustainable Land-Based Aquaculture: Incorporation of biofloc culture and fresh

seaweed to increase production of the white shrimp, *Litopenaeus vannamei*. FL AQUA Specialty License Plate Fund. 10/2014-6/2015. S. Laramore. $33K.
10 - Increasing Shrimp Production in Florida by Establishing Environmental Mineral Guidelines for Low-Salinity Shrimp Culture Operations. FL-ARC July 2014-June 2015.S. Laramore. $66 K.
11 – Experimental Challenge of Tilapia with S. agalactiae biotype 2. Private Industry. March 2014-Sept 2014. S. Laramore, P. Wills, P. McCarthy. $38K.
12-An Initiative to Design and Demonstrate a Prototype IMTA System for Sustainable Land-Based Aquaculture: Incorporation of ex-situ biofloc and seaweed into shrimp diets. FL AQUA Specialty License Plate Fund. July 2013-June 2014. S. Laramore. $46K;
13 – Aquaculture in Action: Enhancing the Teach Aquaculture Curriculum for the Novice Teacher. FL-ARC July 2012-June 2013. A. Garr, S. Laramore, C. Ohs, B. Myers.
14- An Initiative to Design and Demonstrate a Prototype IMTA System for Sustainable Land-Based Aquaculture: Fed Biofloc Component. FL AQUA Specialty License Plate Fund. July 2011-March 2013. S. Laramore. $60K;
15-The Impact of Crude Oil and the Corexit Dispersant on Three Key Gulf of Mexico Invertebrate Species. Florida Institute of Oceanography/BP. August 2010-December 2012. S. Laramore and A. Garr. $104K;
16 - The Deepwater Horizon Oil Spill: Assessing Impacts on a Critical Habitat, Oyster Reefs and Associated Species in Florida Gulf Estuaries. FIO/BP. August 2010-December 2012. C.E. Proffitt, S. Geiger, D Kimbro, L. Coen, G. Tolley, J. Weinstein and S.E. Laramore. $316K;
17 –Immunity Study in Shrimp following Injection with dsRNA. Private Industry. May-July 2011. S. Laramore $10.5K

TEACHING:
Aquaculture Center for Training, Education, and Demonstration, Instructor (1998-present): Biosecurity, Fish Health Management, Aquatic Animal Health Laboratory tours and services
Indian River State College, Adjunct Instructor (1998-Present): Introduction to Aquaculture, Aquatic Animal Health Management, Hydroponics, Molluscan Culture, Crustacean Culture.

RELATED ACTIVITIES:
Mentoring of 7 Link summer interns; Supervision of 2 thesis and membership on 5 total graduate student committees.

SELECT PUBLICATIONS (Peer reviewed):
1) Laramore, S., Krebs, W., and Garr, A. 2016. Effects of exposure of pink shrimp, *Farfantepenaeus duorarum*, larvae to Macondo Canyon 252 crude oil and Corexit dispersant. J. Mar. Sci. Eng. In press.
2) Prangell, D.I., Castro, L.F., Abdulmehdi, S. A., Browdy, C.L., Zimba, P.V., Laramore, S.E., and Samocha, T.M. 2016. Some limiting factors in super-intensive production of juvenile pacific white shrimp, *Litopeaneus vannamei*, in no water exchange, biofloc-dominated systems. J. World Aqua. In press.
3) Kumar, A., Laramore, S.**,** Prewich, A., and Sayre, R.T. 2015. Delivery of a master mix of dsRNA targeting four white spot syndrome virus (WSSV) genes provides very potent protection to shrimp against WSSV. International Journal of Marine Science and Ocean Technolology 2 (2):5-10.
4) Laramore S., Krebs W. and Garr, A. 2014. Effects of Macondo Canyon 252 oil (naturally and

chemically dispersed) on larval *Crassostrea virginica* (GMELIN, 1791). J. Shellfish Res. 33 (3): 709-718.
5) Garr A, Laramore S and Krebs W. 2014. Toxic Effects of Oil and Dispersant on Marine Microalgae. Bull Environ Contam Toxicol 93 (6):654-659.
6) Dungan CF, Carnegie RB, Hill KM, McCullough CB, Laramore SE, Kelly CJ, Stokes NA, and Scarpa J. 2012. Diseases of oysters *Crassostrea ariakensis* and *C. virginica* reared in ambient waters from the Choptank River, Maryland and the Indian River Lagoon, FL. Dis Aquat Org 101:173-183.
7) Kelly CJ, Laramore SE, Scarpa J, and Newell REI. 2011. Seasonal comparison of physiological adaptation and growth of suminoe (*Crassostrea ariakensis)* and eastern oysters (*Crassosstrea virginica*). J Shellfish Res 30(3):737-749.
8) Laramore S, Laramore R, Scarpa J, and Lin J. 2009. Virulence variation of white spot syndrome virus in shrimp. J Aquat Anim Health, 21:82-90.
9) Laramore, S. 2007. Susceptibility of the peppermint shrimp, *Lysmata wurdemanni*, to the white spot syndrome virus. J. Shellfish Res., 26(2): 1-5.
10) Montiel de Morales M, Laramore SE, Laramore CR, Morales F, Scarpa J. 2006. Transmision Experiemental del virus de la necrosis Hipodermica y Hematopoyetica infecciosa (IHHNV) en *Litopenaeus vannamei*: Influencia de la salinidad en la expression de la Infeccion. Ciencia, 15(3): 311-318
11) Wilson C, Scotto L, Scarpa J, Volety A, Laramore S, and Haunert D. 2005. Survey of wáter quality, oyster reproduction and oyster health in the St. Lucie Estuary. J Shellfish Res 24 (1):157-165.
12) Laramore, S., Laramore, C.R. and Scarpa, J. 2001. Effect of low salinity on growth and survival of postlarvae and juvenile *Litopenaeus vannamei*. J. World Aqua. Soc., 32:385-392.

SELECT PUBLICATIONS (Non-Peer reviewed):
1) Samocha, T., Prangnell, D., Castro, L., and Laramore, S. 2015**.** Stress-*Vibrio* dynamics during high-density zero-exchange production of white shrimp. Global Aquaculture Advocate 18(3): 18-20.
2) Laramore, S., Gordon, B., Baptiste, R., Wills, P., and Hanisak, D. 2014. Utilization of *Ulva lactuca* as a supplement or partial replacement diet in *Litopenaeus vannamei* production. Global Aquaculture Advocate 17 (6): 44-45.
3) Scarpa, J., Baker, S., Sturmer, L., Laramore, S**.,** El-Wazzan, E., Hoover, E., and Weber, K. 2009. Evaluation of triploid hard clams for Florida aquaculture. Global Aquaculture Advocate 12 (2): 48-50.
4) Laramore, S. 2007. Establishing a biosecure hatchery. Hatchery International 8 (3): 32-33.
5) Laramore, S. 2004. Biosecurity practices – effective or merely window dressing. Global Aquaculture Advocate 7 (5): 60-61.
6) Laramore, S. 2003. Farming marine shrimp in freshwater, Dr. Susan Laramore says check your ionic balance first. Shrimp News International 2003: 98-101.
7) Laramore, S., Scarpa, J., and McGraw, W.M. 2003. Concentration de iones requirida para el cultivo de *Litopenaeus vannamei* en aqua dulce. Panorama Acuicola Magazine 8 (2):60-63

Scott H. Markwith, Associate Professor

Professional Preparation:
• Ph.D., Biogeography, University of Georgia, May 2007.
• M.S., Biogeography, University of Georgia, December 2001.
• B.A., Physical Geography, University of Mary Washington, May 1997.

Appointments:
• Associate Professor, Department of Geosciences and Environmental Science Program, Florida Atlantic University, August 2007 – Present.

Selected Peer Reviewed Publications:
• de Souza, J. C., da Cunha, V. P., and Markwith, S. H. 2014. Spatiotemporal Variation in Human-Wildlife Conflicts Along Highway BR262 in the Brazilian Pantanal. *Wetlands Ecology and Management* DOI: 10.1007/s11273-014-9372-4.
• Markwith, S. H., Mezza, G., Kennard, S., and Bousquin, S. 2014. Intra-Floodplain Seed Dispersal Limitation and Wetland Community Restoration. *Ecological Restoration* vol. 32, no. 3, p. 249-259.
• Markwith, S. H. 2013. Stream Restoration and Hydrochory: Seed Dispersal Variation in Restored and Degraded Reaches of the Kissimmee River, Florida. *Papers in Applied Geography* vol. 36, p. 27-36.
• Monette, D. and Markwith, S. H. 2012. Hydrochory in the Florida Everglades: Temporal and Spatial Variation in Seed Dispersal Phenology, Hydrology, and Restoration of Wetland Structure. *Ecological Restoration*, vol. 30, no. 3, p. 180-191.
• Markwith, S. H. and Leigh, D. S. 2012. Comparison of Estimated and Experimental Subaqueous Seed Transport. *Ecohydrology*, vol. 5, p. 346-350.

Selected Other Publications:
• Markwith, S. H. 2011. Biogeography and Environmental Restoration: An Opportunity in Applied Research. *Geography Compass*, vol. 8, p. 531-543.
• Markwith, S. H. 2009. Temporal Change and Disturbance in a Mixed Hardwood Forest in Blood Mountain Wilderness Area. *Florida Geographer*, vol. 40, p. 14-30.
• Markwith, S. H., Davenport, L. J., Shelton, J., Parker, K. C., Scanlon, M. J. 2009. Ichthyochory, the Suwannee Strait, and Population Divergence in *Hymenocallis coronaria*. *Florida Scientist*, vol. 72, no. 1, p. 28-36.
• Markwith, S. H and Leigh, D. S. 2008. Subaqueous Hydrochory: Open-Channel Hydraulic Modeling of Non-Buoyant Seed Movement. *Freshwater Biology*, vol. 53, no. 11, p. 2274-2286.
• Parker, K. C. and Markwith, S. H. 2007. Expanding Biogeography's Horizons with Genetic Approaches. *Geography Compass*, vol. 1, no. 3, p. 246-274.

Synergistic Activities:
• Development and oversight of FAU's Environmental Restoration Certificate program.
• Organization of the Spring 2011 1st International Forum for Environmental Issues for the Encontro Regional de Estudantes de Engenharia Ambiental - EREEAMB, Marabá, Pará, Brazil, involving FAU and Universidade do Estado do Pará.
• Session Organizer and Chair for Biogeography and Geomorphology Specialty Groups Paper Session at the Association of American Geographers Annual Meeting in Washington D.C., Session Title: Environmental Restoration Research, Spring 2010 .
• Development of TETRASAT, a program specifically designed to analyze genetic diversity and differentiation among populations with allotetraploid microsatellite data.
• Editorial board membership of both Freshwater Biology and Southeastern Naturalist.

Collaborators and Other Affiliations:

Collaborators:

• Steve Bousquin, South Florida Water Management District
• Vanessa da Cunha, Universidade Federal de Mato Grosso do Sul
• Sharon Ewe, Ecology and Environment, Inc.
• Stevee Kennard, Kaiser University
• David Leigh, University of Georgia
• Garren Mezza, Patch Market Garden
• Dean Monette, Florida Atlantic University
• Julio de Souza, Universidade Federal de Mato Grosso do Sul

Graduate Advisor:

• Kathleen C. Parker, Emeritus Professor, University of Georgia

Thesis and Dissertation Advisees (Total advised = 4 Ph.D. and 2 Master's; Committees = 2 Ph.D. and 9 Master's**):**

Ph.D.

• Dean Monette, Fall 2009 – Present
• Danielle Romais, Fall 2012 – Present
• Alana Edwards, Fall 2012 – Present
• Anthony Planas, Fall 2014 – Present

Master's

• Stevee Norman, Environmental Sciences Program, Spring 2011 – Spring 2013
• Garren Mezza, Environmental Sciences Program, Fall 2010 – Fall 2012

Courses Taught:

• Environment and Society, EVR 2017, Spring 2009, 2010, Summer 2008, 2010, 2011, 2013.
• Introduction to Physical Geography, GEO 2200, Fall 2009 – 2013, Summer 2014.
• Biogeography, GEO 4300/5305, Fall 2007, 2008, 2009, Spring 2011, 2012, 2013, 2014.
• Seminar in Geographic Methodology, GEO 6117, Fall 2008, Spring 2010.
• Environmental Restoration, EVR 6334, Spring 2008, 2009, Fall 2010 – 2014.
• Restoration Implementation and Management, EVR 6358, Spring 2013, 2014.

Community Engagement or Outreach:

• Science Olympiad Judge, Spring 2008.

Biographical Sketch

Peter John McCarthy

Harbor Branch Oceanographic Institute at Florida Atlantic University, Fort Pierce, FL
phone: (772)-242-2632 email: pmccart5@fau.edu

(a) Professional Preparation

University of Manchester, England	Biochemistry B.Sc.	1979
University of Kent, England	Microbiology Ph.D.	1983
Smith Kline Beckman, Philadelphia, PA, USA	Microbiology Post Doc	1983-1985

(b) Appointments

2014-present Associate Director for Education, Harbor Branch Oceanographic Institute at Florida Atlantic University. Fort Pierce, FL

2008-present Research Professor, Harbor Branch Oceanographic Institute at Florida Atlantic University. Fort Pierce, FL

2006-2007 Senior Scientist, Head of Microbiology, Center for Ocean Exploration, HBOI, Fort Pierce, FL.

2003-2007 Affiliate Professor, Biology Department, Florida Atlantic University

2002-2006 Associate Division Director and Head of Microbiology, HBOI, Fort Pierce, FL.

1996-2002 Group Leader, Microbiology, HBOI, Fort Pierce, FL.

1994-1996 Senior Scientist/Group Leader High Throughput Screening and Biochemistry Laboratories, HBOI, Fort Pierce, FL

1992-1994 Group Coordinator High Throughput Screening Laboratory, HBOI, Fort Pierce, FL

1988-1992 Group Coordinator, Antifungal Discovery, HBOI, Fort Pierce, FL

1985-1987 Research Consultant, HBOI/SeaPharm Project, Fort Pierce, FL

(c) Publications (From a total of 66)

Hines, H.N., P.J. McCarthy, G.F. Esteban. *The first record for the Americas of Loxodes rex, a flagship ciliate with an alleged restricted biogeography.* Microbial Ecology 71:5-8 (2016) (First published online 2015, doi:10.1007/s00248-015-0656-x)

Schaefer, A.M., J.S. Reif, E.A. Guzmàn, G.D. Bossart, P. Ottuso, J. Snyder, N. Medalie, R. Rosato, S. Han, P.A. Fair, and P.J. McCarthy. *Towards the identification, characterization and*

experimental culture of Lacazia loboi from Atlantic Bottlenose Dolphin (Tursiops truncatus). Medical Mycology. (2016, In Press).

Barbarite, G., P.J. McCarthy, H. Abeels, and A. Wright. *Frequently asked questions about Vibrio in Florida.* Publication SGEF-228 of the Florida Sea Grant College Program, UF/IFAS Extension. November 2015.

Cuvelier, M.L., E. Smith, R. Mulheron, P. McCarthy, P. Blackwelder, R. L. Vega Thurber, J.V. Lopez. *Two distinct microbial communities revealed in the sponge Cinachyrella.* Frontiers in Microbiology (2014, doi: 10.3389/fmicb.2014.00581).

Hoffmann, M., S. Monday, P.J. McCarthy, J.V. Lopez, M. Fisher, and E. Brown. *Genetic and phylogenetic evidence for horizontal gene transfer among ecologically disparate groups of marine Vibrio*. Cladistics 46-64 (2013).

Bruck, W.M., J.K. Reed and P.J. McCarthy. *The bacterial population of the Lithistid sponge Discodermia sp. as determined by cultivation and culture-independent methods*. Marine Biotechnology 14:762-773 (2012).

Brück, W.M., T.B. Brück, W.T. Self, J.K. Reed, S.S. Nitecki and P.J. McCarthy. *Comparison of the anaerobic microbiota of deep water Geodia sp. and sandy sediments in the Florida straits*. ISME Journal. 4:686-699 (2010).

Hoffmann, M., Fischer, M., Ottesen, A., McCarthy, P.J., Lopez, J.V., Brown, E.W., and Monday, S.F. *Population dynamics of Vibrio spp. associated with marine sponge microcosms*. ISME Journal. 4:1608-1612 (2010).

Bruck, W.M., S.H. Sennett, S.A. Pomponi, P. Willenz and P.J. McCarthy. *Identification of the bacterial symbiont Entotheonella sp. in the mesohyl of the marine sponge Discodermia sp*. ISME Journal. 2:335-339 (2008).

Bruck, T.B., W.M. Bruck, L.Z. Santiago-Vazquez, P.J. McCarthy and R.G. Kerr. *Diversity of the bacterial communities associated with the azooanthellate deep water octocorals Leptogorgia minimata, Icillogorgia scrammii and Swiftia exertia*. Marine Biotechnol. 9:561-576 (2007).

Olson, J.B., D.K. Harmody, A. Bej, and P.J. McCarthy. *Tsukamurella spongiae sp. nov., a novel actinomycete isolated from a deep-water marine sponge*. Int. J. Syst. Evol. Microbiol. 57(7):1478-1481 (2007).

Park, Y.C., S.P. Gunasekera, J.V. Lopez, P.J. McCarthy, and A.E. Wright. *Metabolites from the marine-derived fungus Chromocleista sp. isolated from the deep-water sediment sample collected in the Gulf of Mexico*. J. Nat. Prod. 69:580-584 (2006).

Olson J.B., and P.J. McCarthy. *Associated bacterial communities of two deep-water sponges*. Aquatic Microb. Ecol. 30:47-55 (2005).

Sfanos, K.A., C.L. Peterson, D.K. Harmody, P.J. McCarthy, S.A. Pomponi and J.V. Lopez. *A molecular systematic survey of sponge-derived marine microbes*. Systematic Appl. Microbiol. 28:242-264 (2005).

(d) Synergistic Activities

- Mentor for HBOI summer interns (1-3 students each year for the last 10 years)
- Developed "Marine Microbiology and Molecular Biology" (with Co-Instructor J.V. Lopez). FAU/HBOI one semester course which is offered in the Spring semester
- Developed "Marine Microbiology" a course for undergraduate and graduate students, FAU Summer B 2009
- President, Florida Branch of the American Society for Microbiology (Term 2001-2003)
- American Society for Microbiology, National Councilor (Term 2003-2005)
- Grant review panels for NOAA-Ocean Exploration, Illinois SeaGrant, Mississippi SeaGrant and the European Commission

(e) Graduate and Postdoctoral Sponsors:

Doctoral: Keith Gull, Ph.D. (Graduate Advisor, University of Kent, Canterbury, UK; Currently Sir William Dunn School of Pathology, Oxford University, UK)
Peter Troke, Ph.D. (Graduate Advisor, Pfizer UK, Sandwich, UK; retired)
Neil Ryder, Ph.D. (Graduate Advisor, Sandoz Research Institute, Vienna, Austria; currently Independent Consultant, Cambridge, MA)

Postdoctoral: Louis Nisbet, Ph.D.(Post-Doctoral Advisor, Smith Kline Beckman Corp, Philadelphia, PA; Currently Chief Executive, VivaNova Ltd. UK)

(f) Thesis Advisor and Postdoctoral Fellows:

Currently advising four graduate students and serving on two Graduate committees. Gabriella Barbarite, Ph.D. candidate (Major Advisor); Carlie Perricone, M.S. candidate, Florida Atlantic University (Major Advisor); David Bradshaw, Ph.D. candidate Florida Atlantic University (Major Advisor); Hunter Hines, Ph.D. candidate Bournemouth University (Co-Advisor); Stefan Vasile, Post-Doctoral Fellow; Julie Olson, Post-Doctoral Fellow; Wolfram Bruck, Post-Doctoral Fellow; Jennifer Choate, Post-Doctoral Fellow

Postdoctoral scholars sponsored: 4
Graduate students advised: 5; Committee member for 7 students

ABBREVIATED FACULTY CV
Sarah L. Milton, Ph.D.

A. Professional Preparation

Post-doctoral Fellow: Florida Atlantic University 1995-1996: Anoxia and Physiology

Ph.D.(1994), University of Miami Rosenstiel School of Marine and Atmospheric Science, Miami, Florida; Marine Biology and Fisheries (Biological Oceanography).

B.A. Biology (1988), magna cum laude, Cornell University, Ithaca, New York; Honors: With Distinction in all Subjects.

B. Appointments

2011- Associate Professor, Biological Sciences, Florida Atlantic University
2006- 2011 Assistant Professor, Biological Sciences, Florida Atlantic University
2005- Joint appointment, Assistant Professor, Dept of Biomedical Science, FAU
2005-2006 Visiting Assistant Professor, Biological Sciences, Florida Atlantic University
1996-2005 Research Assistant Professor and Adjunct Lecturer, Florida Atlantic University
1996-1997 Adjunct Lecturer, Palm Beach Community College
1995-1996 Postdoctoral Fellow, Florida Atlantic University
1994-1995 Senior Biologist, Evans Environmental and Geological Science and Management, Inc, Miami FL
1992 – 1996 Adjunct Lecturer, Florida Atlantic University

C. Selected Peer-Reviewed Publications

Nayak, Gauri*, Howard Prentice, and Sarah Milton. 2016. Lessons from Nature: signaling cascades associated with vertebrate brain anoxic survival. Experimental Physiology, in press.

Wood, Lawrence*; Brunnick, Barbara; and Milton, Sarah. 2016. Home-range and Movement Patterns of Sub-adult Hawksbill Sea Turtles in SE Florida, USA. Journal of Herpetology, in press.

Sanchez JR, Milton SL, Corbit KC, Buffenstein R. Multifactorial processes to slowing the biological clock: Insights from a comparative approach. Exp Gerontol.2015 Nov;71:27-37.

Ahles, Natasha and Milton, Sarah. Mid-Incubation Relocation and Embryonic Survival in Loggerhead Sea Turtle Eggs. J. Wildl. Mangmt. 80(3): 430-437.

Larson J, Drew KL, Folkow LP, **Milton SL**, Park TJ. 2014. No oxygen? No problem! Intrinsic brain tolerance to hypoxia in vertebrates. J Exp Biol, 217(Pt 7):1024-39.

Sifuentes-Romero, I, Merchant-Larios, M**, Milton, SL**, Moreno-Mendoza, N, Díaz-Hernández, V, and García-Gasca, A. 2013. RNAi-mediated gene silencing in a gonad organ culture to study sex determination mechanisms in sea turtle. Genes, 4(2): 293 - 305.

D. Grants

National Oceanic and Atmospheric Administration Milton (PI) 9/1/11 – 8-31/16
ECOHAB: Brevetoxin metabolism and physiology - a freshwater model of morbidity in endangered sea turtles $643,000

American Federation of Aging Research Milton (PI) 7/1/08 – 12/31/10
Methionine sulfoxide reductase A and resistance to oxidative damage in an animal model of aging without senescence $60,000

NIH – NIA Milton (PI) 8/01/09-7/31/11
Molecular mechanisms of oxidative stress resistance in an animal model of aging without senescence $213,413

Caribbean Conservation Corp Milton (PI) 6/1/10 – 5/31/11
Quantifying the energetic cost of disorientation in loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) hatchlings $15,957

Morris Animal Foundation Milton (PI) 12/1/10 – 11/30/12
Determination of Innate Immune Function in the Loggerhead (*Caretta caretta*) and Green (*Chelonia mydas*) Sea Turtle by Flow Cytometry $25,202

E. Synergistic Activities

Symposium Chair: Anatomy, Physiology, and Health. 33rd, 34th, 35th Annual Symposium on Sea Turtle Biology, 2013, 2014, 2015

Reviewer: textbooks and numerous journals

2015 Keynote speaker: Lessons from nature; brain tolerance to hypoxia in vertebrates IN The brain in hypoxia; curiosity, cause and consequence; Physiology 2015, Cardiff, Wales

2013 Univ. of Miami RSMAS: Coming Full Circle: Sea turtles to stroke research and back again. Invited talk

2012 Gordon Research Congress: Brain Energy Metabolism and Blood Flow, Colby College, ME (August 2012). Modulation of reactive oxygen species in the anoxia tolerant turtle. Invited talk

F. Collaborators and Other Affiliations

NOAA, Georgia Aquarium, Florida Fish and Wildlife Service, Mote Marine Laboratory

G. Courses Taught

Comparative Animal Physiology plus Lab (UG), Anatomy and Physiology (UG), Environmental Physiology (G), Marine Animal Physiology (G). Seminar in Marine Research (G), Seminar In Hypoxia (G). Respiratory Physiology (Med), Renal Physiology (Med)

H. Community Engagement or Out-reach

Classroom presentations on sea turtle biology: Morikami Elementary School, Boca Raton, FL, 2011.

Invited speaker Eco-Watch Lecture Series, Gumbo Limbo Nature Center, Boca Raton, FL, October 2011.

Classroom presentation (x2) on sea turtle biology and anoxia tolerance: Palmer Trinity High School, Miami, FL March, 2014

ANTON EDUARD OLEINIK

Address:
Department of Geosciences Phone: (561) 297-3297
Florida Atlantic University E-mail: aoleinik@fau.edu
777 Glades Road
Boca Raton, FL 33431-0991

Professional Preparation.
Ph.D. Purdue University, West Lafayette, IN - Geology 1998
B.S. Moscow State University, Moscow, Russia – Geology 1985

Appointments.
2006-Present **Associate Professor**
Department of Geosciences
Florida Atlantic University
1999 – 2006 **Assistant Professor**
Department of Geosciences
Florida Atlantic University
1998 – 1999 **Visiting Assistant Professor**.
Department of Geography and Geology
Florida Atlantic University
1994 **Research Geologist**
New Business Development Group, Mobil Oil, Dallas, Texas.
1992-1998 **Research Assistant** and **Teaching Assistant**
Department of Earth and Atmospheric Sciences, Purdue University.
1986-1992 **Research Scientist**
Russian Academy of Sciences Institute of Geology, Moscow, Russia

Selected Peer-Reviewed Publications.
Oleinik, A. E., Marincovich L, Jr., Barinov, K. B, and Swart, P. K., 2008. Magnitude of Middle Miocene warming in North pacific high latitudes: stable isotope evidence from *Kaheharaia* (Bivalvia, Dosiniidae). Bulletin of the Geological Survey of Japan, vol. 59 (7/8), p. 39-53.
M. G. Harasewych, Oleinik, A. E**.**, and W. J. Zinsmeister. 2009. The Cretaceous and Paleocene Pleurotomariid (Gastropoda; Vetigastropoda) fauna of Seymour Island, Antarctica. Jouranl of Paleontology Vol. 83, No 5, pp. 750-766
Oleinik, A. E., Petuch, E. J., Aley, W. C. IV., 2012. Bathyal Gastropods of Bimini Chain, Bahamas. Proceedings of the Biological Society of Washington 125(1): 19-53.
Strauss, J., Oleinik, A., Swart, P., 2014. Stable isotope profiles from subtropical marine gastropods of the family Fasciolariidae: growth histories and relationships to local environmental conditions. Marine Biology 161: 1593-1602.
Oleinik, A. E., 2014. Biodiversity and habitats of reef mollusks of families Conidae and Conlithidae (Neogastropoda) off northern Roatan Island (Honduras). Marine Biodiversity records, 7:1-6.

Selected Other Publications or Products/Grants.

2005 – 2007 National Science Foundation. "Collaborative Research: The Cold Late Oligocene Arctic Ocean and its Unique Biota", OPP-0425103, co-PI; Total funding: $145,529

Oleinik, A. E., 2010**.** Hooks and Shafts come together in a fragile giant from Antarctica. Feature Article (with my painting on the cover of the magazine) in the American Paleontologist, Vol. 18, No 2, pp. 10 - 13.

Oleinik, A. E., Comas, X., 2012. New data on the stratigraphy and depositional environments of the Anastasia Formation in southeastern Florida. Geological Society of America Annual Meeting Abstracts with Programs, 44(7), 74-2, p. 196

Chrpa, M. E., Oleinik, A.E., 2013. Morphometric analysis of Astarte borealis (Mollusca: Bivalvia) of Camden bay, Northern Alaska. 2013 GSA Annual Meeting, Denver, CO, p.108.

D'Antonio, H., Oleinik, A. E., 2013. Mollusks of the Late Pleistocene oolitic facies of the Miami limestone in the Miami Dade County, South Florida. 2013 GSA Annual Meeting, Denver, CO, p.327.

Zhang, Y. G., Affek, H., Oleinik, A., Wang, Z., Hu, P., 2013. Oligocene-Early Miocene North Pacific temperatures based on clumped isotopes in Kamchatka Bivalves. Goldschmidt 2013 Conference Abstracts, Mineralogical Magazine 77(5): 2597

Synergistic Activities

1993 – Present Reviewer for several journals in the field of specialization:
1998 - Present Associate editor of "Ruthenica" - Russian Journal of Malacology.
2000 – Present Review board of the Office of Polar Programs, National Science Foundation
2002 – Present Reviewer of the Petroleum Research Fund (research grants)
2002 - Present Reviewer for the National Geographic Society (research grants)
2009 - Present Chair of the Florida Atlantic University Diving and Boating Safety Committee.

Collaboarators and Other Affiliations.

California Academy of Sciences
Rosenstiel School of Marine and Atmospheric Sciences
American Association of Petroleum Geologists
Geological Society of America
Paleontological Research Institution
Paleontological Society of America

Courses Developed and Taught:

1998 -Present Global Environmental Issues in Earth and Atmospheric Sciences, Petroleum
Geology, Sedimentation and Stratigraphy, Global Environmental Change, Coastal and Marine Science; Geology Field Camp, Geology Field Methods; Marine Geology; History of the Earth and Life, Comparative Carbonate Sedimentology.

Bing Ouyang

Professional Preparation

Xi'an Jiaotong Univ.	Xi'an, China	B.S.	Electronic & Communication Systems	1989
University of Miami	Miami, FL	M.S.	Applied Marine Physics	1995
University of Florida	Gainesville, FL	M.S.	Computer Engineering	1996
Southern Methodist Univ.	Dallas, TX	Ph.D.	Electrical Engineering	2007

Appointments

2009-Present, Assistant Research Professor, Harbor Branch Oceanographic Institute at Florida Atlantic University

2002-2009 Algorithm Engineer, DLP Division, Texas Instruments Inc.

1996-2002 Software System Engineer, KFAB, Texas Instruments Inc.

Dr. Ouyang joined HBOI/FAU in 2009. He is one the recipients of 2013 Air Force Young Investigator Research Award. He has been PI and co-PI on multiple other grants and projects. His main research interests include compressive sensing based imaging Lidar system through the scattering medium; underwater lidar image enhancement and underwater computer vision. His 2011 SPIE paper was first reported application of compressive sensing in underwater laser imaging systems. He is also applying for a patent on Compressive Sensing based imaging Lidar. Prior to joining HBOI, Dr. Ouyang was with Texas Instruments (TI) between 1996 and 2009. In 2002, he joined TI's Digital Light Processing (DLP) group as an ASIC algorithm engineer, developing front end algorithm for DLP video processor. He was peer-elected to TI's Member Group of Technical Staff. He has four patents on video source detection and semiconductor equipment data acquisition system (US Patent 7,825,990, 7,733,424, 8,112,400 and 8,260,047).

Grants and Projects

- ONR (Expanding applicability of the compressive line sensing underwater laser imaging system),
- $100k, PI: Ouyang, Co-PIs: Dalgleish, Vuorenkoski. 5/11/2015 – 5/10/2016.
- Naval Research Lab, "Development of a Compressive Line Sensing prototype to study turbulence imaging", $60k, PI: Ouyang 12/1/2014 – 11/30/2015.
- AFOSR 2013 Young Investigator Research Award, (**Airborne Compressive Sensing Topographic**
- **Lidar**), $360k, PI: Ouyang. 3/1/2013 – 2/29/2016.
- HBOI Foundation, "Cost effective and non-intrusive larval fish enumeration and growth monitoring using light field rendering (LFR) camera and active learning based classifier", $35k, PI: Ouyang, Co-
- PIs: Wills, Dalgleish, Vuorenkoski. 10/1/2014 – 6/30/2014.
- HBOI Foundation, "Detection & characterization of fish spawning aggregations using a novel, persistent presence robotic approach", $323k, PI: Dalgleish, co-PI: Chérubin, Vuorenkoski, Ouyang and Davis. 02/01/2015 - 01/31/2016.
- DOE, "Unobtrusive Multi-static Serial LiDAR Imager (UMSLI) for Wide-area Surveillance &
- Identification of Marine Life at MHK Installations", $500k, PI: Dalgleish, Co-PI: Vuorenkoski, Ouyang. 0/1/14-9/30/16.
- NOAA, "CIOERT AUV Enhancement (application of Hybrid AUV-ROV platform, equipped with benthic imaging and near-bottom carbonate chemistry sensors, to mesophotic coral reef ecosystem studies)", $250k, PI: Dalgleish, co-PI: Pomponi, Vuorenkoski, Jiang and Ouyang. 7/1/2014-6/30/2015.
- ONR (Feasibility Study of Compressive Sensing Underwater Imaging Lidar), $103k, PI: Ouyang, Co-
- PIs: Dalgleish, Vuorenkoski. 7/1/2012 – 12/31/2013.
- ONR (Underwater Laser Imaging and Communications Research – Phase II), $2M, PI: Dalgleish, Co-
- PI: Ouyang, Vuorenkoski. 7/1/2010 - 1/31/2013

- Battelle Memorial Institute, “Bluefin Glider Research and Operations Center (Cost Amendment II: hardware modification to Spray gliders to accommodate more powerful processors, more sensor channels and acoustic modems)”, $90k, PI: Dalgleish, Co-PIs: Ouyang, Vuorenkoski. 1/1/2013 –
- 9/30/2013.
- Battelle Memorial Institute, “Bluefin Glider Research and Operations Center (Cost Amendment I: hardware modification to Spray gliders to accommodate more powerful processors, more sensor channels and acoustic modems)”, $65k, PI: Dalgleish, Co-PIs: Ouyang, Vuorenkoski. 3/1/2012 –
- 12/31/2012.
- Battelle Memorial Institute, “Bluefin Glider Research & Operations Center”, $150k, PI: Dalgleish,
- Co-PIs: Ouyang, Vuorenkoski - 04/25/2011 – 04/24/2012.
- BP GCRO via Liquid Robotics, “Gulf of Mexico Natural Oil Seepage Monitoring and Research (Cost channels and acoustic modems)”, $65k, PI: Dalgleish, Co-PIs: Ouyang, Vuorenkoski. 3/1/2012 –
- 12/31/2012.
- Battelle Memorial Institute, “Bluefin Glider Research & Operations Center”, $150k, PI: Dalgleish,
- Co-PIs: Ouyang, Vuorenkoski - 04/25/2011 – 04/24/2012.
- BP GCRO via Liquid Robotics, “Gulf of Mexico Natural Oil Seepage Monitoring and Research (Cost
- Amendment IV)”, $22k, PI: Dalgleish, Co-PI: Ouyang, Vuorenkoski. 9/1/2013 – 12/31/2013.
- BP GCRO via Liquid Robotics, “Gulf of Mexico Natural Oil Seepage Monitoring and Research (Cost
- Amendment III)”, $80k, PI: Dalgleish, Co-PI: Ouyang, Vuorenkoski. 1/1/2013 – 9/30/2013.
- BP GCRO via Liquid Robotics, “Gulf of Mexico Natural Oil Seepage Monitoring and Research (Cost
- Amendment II)”, $70k, PI: Dalgleish, Co-PI: Ouyang, Vuorenkoski. 6/1/2012 – 12/15/2012.
- BP GCRO via Liquid Robotics, “Gulf of Mexico Natural Oil Seepage Monitoring and Research (Cost
- Amendment I)”, $70k, PI: Dalgleish, Co-PI: Ouyang, Vuorenkoski. 8/15/2012 – 12/15/2012.
- BP GCRO via Liquid Robotics, “Gulf of Mexico Natural Oil Seepage Monitoring and Research (Base
- Funds: first generation payload sensor characterization/calibration, data analysis, visualization and event detection algorithm development)”.

Synergistic Activities

- Invited talk at Naval Research Lab, “Targeting Next Generation Compact UUV/UAV Imaging Systems: Compressive Sensing, Light Field Rendering and Post Processing”, Dec. 16, 2013.
- Invited talk at UF ECE CNEL Seminars, “Compressive Sensing Underwater Laser Serial Imaging System”, Feb. 6, 2013.
- Underwater Imaging and Vision session co-chair, Ocean’s 12.
- Invited Speaker at Satellite Earth Workshop PABU, Nov, 2012.
- Reviewer, Journal of Computer Vision and Image Understanding.
- Reviewer, SPIE Journal of Optical Engineering.
- Reviewer, SPIE Journal of Electronic Imaging.
- Reviewer, SPIE Journal of Applied Remote Sensing.
- Reviewer, IEEE Journal of Oceanic Engineering.
- Reviewer, Methods in Oceanography.

Publications:

Patents

- Ouyang, B., Dalgleish F., Dalgleish, A., "Mems microdisplay optical imaging and sensor systems for underwater and other scattering environments", 9,019,503, 4/28/2015.
- Dalgleish F., Dalgleish, A. Ouyang, B., "MEMS Microdisplay Optical Imaging and Sensor Systems for Underwater Scattering Environments", 8,917,395 12/23/2014.
- Ouyang, B., "System and method for determining high frequency content in an analog image source", 8,260,047 09/04/2012.
- Ouyang B., Baweja, S. G., Rigsby D. J, "Method for collecting data from semiconductor equipment", US Patent 8,112,400, 02/07/2012.
- Ouyang B., Hayden J. M., Ethridge T. L., Sundararajan A., Dickinson, L. D., "Method and apparatus for analog graphics sample clock frequency offset detection and verification", US Patent 8,111,330, 02/07/2012.
- Hayden J. M., Ouyang B., Ethridge T. L., Sundararajan A., Dickinson, L. D., "Method and apparatus for analog graphics sample clock frequency verification", US Patent 7,733,424, 06/08/2010.

Book Chapters

- Kovacs, D.M. and Ouyang, B., "Underwater Imaging: Photographic, Digital and Video Techniques" in Watson J. and Zielinski, O. eds "Subsea Optics and Imaging", Woodhead Publishing Limited, *to be published in 2013.*
- Ouyang B., "Watermarking based on unified pattern recognition framework", Ph.D Dissertation, Dec. 2007.

Peer-reviewed Journal Papers

- Ouyang B., Dalgleish F. R, Caimi F. M., Giddings T. E., Vuorenkoski A. K., Britton W. and Nootz G., "Compressive Line Sensing Underwater Imaging System", Journal of Optical Engineering, special edition on Ocean Optics, Vol. 53, Issue 5, 2014.
- Ouyang B., Dalgleish F. R., Caimi F. M., Giddings T. E., Shirron J. J., Vuorenkoski A. K., Nootz G., Britton W. and Ramos B., "Compressive Sensing Underwater Laser Serial Imaging System ", Journal of Electronic Imaging, special edition on Compressive Sensing, Vol. 22, Issue 2, 2013.
- Ouyang B., Dalgleish F. R., Vuorenkoski A., Britton W., Ramos B. and Metzger B., "Visualization for multi-static underwater LLS system using Image based Rendering", IEEE Journal of Oceanic Engineering, Vol. 38, pp. 566 – 580, 2013.
- Dalgleish F. R., Vuorenkoski A. K. and Ouyang B., "Extended Range Undersea Laser Imaging - Current Research Status and A Glimpse At Future Technologies", Journal of MTS, 2013.
- Dalgleish, F.R., Vuorenkoski, A.K, Nootz, G., Ouyang, B. and Caimi, F.M., "Environmental Performance Bounds for Undersea Pulsed Laser Serial Imagers", Submitted to Journal for Underwater Acoustics (USN), Special Edition on Electro-Optics, 2011.

Conference Papers

- Ouyang B., Hou, W., Dalgleish F. R., Caimi F. M., Vuorenkoski A. K., Gong, C., "Distributed Compressive Sensing vs. Dynamic Compressive Sensing: Improving the Compressive Line Sensing Imaging System through Their Integration", SPIE Proceedings Vol. 9459, 2015.
- Ouyang B., Hou, W., Dalgleish F. R., Caimi F. M., Vuorenkoski A. K., Gong, C., Britton, W., "Near-Infrared Compressive Line Sensing Imaging System Using Individually Addressable Laser Diode Array", SPIE Proceedings Vol. 9484, 2015.
- Ouyang B., Caimi F. M., Dalgleish F. R., Nootz G., Vuorenkoski A. K., "3D imaging using compressive line sensing serial imaging system", SPIE Proceedings Vol. 9109, 2014.
- Ouyang B., Caimi F. M., Dalgleish F. R., Vuorenkoski A. K., Hou, W., "Experimental studies of the compressive line sensing underwater serial imaging system", SPIE Proceedings Vol. 9111, 2014.

- Ouyang B., Dalgleish F. R., Giddings, T., Caimi F. M., Nootz G., Vuorenkoski A. K., (Invited talk) "Compressive Line Sensing Underwater Imaging System", 11th Intl. Mine Warfare Tech. Symp., 2014.
- Ouyang B., Caimi F. M., Dalgleish F. R., Vuorenkoski A. K., and Britton W., "(JEI Invited) Compressive sensing underwater active serial imaging systems", IS&T/SPIE Electronic Imaging 2014.
- Ouyang B., Dalgleish F. R., Vuorenkoski A. K., Caimi F. M., and Britton W., "Compressive line sensing underwater imaging system", SPIE Proceedings Vol. 8717, 2013.
- Ouyang B., Dalgleish F. R., Negahdaripour, S., Vuorenkoski A. K., Britton W. and Wang, Y.X., "Experimental Study of Underwater Stereo via Pattern Projection", IEEE/MTS Oceans'12.
- Dalgleish F. R., Ouyang B., , Vuorenkoski A. K., Metzger B., Ramos B. , and Britton W., "Extended range distributed laser serial imaging in turbid estuarine and coastal conditions", IEEE/MTS Oceans'12
- Ouyang B., Dalgleish F. R., Caimi F. M., Giddings T. E., Shirron J. J., Vuorenkoski A. K., "Image enhancement for underwater pulsed laser line scan imaging system", Proc. SPIE 8372, 2012.
- Ouyang B., Dalgleish F. R., Caimi F. M., Giddings T. E., Shirron J. J., Vuorenkoski A. K., Nootz G., Britton W. and Ramos B., "Underwater laser serial imaging using Compressive Sensing and Digital Mirror Device", Proc., SPIE 8037, 2011.
- Dalgleish, F. R., Vuorenkoski, A. K., Nootz, G., Ouyang, B., Caimi, F. M. "Experimental imaging performance evaluation for alternate configurations of undersea pulsed laser serial imagers", Proc., SPIE 8030, 2011.
- Ouyang B., Dalgleish F. R., "Underwater laser serial imaging using Compressive Sensing", Proc. Ocean Optics XX, September 27 – October 1 2010.
- Ouyang B., Dalgleish F. R., Vuorenkoski A., Britton W., Ramos B. and Metzger B., "Visualization for multi-static underwater LLS system using Image Based Rendering", IEEE/MTS Ocean'10, 2010.
- Ouyang B. and Srinath M. D., "Robust image watermarking based on affine invariant point detection and Zernike moments", 2007 IEEE BMSB'07, 2007.

Patent Applications

- US Patent Application US 14/021,822: MEMS Microdisplay Optical Imaging and Sensor Systems for Underwater Scattering Environments, Sept, 2013.
- US Patent Application 20090256829: System and Method for Detecting a Sampling Frequency of an Analog Video Signal
- US Patent Application 20100007795: System and Method for Clock Offset Detection
- US Patent Application 20100008575: System and Method for Tuning a Sampling Frequency

Biographical Sketch
Marianne E. Porter, Ph.D.
me.porter@fau.edu

Florida Atlantic University
777 Glades Rd.
Boca Raton, FL 33431

A. Professional Preparation

Institution	Major / Area	Degree	Year
– Northern Arizona University	Zoology	B.S.	2000
– Northern Arizona University	Biology	M.S.	2002
– University of California, Irvine	Biology	Ph.D.	2007
– Vassar College	Biomechanics, Bioinspired design	Post-doctoral	2008-2013

B. Academic Appointments

Institution	Position	Date
– Florida Atlantic University	Assistant Professor	2014-present
– Florida Atlantic University	Visiting Assistant Professor	2013
– University of Washington, Friday Harbor Laboratories	Visiting Lecturer	2012
– Vassar College	Visiting Assistant Professor	2009-2009
– University of California, Irvine	Lecturer	2005-2007

C. Selected Publications

Undergraduate collaborators are underlined

– **Porter, M.E**.; R.H. Ewoldt, and J.H. Long Jr. Automatic control: the vertebral column of dogfish sharks behaves as a continuously variable transmission with smoothly shifting functions. 2016. The Journal of Experimental Biology. In Press. Featured article in *Inside JEB*.

– Roberts, S.F., J. Hirokawa, H.G. Rosenblum, H. Sakhtah, A. A. Gutierrez, **M.E. Porter** and J.H. Long, Jr. 2014. Testing biological hypotheses with embodied robots: adaptations, accidents, and by-products in the evolution of vertebrates. Frontiers in Robots and AI. November. 1: 1-16.

– Porter, M.E., C. Diaz Jr., J.J. Sturm, S. Grotmol, A.P. Summers, and J.H. Long Jr. 2014. Built for speed: Strain in the cartilaginous vertebral columns of sharks. Zoology. 117: 19-27.

– Siciliano, A.M. ,J.H. Long Jr., S.M. Kajiura, and **M.E. Porter**. 2013. Are you positive? Electric dipole polarity discrimination in the yellow stingray, *Urobatis jamaicensis*. Biological Bulletin. 25: 85-91.

– Porter, M.E., C.M. Roque, and J.H. Long Jr. 2011. Body form and posture predict the performance of leopard sharks (*Triakis semifasciata*) in yaw turning. Zoology. 114: 348-359.

– Long, J.H., Jr., T.J. Koob, J.T. Schaefer, A.P. Summers, K. Bantilan, S. Grotmol, and **M.E. Porter**. 2011. Inspired by sharks: a biomimetic skeleton for the flapping, propulsive tail of an aquatic robot. Marine Technology Society Journal. 45(4): 119-129.

– Rosenblum, H.G., J.H. Long Jr, and **M.E. Porter**. 2011. Sink and swim: kinematic evidence for axial undulatory and lifting-body mechanisms in negatively-buoyant electric rays (*Narcine brasiliensis*). The Journal of Experimental Biology. 214: 2935-2948.

– Long, J.H. Jr., N. Krenitsky, S.F. Roberts, J. Hirokawa, J. deLeeuw, and **M.E. Porter**. 2011. Testing biomimetic structures in bioinspired robots. Integrative and Comparative Biology. 51 (1): 158-175.

– Flammang, B.E. and **M.E. Porter**. 2011. Bioinspiration: Applying mechanical design to experimental biology. Integrative and Comparative Biology. 51 (1): 128-132.

– Long, J.H. Jr., **M.E. Porter**, R.G. Root, and C.W. Liew. 2010. Go Reconfigure: How fish change shape as they swim and evolve. Integrative and Comparative Biology. 50 (6): 1120-1139.

Florida Atlantic University
777 Glades Rd.
Boca Raton, FL 33431

– Krishnamurthy, P., F. Khorrami, J.R. de Leeuw, **M.E. Porter**, K. Livingston, and J.H. Long Jr. 2010. An electric ray inspired biomimetic autonomous underwater vehicle. In American Control Conference, IEEE, 5224-5229.

– Porter, M.E. and J.H. Long Jr. 2010. Vertebrae in Compression: Mechanical Behavior of Arches and Centra in the Gray Smooth-hound (*Mustelus californicus*). Journal of Morphology. 271 (3): 366-375.

– Krishnamurthy, P., F. Khorrami, J.R. de Leeuw, **M.E. Porter**, K. Livingston, and J.H. Long Jr. 2009. A multi-body approach for 6DOF modeling of biomimetic autonomous underwater vehicles with simulation and experimental results. In Control Applications, (CCA) & Intelligent Control, (ISIC), IEEE, 1282-1287.

– **Porter, M.E.**, C.M. Roque, and J.H. Long Jr. 2009. Turning maneuvers in sharks: predicting body curvature from vertebral morphology. Journal of Morphology. 270: 954-965.

– Porter, M.E., T.J. Koob, and A.P. Summers. 2007. The contribution of mineral to the material properties of vertebral cartilage from the smooth-hound shark *Mustelus californicus*. The Journal of Experimental Biology. 210: 3319-3327. Featured article in *Inside JEB.*

– Porter, M.E., J.L. Beltrán, T.J. Koob, and A.P. Summers. 2006. Material properties and biochemical composition of mineralized vertebral cartilage in seven elasmobranch species (Chondrichthyes). The Journal of Experimental Biology. 209:2920-2928.

– Mueller, R.C., C.M. Scudder, **M.E. Porter**, R.T. Trotter III, C.A. Gehring, and T.G. Whitham**.** 2005. Differential tree mortality in response to severe drought: evidence for long-term vegetation shifts. Journal of Ecology. 93:1085-1093.

– Porter, M.E. and M.J.C. Kearsley. 2001. The response of Tamarix to experimental flows in Grand Canyon. Hydrology and Water Resources in Arizona and the Southwest. 31:45-50.

D. Synergistic Activities

University

2015	Member of University Graduate Council

Society

2015	Society of Integrative and Comparative Biology *ad hoc* committee assessing student outcomes and diversity within the society
2012 - 2015	Society of Integrative and Comparative Biology, Student Support Committee
2010-2012	Society of Integrative and Comparative Biology, Division of Comparative Biomechanics graduate student / postdoc representative
2011	Society of Integrative and Comparative Biology, Symposium Organizer for annual meeting, sponsored by three society divisions

Local

2015	Lecture to dual enrolled students at FAU high school
2014	Lecture to dual enrolled students at FAU high school
2011	Vassar Science Scholars Program for Poughkeepsie High School science students
2010	Vassar Science Scholars Program for Poughkeepsie High School science students
2008	Duchess County Science Fair, Judge
2007	Irvine Unified School District Science Fair, Judge Costa Mesa High School, Ask a Scientist Afternoon Irvine Unified School District, Ask a Scientist Night
2006	Irvine Unified School District Science Fair, Judge Irvine Unified School District, Ask a Scientist Night
2004	Irvine Unified School District Science Fair, Judge

Biographical Sketch
Marianne E. Porter, Ph.D.
me.porter@fau.edu

Florida Atlantic University
777 Glades Rd.
Boca Raton, FL 33431

Irvine Unified School District, Ask a Scientist Night
James Irvine Intermediate School Career Exploration Day

E. Collaborators

Thomas J. Koob, MiMedx, Tampa, FL. (co-author)
Chun Wai Liew, Lafayette College, Easton, PA. (co-author)
Robert Root, Lafayette College, Easton, PA. (co-author)
Randy Ewoldt, University of Illinois Champagne Urbana (co-author)
Sindre Grotmol (co-author)
Justin Schaefer, University of California, Irvine (co-author)
Brooke Flammang, New Jersey Institute of Science. (co-author)

Graduate and Postdoctoral Advisors

Adam P. Summers, University of California, Irvine. Ph.D. Advisor.
Matt McHenry, University of California, Irvine. Ph.D. committee member.
Timothy Bradley, University of California, Irvine. Ph.D. committee member.
Albert Bennett, University of California, Irvine. Ph.D. committee member.
John Long, Vassar College, Poughkeepsie, NY. Post-doc advisor.

F. Grants and Fellowships (since coming to FAU)

2016	HHMI and National Academies Summer Institute on Undergraduate Education in Biology Alumni Workshop; participant
2016	SICB Broadening Participation travel funds for annual meeting. $500.
2015	HHMI and National Academies Summer Institute on Undergraduate Education in Biology Alumni Workshop, participant
2014	SICB Broadening Participation travel funds for annual meeting. $500. (Declined)

Charles E. Roberts

Date of Birth: April 3, 1953
Place of Birth: Houston, Texas

Degrees:
PhD. (Geography) The Pennsylvania State University, 1992.
"Textural Analysis of Urban Thematic Mapper Data."
M.A. (Geography) The Pennsylvania State University, 1987.
"From Parkway to Freeway: Roadside Design before the Interstate, 1858-1956".
A.B. (Geography/Anthropology) Vassar College, 1983.
"Farmland Preservation in the Northeast."

Appointments:
First Year at FAU: Fall 1990
Tenured and Promoted to Associate Professor, 1996
Promoted to Associate Dean of Graduate Studies,
Charles E. Schmidt College of Science, 2011
Appointed to Interim Chair, Geosciences, Fall 2013

Selected Peer Reviewed Publications
Zhang, C., D. Selch, Z. Xie, C. Roberts, H. Cooper, and G. Chen, 2013. Object-based Benthic Habitat Mapping in the Florida Keys from Hyperspectral Imagery. *Estuarine, Coastal and Shelf Science*, 134, 88-97. (2013)
Zhang, C., Z. Xie, C. Roberts, and L. Berry, 2012 Salinity Assessment for Northeastern Florida Bay Using Landsat TM Data. Southeastern Geographer, Vol. 52, Number 3.
Delahunty, J.L, Phelps, Jack, Roberts, Charles and Sawicki, Ben, 2010 Quantification of Historical Urban Growth in a Dallas Suburb Southwestern Geographer.
Mary Beth Crile and Charles Roberts, 2009 Paleoterrain Model of the Yamato Marsh, Palm Beach County. Florida, International Geoscience and Remote Sensing Symposium Proceedings of the IEEE.
J.l.Delahunty, Charles Roberts, Gullian Breary, 2009 Arvida and the Planned Sprawl of West Boca Raton,Florida Florida Geographer,Vol. 40, 2009.
Xie, Zhou, Charles Roberts and Brian Johnson 2008 Object based target search using remotely sensed data: A case study in detecting the invasive exotic Australian Pine in south Florida. ISPRS Journal of Photogrammetry and Remote Sensing.
Edward J. Petuch and Charles E. Roberts, 2007 The Geology of the Everglades and Adjacent Areas, CRC Press; Boca Raton

Selected Other Publications or Products/Grants
2008 "Nearshore Reef Analysis and Quantification project" $58,000. Funded

Teaching Experience Undergraduate Courses: 2
Map Analysis and GIS (now online, both graduate and undergraduate versions)
Geovisualization and Geographic Information Systems
Remote Sensing of the Environment (online now, both undergraduate and graduate versions)
Digital Image Analysis (online now, both undergraduate and graduate versions)
Introductory Physical Geography, emphasizing water resource issues
Field methods in the Mapping Sciences
Geography Field Camp
Regional Geography of U.S. and Canada
Urban Geography (online now)

American Cultural Landscapes (online now)
Human-Environmental Interactions in south Florida
Art, Architecture and Environment: The Cultural Landscape of Venice
Graduate Courses:
Cultural Geography Seminar, Field Camp,Advanced Remote Sensing, Research in the Geoscience
Human-Environmental Interactions. Historical Preservation

Synergistic Activity
Department Level
GIS Lab and Center Director, 1992-1996, 2006-2011
Graduate Program Chair 1991-1999
Graduate Program Coordinator 2006-2011
Undergraduate curriculum chair, 1991-1997,2001-2006
Graduate curriculum chair 1991-1999,2006-2011
Chair, College of Science graduate programs committee, 2006-2013
Science representative of the University Graduate Programs committee, 2006-2013

Contributions to New Program Creation and Implementation
Development of a PSM in GIS (in process)
Development of an MS in Coastal and Marine Science (in process)
Updated the Environmental Science MS degree, University
Environmental Certificate, Biology
GIS certificate, Geography
Advanced GIS certificate, Geoscience
Medical Physics Minor, Physics
PSM in Medical Physics, Physics
PSM in Business Biotechnology, Biology-Business College
Neuroscience Graduate Certificate, Complex Systems program
Geoscience PhD , Geosciences
College Level Committee Membership
Public Intellectuals PhD committee, Arts and Humanities, 1999
Graduate Environmental Certificate committee, Arts and Humanities, 1999
Graduate curriculum committee chair, 2006-2008, College of Science
Undergraduate curriculum committee, 2001-2006, College of Science
Environmental Science MS degree (college wide) curriculum chair
Strategic Planning Committee, 2011-2012
University Level Committee Membership
Member and Chair University, Environmental Affairs Committee, 1992-1996 3
Science representative , University Graduate Council, 2006-present
Science representative, University Graduate Programs Council, 2006-present
Provost Committee on SACS Credentialing, 2012-2013
Provost Strategic Planning committee 2011-2012, 2012-2013
Graduate College Academic Affairs Committee, 2009-2014

CURRICULUM VITA: Michael Salmon

A. Education

Earlham College	BA	1959
University of Maryland	MS	1962
	PhD	1964
University of Hawaii	Postdoc	1965

B. Appointments

DePaul University	Biological Sciences	1965-1967
University of Illinois	Dept. of Ecology, Ethology and Evolution	1967-1990
Florida Atlantic University	Biological Sciences	1990-present

C. Research interests, support

My field is animal behavior. I work exclusively with marine animals on topics that emphasize adaptive significance and evolution. Subjects include: form and evolution of mating systems, sensory processes, biological clocks, mechanisms underlying orientation, navigation and communication, and the conservation and management of threatened and endangered species. My research is supported by personal funds and contributions from the National Save-the-Sea-Turtle Foundation of Fort Lauderdale, Florida.

D. Service, other contributions

I serve on the Research Committee of the Marinelife Center of Juno Beach, Florida. I also have a volunteer appointment as Science Editor for *Environmental Outreach*, published by the Foundation, and am a frequent contributor of articles written for the general public. I have also encouraged the Foundation to provide scholarships for our graduate students at both the Masters and PhD level.

E. Publications, last 5 years

*Mott, C.M & Salmon, M. 2011. Sun compass orientation by juvenile green sea turtles (*Chelonia mydas*). Chelonian Conservation and Biology 10:73-81.

*Young, M., Salmon, M., & Forward, R. 2012. Visual wavelength discrimination by the loggerhead turtle, *Caretta caretta*. Biological Bulletin (Woods Hole) 222:46-55.

Salmon, M., Carthy, R.R., Lohmann, C.M.F., Lohmann, K.J., & Wyneken, J. 2012. Collecting a sample of loggerhead sea turtle hatchlings before a natural emergence does not reduce nest productivity. Endangered Species Research 16:295-299.

Salmon, M. & *Scholl, J. 2014. Allometric growth in juvenile marine turtles: possible role as an antipredatory adaptation. Zoology 117:131-138.

*Reintsma, N., *Young, M., & Salmon, M. 2014. Do lighthouses disrupt the orientation of sea turtle hatchlings? Hypothesis testing with arena assays at Hillsboro Beach, Florida, U.S.A. Marine Turtle Newsletter 140:1-3.

Salmon, M. & M. *Reising. 2014. (Commentary) Emergence rhythms of marine turtles: Is a time sense involved? Chelonian Conservation and Biology 13:282-285.

*Stadler, M., Salmon, M., & Roberts, C. 2015. Ecological correlates of green turtle **(***Chelonia mydas***)** abundance on the nearshore worm reefs of southeastern Florida. J. Coastal Research 31(2):244–254.

Salmon, M., Higgins, B., Stewart, J. & Wyneken, J. 2015. The ontogeny of morphological defenses in Kemp's ridley (*Lepidochelys kempii*) and loggerhead (*Caretta caretta*) sea turtles. J. Morphology 276:929–940.

*Reising, M., Salmon, M, & Stapleton, S. 2015. Hawksbill nest site selection affects hatchling survival at a rookery in Antigua, W.I. Endangered Species Research 29: 179–187.

*Kedzuf, S. & Salmon, M. 2016. Do marine turtles use odors to locate foraging hotspots in the open ocean? Chelonian Conservation and Biology 15: 90–101.

Salmon, M., *Reising, M., & Stapleton, S. 2016. The evolution of hatchling morphology. Marine Turtle Newsletter 149:9-12.

*student publication

JAMES M. SULLIVAN

Florida Atlantic University - Harbor Branch Oceanographic Institute
5600 US 1 North, Fort Pierce, FL 34946
e-mail: jsullivan@fau.edu; office phone: 772-242-2404; cell phone: 401-290-7156
http://www.fau.edu/hboi/meh/phytoplankton.php

PROFESSIONAL PREPARATION

Ph.D.	Biological Oceanography, *University of Rhode Island*	2000
M.S.	Biological Oceanography, *University of Rhode Island*	1993

APPOINTMENTS

Full Research Professor, *Florida Atlantic University*	2015-present
Senior Oceanographer, *WET Labs, Inc.*	2008-2015
Faculty, Marine Research Scientist, *University of Rhode Island*	2005-2015
Marine Research Specialist, *University of Rhode Island*	1998-2005

Ph.D. and M.S. Advisor: Elijah Swift (University of Rhode Island)

RESEARCH INTERESTS

Understanding the biological and physical mechanisms that control the spatial-temporal distribution of phytoplankton populations and optical fine-structure in coastal oceans; Harmful Algal Bloom ecology; ocean optics, remote sensing and sources of optical backscattering; biophysical responses of phytoplankton to small-scale turbulence and shear; bioluminescence physiology of dinoflagellates; oceanographic instrument development and autonomous sampling platforms.

GRANTS AND CONTRACT AWARDS

"Layered Organization in the Coastal Ocean: 4-D Assessment of Phytoplankton Thin Layer Structure, Dynamics and Impacts." ONR Departmental Research Initiative - Biology, 10/01/05-9/31/10: **$2300K** (URI-GSO).

"In-situ quantification of the impact of episodic enhanced turbulent events on large phytoplankton." ONR, Biology, 10/01/09-9/31/11: **$502K** (URI-GSO).

"The Backscattering Enigma in Natural Waters." ONR Optics-Biology Core, 10/01/04-9/30/06: **$225K** (WET Labs).

"Blue water optical studies in support of Rhode Island private industry, URI academics, RI Public Schools and the U. S. Navy." RI Endeavor Program, 2006: **$75K** (URI-GSO).

"An examination of phytoplankton biodiversity, physiology and optical characteristics from coastal to open ocean ecosystems: implications to remote sensing,

biogeochemical cycles and environmental change." RI Endeavor Program, 2007: **$128K** (URI-GSO).

"In-situ Validation of the Source of Thin Layers Detected by NOAA Airborne Fish Lidar." ONR, Biology, 10/01/10-9/31/12: **$360K** (URI-GSO).

"Biological Response to the Dynamic Spectral-Polarized Underwater Light Field." M. Cummings (UT), project lead; ONR Multi-University Research Initiative, 06/09 – 05/15: **$1017K** (URI).

"Resolving Optical Property Dynamics in the Surfzone with Eulerian and Lagrangian Platforms." ONR Optics and Biology, 10/09-10/12: **$95K** (WET Labs).

"An in-situ holographic camera for characterizing optically relevant particles (HOLOCAM)." NOPP (admin by ONR), 08/09-08/13: **$1566K** (WET Labs).

"BCSA tracer dispersion study." Geosyntec Consultants, 06/10-12/11: **$180K** (WET Labs).

"Performance Prediction for Shallow Water Electro-Optical Remote Sensing." ONR Coastal Geophysics, 05/11-09/13: **$233K** (WET Labs).

"Development of novel detection and prediction algorithms for Microcystis blooms." T. Moore (UNH), PI. NIH and NSF joint project, 11/12-10/15: **$344K** (WET Labs).

"Wide-Angle-Scattering Inversion to Detect Oil in Water (WINDOW)." US Coast Guard, Phases I and II, 03/12-01/14: **$254K** (WET Labs).

"Oceanographic Sensor and Visibility Algorithm LT Feasibility Study Support (TOPGATE)." Naval Underwater Warfare Center through Wyle and SeaCORP acting as Prime Defense Contractors, Phases I and II, 12/12-08/14: **$275K** (WET Labs).

"Polarized volume scattering function measurements and analysis in support of the August 2014 joint OBB cruise." NASA Ocean Biology and Biogeochemistry: 01/14-12/14: **$57K** (WET Labs).

"Development and Testing of Major New Instrumentation for High Accuracy Measurement of Backscattering-bb and Total Scattering-b in Natural Waters." Ed Fry (TAMU), PI. NSF OTIC, 03/14 - 03/17: **$529K** (WET Labs).

"Surface drifter buoy transponder repeater." Naval Underwater Warfare Center through SeaCORP acting as Prime Defense Contractor, 03/14 - 06/14: **$40K** (WET Labs).

"Transitioning state-of-the-art nutrient sensing technology to develop an operational nutrient observatory for NERACOOS." NOAA/IOOS, 9/14 - 8/17: **$750K** (WET Labs).

"Effects of natural, undisturbed particle fields on light transmission and dispersion in coastal waters." ONR Coastal Geophysics, 10/14-09/16: **$330K** (WET Labs).

"Improving retrieval of IOPs from ocean color remote sensing through explicit consideration of the volume scattering function" NASA, 10/14 - 9/16: **$331K** (HBOI).

"Improving IOP measurement uncertainties for PACE ocean color remote sensing applications." NASA, 10/15 - 9/17: **$436K** (HBOI).

"Assessing the Impacts of HAB Toxins on Dolphins." FAU-HBOI SLP, 1/16 – 12/16: **$35K** (HBOI)

TOTAL AWARDED TO DATE: > **$10M**

JAMES M. SULLIVAN

INVITED PARTICIPANT

ONR BIOWATT Bioluminescence Data Workshop -1989, Lamont-Doherty Geological Observatory, Palisades NY

ONR Marine Light in the Mixed Layer (MLML) Planning Meeting - 1990, Lamont-Doherty Geological Observatory, Palisades NY

ONR Marine Light in the Mixed Layer (MLML) Data Workshop - 1992, Lamont-Doherty Geological Observatory, Palisades NY

ONR Marine Light in the Mixed Layer (MLML) Data Workshop - 1993, Lamont-Doherty Geological Observatory, Palisades NY

International Council for the Exploration of the Sea **(**ICES), ICES International Symposium - 1997, Baltimore, MD

ONR Workshop on Planktonic Thin Layers – 1997, Corvallis, OR

ONR Workshop on Planktonic Thin Layers – 1999, Narragansett, RI

ONR Workshop on Critical Scales – 2002, Narragansett, RI

GEOHAB Workshop on detection technology for Harmful Algal Blooms, Invited Lecturer – 2004, Galway, Ireland

ONR Layered Organization in the Coastal Ocean (LOCO) Planning Meeting – 2005, La Jolla, CA

ONR Layered Organization in the Coastal Ocean (LOCO) Science Meeting – 2006, La Jolla, CA

ONR LOCO Data Workshop – 2008, Orlando, FL

NOPP Holographic camera for characterizing aquatic particles Workshop, Convener - 2009, Narragansett, RI

NOPP Holographic camera for characterizing aquatic particles Workshop, Convener - 2010, Baltimore, MD

ONR MURI Biological Camouflage Response to the Dynamic Spectral-Polarized Underwater Light Field Workshop – 2010, San Deigo, CA.

ONR MURI Biological Camouflage Response to the Dynamic Spectral-Polarized Underwater Light Field Workshop – 2011, Austin, TX.

GEOHAB Science Meeting: Understanding harmful algae in stratified systems, Plenary Speaker - 2012, Moss Landing, CA

SPIE Ocean Sensing and Monitoring, Invited Speaker – 2012, Baltimore, MD.

NASA Interdisciplinary Science proposal review panel – 2013, Washington, D.C.

ONR MURI Biological Camouflage Response to the Dynamic Spectral-Polarized Underwater Light Field, ONR Review – 2013, Chapel Hill, NC

NIH Oceans and Human Health Grantee Meeting, Scripps – 2014, La Jolla, CA.

NASA Workshop on Particulate Absorption – 2014, Baltimore, MD.

ONR MURI Biological Camouflage Response to the Dynamic Spectral-Polarized Underwater Light Field, ONR Review – 2014, Washington, DC

IOCCG/TOS Workshop on NASA Ocean Optics Protocols, Plenary Speaker - 2014, Portland, ME.

NASA Workshop to revise optical backscattering protocols – 2014/2015. Invited by NASA to lead workshop and protocol revisions, March - 2015, Austin, TX.

JAMES M. SULLIVAN

MENTORING

Post-Doctoral Researchers – Aditya Nayak (FAU-HBOI, 2015 – present), Malcolm McFarland (FAU-HBOI, 2015 – present).
M.S. and Ph.D. Researchers - Yaqin Li (URI, 1990-1995), Scott Freeman (URI, 2004-2006), Jason Graff (URI, 2006-2007), Zhankun Wang (Ph.D. outside committee member, U Mass, 2007), Malcolm McFarland (URI, 2009-2014).
Undergraduate Student Advisor - Summer Undergraduate Research Fellowships in Oceanography (URI-GSO SURFO Program) - Lauren Wilkinson (2000), Shannon Donovan (1994), Patrick Forster (1991).
Host Researcher - "Teacher-at-Sea" program coordinated by the URI Office of Marine Programs (2005 and 2006).

LECTURES AND TEACHING

Phytoplankton Physiology course, Guest Lecturer – 2003, Elijah Swift lead lecturer, University of Rhode Island, Narragansett, RI.
Ocean Optics Conference XVIII – 2006; Short-course on "Observational Approaches in Ocean Optics," Montreal, Canada.
Invited Seminar - 2006, University of Massachusetts, Dartmouth, MA.
Invited Seminar - 2006, University of Connecticut, Avery Point, CT.
Phytoplankton Ecology course, Guest Lecturer – 2009, Ted Smayda lead lecturer, University of Rhode Island, Narragansett, RI.
Ocean Optics Conference XX – 2010; Short-course on "Observational Approaches in Ocean Optics," Anchorage, Alaska.
Plenary Lecturer, GEOHAB science meeting - 2012, MBARI, Moss Landing, CA
Invited Speaker - 2012, SPIE Ocean Sensing and Monitoring, Baltimore, MD.
Ocean Optics Conference XXI – 2012; Short-course on "Observational Approaches in Ocean Optics," Glasgow, Scotland.
Plenary Lecturer, Ocean Optics Protocols meeting - Ocean Optics Conference XXII – 2014, Portland, ME
Plenary Lecturer and Chair, NASA VSF Protocols meeting - 2015, Austin, TX

PROFESSIONAL AWARDS AND ACTIVITIES

Collici Award for Ocean Engineering, URI-GSO 1994.
Managing Editor, *Continental Shelf Research* special issue on Planktonic Thin Layers and the LOCO Project (2009-2010)
Lead Author/Editor, Revisions to NASA VSF and backscattering protocols for Ocean Optics (current)
Member, NASA PACE Science Team (current)

OCEAN-GOING EXPERIENCE (MULTI-DAY CRUISES)

07/87 Sargasso Sea, Atlantic Ocean ONR: BIOWATT Project

08/88	Sargasso Sea, Atlantic Ocean	ONR: BIOWATT Project
07/91	Iceland, NW Atlantic	ONR:MLML Project
05/92	Iceland, NW Atlantic	ONR:MLML Project
06/95	East Sound and Puget Sound, WA	ONR: Thin Layers Project
05/96	East Sound and Puget Sound, WA	ONR: Thin Layers Project
07/96	East Sound and Puget Sound, WA	ONR: Thin Layers Project
09/96	East Sound and Puget Sound, WA	NSF: Holocamera Project
03/97	Georges Bank, NW Atlantic	NSF GLOBEC: Zooplankton Patch Project
04/97	Georges Bank, NW Atlantic	NSF GLOBEC: Zooplankton Patch Project
06/98	East Sound and Puget Sound, WA	ONR: Thin Layers Project
09/98	East Sound and Puget Sound, WA	NOPP: Autonomous Winch Project
08/00	East Sound and Puget Sound, WA	NOPP: Autonomous Winch Project
09/01	Northern Gulf of Mexico	NOPP: Autonomous Winch Project
06/02	Corpus Christi, TX	ONR: Critical Scales Project
08/02	Monterey Bay, CA	ONR: Critical Scales Project
06/03	East Sound and Puget Sound, WA	ONR: Critical Scales Project
07/04	Western Ireland	GEOHAB
08/05	Monterey Bay, CA	ONR LOCO Project
08/06	Monterey Bay, CA	ONR LOCO Project
10/06	Northwest Atlantic	Endeavor Program
07/08	New York Bight, NY	NASA: Ocean color validation
05/10	East Sound, WA	NOPP: HOLOCAM
01/11	Keys Marine Lab, FL	ONR MURI: biological camouflage
08/11	Keys Marine Lab, FL	ONR MURI: biological camouflage
07/12	Curacao	ONR MURI: biological camouflage
08/13	Western Lake Erie	NSF/NIH: HABs
09/13	East Sound, WA	NOPP: HOLOCAM
06/14	Keys Marine Lab, FL	NUWC: TOPGATE
08/14	Western Lake Erie	NSF/NIH: HABs
09/15	East Sound, WA	ONR: ORIENTATION

PUBLICATIONS: PEER-REVIEWED (reverse chronological)

Brady, P., A. Gilerson, G. Kattawar, J. M. **Sullivan**, M. Twardowski, H. Dierssen, M. Gao, K. Travis, R. I. Etheredge, C. Carrizo, Y. Gu, B. Russel, S. Zhao & M. Cummings (2015). Open ocean fish are camouflaged in polarized light. Science (*accepted*).

Gu, Y., C. Carrizo, A. A. Gilerson, P. Brady, M. E. Cummings, M. S. Twardowski, J. M. **Sullivan**, A. I. Ibrahim & G. W. Kattawar. (2015). Polarimetric imaging and retrieval of target polarization characteristics in underwater environment. Applied Optics (*submitted*).

Sun, B., G. W. Kattawar, P. Yang, M. S. Twardowski & J. M. **Sullivan** (2015). Simulation of the optical properties of a chain-forming triangular prism oceanic diatom. J. Quant. Spectro. & Rad. Trans. (*submitted*).

Churnside, J. H., R. D. Marchbanks, P. L. Donaghay, J. M. **Sullivan** & W. M. Graham (2015). Hollow aggregations of moon jellyfish (*Aurelia spp.*). J. Plankton Res. (*accepted*).

McFarland, M. N., J. E. B. Rines, J. M. **Sullivan** & P. L. Donaghay (2015). Impact of phytoplankton size and physiology on particulate optical properties determined with scanning flow cytometry. Mar. Ecol. Progr. Ser. (*submitted*)

McFarland, M. N., J. E. B. Rines, P. L. Donaghay, & J. M. **Sullivan**. (2015). Optical signatures of marine phytoplankton communities over small scales. Mar. Ecol. Progr. Ser. (*in press*).

Zamankhan, H., J. Westrick, F. Anscombe, R. Stumpf, T. T. Wynne, J. **Sullivan**, M. Twardowski, T. Moore, & H. Choi. (2015) Sustainable Monitoring of Algal Blooms, in: *Sustainable Water Management and Technologies* (Ed. Daniel Chen), Taylor and Francis Group, Boca Raton, FL (*in press*).

Churnside, J. H., J. M. **Sullivan** & M.S. Twardowski. (2014). Lidar extinction-to-backscatter ratio of the ocean. Optics Express, 22(15): 18698-18706.

Berdalet, E., M. A. McManus, O.N. Ross, H. Burchard, F. P. Chavez, J. S. Jaffe, I. R. Jenkinson, R. Kudela, I. Lips, U. Lips, A. Lucas, D. Rivasi, M. C. Ruiz-delaTorre, J. Ryan, J. M. **Sullivan**, & H. Yamazaki (2014). Understanding harmful algae in stratified systems: Review of progress and identification of gaps in knowledge. Deep-Sea Res. II, Vol. 101:4-20, doi: 10.1016/j.dsr2.2013.09.042

Gilerson, A. A., Stepinski, J., Ibrahim, A. I., You, Y., **Sullivan**, J. M., Twardowski, M. S., & Kattawar, G. W. (2013). Benthic effects on the polarization of light in shallow waters. Applied Optics, 52(36), 8685-8705.

Lee, J. H., J. H. Churnside, R. D. Marchbanks, P. L. Donaghay & J. M. **Sullivan** (2013) - Oceanographic lidar profiles compared with estimates from *in situ* optical measurements, Applied Optics, 52(4): 786-794.

Talapatra, S., Hong, J., McFarland, M., Nayak, A.R., Zhang, C., Katz, J., **Sullivan**, J. M., Twardowski, M. S., Rines, J., & P. Donaghay (2013). Characterization of biophysical interactions in the water column using *in situ* holography. Mar. Ecol. Prog. Ser., Vol. 473: 29-51., doi: 10.3354/meps10049.

Sullivan, J. M., M. S. Twardowski, J. R. V. Zaneveld & C. Moore (2013) – Measuring optical backscattering in water. *Light Scattering Reviews 7: Radiative Transfer and Optical Properties of Atmosphere and Underlying Surface*, A.A. Kokhanovsky [Ed.], S Praxis Books, DOI 10.1007/978-3-642-21907-8_6, pp. 189-224.

Twardowski, M., X. Zhang, S. Vagle, J. **Sullivan**, S. Freeman, H. Czerski, Y. You, L. Bi, G. Kattawar. (2012). The optical volume scattering function in a surf zone inverted to derive sediment and bubble particle subpopulations. Journal of Geophysical Research, 117, C00H17, doi:10.1029/2011JC007347.

Gleason, A.C.R., K. J. Voss, H. R. Gordon, M. Twardowski, J. M. **Sullivan**, C. Trees, A. Weidemann, J. F. Berthon, D. Clarke & Z. Lee (2012) - Detailed validation of the bidirectional effect in various Case I and Case II waters. Optics Express, 20(7): 7631-7645.

Erickson, J. S., N. Hashemi, J. M. **Sullivan**, A. D. Weidemann, and F. S. Ligler (2011) - In Situ phytoplankton analysis: There's plenty of room at the bottom. *Analytical Chemistry*, DOI**:** 10.1021/ac201623k.

Yu Y., A. Tonizzo, A. A. Gilerson, M. E. Cummings, P. Brady, J. M. **Sullivan**, M. S. Twardowski, H. M. Dierssen, S. A. Ahmed, and G. W. Kattawar (2011). Measurements and simulations of polarization states of underwater light in clear oceanic waters. Applied Optics, 50, 4873-4893.

JAMES M. SULLIVAN

Sullivan, J. M., P. L. Donaghay & J. E. B. Rines (2010) - Coastal thin layer dynamics: consequences to biology and optics. Continental Shelf Research, 30(1): 50-65. doi:10.1016/j.csr.2009.07.009.

Sullivan, J. M, M. M. McManus, O. Cheriton, K. Benoit-Bird, L. Goodman, Z. Wang, J. Ryan, M. Stacey, D. V. Holliday, C.F. Greenlaw,M. Moline & M. McFarland. (2010) - Layered Organization in the Coastal Ocean: An Introduction to Planktonic Thin Layers and the LOCO Project. Continental Shelf Research, 30(1): 1-6.

Ryan, J. P., M. M. McManus & J. M. **Sullivan** (2010) - Geophysical and biological forcing of phytoplankton thin layer variability in Monterey Bay, California. Continental Shelf Research, 30(1): 7-16. doi:10.1016/j.csr.2009.10.017.

Rines, J. E. B., M. McFarland, P.L. Donaghay & J. M. **Sullivan** (2010) - Thin Layers and Species-Specific Characterization of the Phytoplankton Community in Monterey Bay, California USA. Continental Shelf Research, 30(1): 66-80. doi:10.1016/j.csr.2009.11.001.

Cheriton, O. M., M. A. McManus, J. V. Steinbuck, M. T. Stacey and J. M. **Sullivan** (2010) - Towed vehicle observations of thin layer structure and a low-salinity intrusion in Northern Monterey Bay, CA. Continental Shelf Research. Continental Shelf Research, 30(1): 39-49. doi:10.1016/j.csr.2009.09.005.

Sullivan, J. M., & M. S. Twardowski (2009) - Angular shape of the oceanic particulate volume scattering function in the backward direction. Applied Optics, 48(35): 6811-6819.

Zhang, X., L. Hu, M. S. Twardowski, & J.M. **Sullivan**. (2009) - Scattering by solutions of major sea salts. Optics Express, 17(22): 19585.

Holliday, D.V., P.L. Donaghay, C.F. Greenlaw, J.M. Napp, & J.M. **Sullivan** (2009) - High-frequency acoustics and bio-optics in ecosystems research. ICES Journal of Marine Science, 66: 974–980.

McManus, M. A., R. M. Kudela, M. W. Silver, G. F. Steward, P. L. Donaghay & J. M. **Sullivan** (2007) - Cryptic blooms: Are thin Layers the missing connection? Estuaries & Coasts, 31(2): 396-401.

Sullivan, J. M., M. S. Twardowski**,** J. R. Zaneveld, C. Moore, A. Barnard, P. L. Donaghay & B. Rhoades (2006) -The hyper-spectral temperature and salinity dependent absorption of pure water, salt water and heavy salt water (D_2O) in the visible and near-IR wavelengths (400 - 750 nm). Applied Optics, 45(21): 5294-5309.

Sullivan, J. M., M. S. Twardowski, P.L. Donaghay & S. Freeman (2005) – Using optical scattering to discriminate particle types in coastal waters. Applied Optics, 44 (9): 1667-1680.

Ryan, J. P., H. Dierssen, R. Kudela, C. Scholin, K. Johnson, F. Chavez, J. **Sullivan**, A. Fischer, E. Rienecker & P. McEnaney (2005) – Birth of a red tide in a coastal ocean upwelling ecosystem. Oceanography, 18(2):246-255.

Twardowski, M.S., E. Boss, J. M. **Sullivan**, & P.L. Donaghay (2004) - Modeling spectral absorption by chromophoric dissolved organic matter (CDOM). Marine Chemistry, 89: 69-88.

Sullivan, J. M., E. Swift, P. L. Donaghay & J. E. B. Rines (2003) - Small-scale turbulence affects the division rate and morphology of two red-tide dinoflagellates. Harmful Algae, 2(3): 183-199.

Sullivan, J. M. & E. Swift (2003) - Effects of small-scale turbulence on the net growth rate and size of ten species of marine dinoflagellates. Journal of Phycology, 39(1): 83-94.

Holliday, D. V., P. L. Donaghay, C. F. Greenlaw, D. E. McGehee, M. M. McManus, J. M. **Sullivan**, & J. L. Miksis (2003) – Advances in defining fine- and micro-scale pattern in marine plankton, Aquatic Living Resources, 16: 131-136.

McManus, M. A., A. L. Alldredge, A. H. Bernard, E. Boss, J.F. Case, T. J. Cowles, P. L. Donaghay, L.B. Eisner, D.J. Gifford, C. F. Greenlaw, C. M. Herren, D. V. Holliday, D. Johnson, S. MacIntyre, D. M. McGehee, T.R. Osborn, M. J. Perry, R. E. Pieper, J.E.B. Rines, D.C. Smith, J. M. **Sullivan**, M. K. Talbot, M. S. Twardowski, A. Weidemann & R. V. Zaneveld. (2003) – Characteristics, distribution and persistence of thin layers over a 48 hour period. Marine Ecology Progress Series, 261: 1-19.

Dekshenieks, M. M., P.L. Donaghay, J. M. **Sullivan**, J. E. B. Rines, T. R. Osborn, & M.S. Twardowski (2002) - Temporal and spatial occurrence of thin phytoplankton layers in relation to physical processes. Marine Ecology Progress Series, 223: 61-71.

Rines, J. E. B., P. L. Donaghay, M. M. Dekshenieks, & J. M. **Sullivan** (2002) - Thin layers and camouflage: hidden *Pseudo-nitzschia* populations in a fjord in the San Juan Islands, Washington, USA. Marine Ecology Progress Series, 225: 123-137.

Alldredge, A.L., T. J. Cowles, S. MacIntyre, J.E.B. Rines, P. L. Donaghay, C. F. Greenlaw, D. V. Holliday, M. M. Dekshenieks, J. M. **Sullivan**, & R. V. Zaneveld. (2002) Occurrence and mechanisms of formation of a dramatic thin layer of marine snow in a shallow Pacific fjord, Marine Ecology Progress Series, 233: 1-12.

Twardowski, M.S., J. M. **Sullivan**, P.L. Donaghay & R. V. Zaneveld (1999) - Microscale quantification of the absorption of dissolved and particulate material in coastal waters with an ac-9. Journal of Atmospheric and Oceanic Technology 16: 691-707.

Sullivan, J. M., J. E. B. Rines, E. Swift, & P. L. Donaghay (1997) - The effects of small-scale turbulence on marine dinoflagellates. ICES ASM 1997 (ICES CM 1997/O:06).

Sullivan, J. M. & E. Swift (1995) - Photoenhancement of bioluminescence capacity in natural and laboratory populations of the autotrophic dinoflagellate *Ceratium fusus* (Ehrenb.) Dujardin. Journal of Geophysical Research, 100 (C4): 6565-6574.

Swift, E., J. M. **Sullivan**, H. P. Batchelder, J. Van Keuren & R. D. Vaillancourt (1995) - Bioluminescent organisms and bioluminescence measurements in the North Atlantic Ocean near latitude 59.5 N, longitude 21 W. Journal of Geophysical Research, 100 (C4): 6527-6547.

Sullivan, J. M. & E. Swift (1994) - Photoinhibition of mechanically stimulable bioluminescence in the autotrophic dinoflagellate *Ceratium fusus* (Pyrrophyta). Journal of Phycology, 30(4): 627-633.

PUBLICATIONS: THESIS AND DISSERTATION

Sullivan, J. M. 2000. Ph.D. Dissertation: The Effects of Small-Scale Turbulence on Marine Dinoflagellates. University of Rhode Island, Kingston.

Sullivan, J. M. 1993. M.S. Thesis: The Effects of Light on the Bioluminescence Physiology of the Marine Autotrophic Dinoflagellate *Ceratium Fusus* (Ehrenb.) Dujardin. University of Rhode Island, Kingston.

PUBLICATIONS: EXTENDED ABSTRACTS (reverse chronological)

Sullivan, J., and M. Twardowski. 2013. Optical backscattering in water: measurements and uncertainties. *Proc. SPIE Ocean Sensing and Monitoring*, Baltimore, MD, April 29- May 3.

Rines, J., McFarland, M., Donaghay, P., **Sullivan**, J. & J. Churnside. 2013. A massive and unusual diatom bloom: ecology and oceanography of a rarely reported planktonic *Haslea* in East Sound, Washington, USA. Phycologia, 52(4): 91-92.

McFarland, M., Rines, J., Donaghay, P., & J **Sullivan**. 2013. Variation of phytoplankton community characteristics over centimeter to kilometer scales. Phycologia, 52(4): 71.

Sullivan, J., and M. Twardowski. 2012. Biological thin layers: history, ecological significance and consequences to oceanographic sensing systems. *Proc. SPIE Ocean Sensing and Monitoring*, Baltimore, MD, April 23-27.

Sullivan, J. M.; Twardowski, M.; Zaneveld, R.; Moore, C.; McKee, D. 2012. Measuring optical backscattering in water. *Proc. Ocean Optics XXI*, Glasgow, Scotland, Oct 7 - 12.

Twardowski, M.; **Sullivan**, J.; Bi, L.; You, Y.; Kattawar, G. 2012. Linear polarization specificity of scattering by oceanic particles. *Proc. Ocean Optics XXI*, Glasgow, Scotland, Oct 7 - 12.

Talapatra, S., J. **Sullivan**, J. Katz, M. Twardowski, H. Czerski, P. Donaghay, J. Hong, J. Rines, M. McFarland, A. R. Nayak & C. Zhang. 2012. Application of *in-situ* digital holography in the study of particles, organisms and bubbles within their natural environment. Proc. SPIE 8372, Ocean Sensing and Monitoring IV, 837205 doi:10.1117/12.920570.

Rines, J., McFarland, M., Donaghay, P. & J. **Sullivan**. 2011. The role of thin layer formation in the sexual reproduction of the planktonic diatom *Chaetoceros concavicornis* in Montery Bay, California. Journal of Phycology, 47:S46.

Sullivan, J., J. Katz, S. Talapatra, M. Twardowski, J. Hong, and P. Donaghay. 2011. Using *in-situ* holographic microscopy for ocean particle characterization. *Proc. SPIE OCEANS11*.

Sullivan, J. M., M. S. Twardowski, J. Katz, J. Hong, S. Talapatra & P. Donaghay (2010) – Understanding particle dynamics using *in-situ* holography. *Proc. Ocean Optics XX*, Anchorage, AK, Sep 27 - Oct 1.

Talapatra, S., A.R. Nayak, C. Zhang, J. Hong, J. Katz, M. Twardowski, J. **Sullivan**, and P. Donaghay. 2010. Characterization of organisms, particles, and bubbles in the water column using a free-drifting, submersible, digital holography system. *Proc. Ocean Optics XX*, Anchorage, AK, Sep 27 - Oct 1.

Twardowski, M., X. Zhang, S. Freeman, M. Slivkoff, J. **Sullivan**, H. Czerski, S. Vagle, Y. You, and G. Kattawar. 2010. Inverting the Volume Scattering Function to Infer Particle Composition at the Near-Surface. *Proc. Ocean Optics XX*, Anchorage, AK, Sep 27 - Oct 1.

McFarland, M., Rines, J., Donaghay, P. & J. **Sullivan**. 2007. Fine-scale distribution and abundance of large and small phytoplankton in Monterey Bay, CA. Journal of Phycology, 43:25-26.

Sullivan, J.M., M.S. Twardowski, J.R.V. Zaneveld, C. Moore, B. Rhoades, and R. Miller. 2004. The hyperspectral temperature and salinity dependent absorption coefficients of pure water. *Proceedings of Ocean Optics XVII*, October 25-29, Freemantle, Australia.

Sullivan, J.M., M.S. Twardowski, P.L. Donaghay, and S. Freeman. 2002. Particulate bulk refractive index distributions in coastal regions as determined from backscattering ratio measurements. *Proceedings from Ocean Optics XVI*, November 18-22, Santa Fe.

PATENTS

Method and Apparatus for Controlling the Motion of an Autonomous Moored Profiler, Patent number: US 8382540 B2, Inventors: Barnard, A. Rhodes, B., Koegler, J., Derr, A., Moore, C., Whiteman, D., Donaghay, P., & J. **Sullivan** - 2007.

Digital Holographic Microscopy Apparatus and Method for Clinical Diagnostic Hematology, Provisional Patent Docket number 3759.001P, Inventors: Twardowski, M., & J. **Sullivan** - 2014

Abbreviated Curriculum Vitae 2016

Timothy Charles Theisen, Ph.D.

Senior Instructor, Department of Biological Sciences
Florida Atlantic University,
3200 College Avenue • Davie, Florida 33314
954-236-1061 • ttheisen@fau.edu
http://www.science.fau.edu/biology/faculty_staff/Theisen.htm

Education:

- Ph.D. (2007) Florida Atlantic University, Davie, Florida
  Integrative Biology (fisheries and marine science)
- B.S. (2000) Florida Atlantic University, Davie, Florida
  Biology (marine)

Current and Previous Positions:

- **2014 - Present:** Senior Instructor, Florida Atlantic University, Department of Biological Sciences
- **2007 – 2014 :** Faculty Instructor, Florida Atlantic University, Department of Biological Sciences
- **2003 - 2007:** Research Assistant, Florida Atlantic University
- **2001 - 2007**: Teaching Assistant, Florida Atlantic University

Refereed Publications in Print:

Articles

- **Theisen TC** and Baldwin JB (2012) Movements and depth/temperature distribution of the ectothermic Scombrid, *Acanthocybium solandri* (wahoo), in the western North Atlantic. Marine Biology **157**(10), 2249-2258.
- **Theisen TC** (2009) Report on the status of walleye pollock (*Theragra chalcogramma*) and its fisheries in the eastern Bering Sea and Gulf of Alaska. Seafood Watch seafood report, Monterey Bay Aquarium, San Francisco.
- **Theisen TC**, Bowen B, Lanier W and Baldwin JB (2008) High connectivity on a global scale in the pelagic wahoo, *Acanthocybium solandri* (tuna family Scombridae). Molecular Ecology **17**, 4233-4247.
- **Theisen TC** (2008) Report on the status of Pacific cod (*Gadus macrocephalus*) and its fisheries. Seafood Watch seafood report, Monterey Bay Aquarium, San Francisco.

Refereed Presentations:

International

- Bowen B and **Theisen TC** (2008) Global population structure of the wahoo. Pelagic Fisheries Research Program Principal Investigators Workshop, Waikiki, Hawaii. Presentation by Bowen B.
- **Theisen TC** and Baldwin JB (2006) Movement patterns and environmental preferences of wahoo, *Acanthocybium solandri.* 59th Annual Meeting, Gulf and Caribbean Fisheries Institute, Belize City, Belize. Presentation by Theisen TC.

Courses Taught:

- Lecture Courses:

BSC 5931	Genetic Sequencing and Analyses	developed course
PCB 4723	Comparative Animal Physiology	
PCB 4674	Evolution	
OCB 4043	Marine Biology	
PCB 4023	Molecular and Cell Biology	redesigned course
PCB 3063	Genetics	

- Laboratory and Field Courses:

ZOO 6456L	Natural History of Fishes	redesigned course
BSC 4403L	Biotechnology Laboratory I	redesigned course
BSC 4428L	Biotechnology Laboratory II	redesigned course
OCB 4043L	Marine Biology Lab	
MCB 3023L	Microbiology Lab	
ZOO 2203L	Invertebrate Zoology Lab	

- Seminar Courses:

ZOO 6459	Graduate Seminar in Ichthyology	developed course

- Guest Lectures:

BSC 6936	Ecosystem Based Fisheries Management
BSC 6390	Integrative Biology

Student Mentoring:

- **Masters Student Committee Memberships:**

  Adam Matulik. Dissertation working title: Relationship between metabolic rate and deposition of heavy metal toxins into tissues of marine fish. Graduated Summer 2016, MS Biology.

  Karen Pankaew. Thesis title: Physiological Effects of Disorientation in Loggerhead (*Carettacaretta*) and Green (*Cheloniamydas*) Sea Turtle Hatchlings. Graduated Spring 2016, MS Biology.

  Marwa Tawa. Non-thesis. Graduated Fall 2013, MS Biology.

  Saheed Osini. Thesis title: Phytotherapeutic synergism of *beta-lapachone* and soybean-derived genistein isoflavone in human prostate cancer. Graduated Spring 2015, MS Biology.

  Alyssa Jordan. Thesis title: An evaluation of methodology, dispersal and habitat usage of largemouth bass (*Micropterus salmoides floridanus*) from a supplemental stocking on Lake Okeechobee, Florida. Graduated Spring 2012, M.S. Biology.

  Jessica Noble. Thesis topic: Effects of a severe cold event on the Common Snook, *Centropomus undecimalis,* in the Indian River Lagoon and St. Lucie River system. Expected graduation Fall 2017.

- **DIS Students:** Lexie Ann Holgate, Christian Castilla, Lizbeth O'Hara, Brian Cooney, Jorge Costa, Beatrice Garrido, Michelle Creamer, Dianna Gaballa, Rafaella Derbernadi, Wendy Lewis

Professional Associations:

- American Fisheries Society
- Gulf and Caribbean Fisheries Institute
- Jupiter Inlet Offshore Fishing Club (honorary)

Research Experience:

- Deployment of pop-up satellite tags (PSAT's) onto marine fish; implementation of a program utilizing PSAT's to investigate movement patterns and temperature / depth profiles of marine fish
- Collection of DNA from tissues, generation and analyses of DNA sequence data to describe population genetic structure and phylogeography of highly mobile, pelagic marine fish
- Collection of DNA from tissues, generation and analyses of DNA sequence data and wildlife tag data to investigate distribution of terrapins within Florida Bay
- Analyses of factors affecting growth rates in cultured coral species to be used for regeneration of damaged natural coral reefs

Field Experience:

- Collection of live fish, reptiles, and invertebrate specimens for preservation and for tag and release
- Collection of tissue samples for DNA analyses from a variety of organisms
- Removal of otoliths and other hard parts from marine fish for age and growth studies
- Removal of gonads from marine fish for reproductive studies

Joshua D. Voss, Ph.D.
Curriculum Vitae

Phone	Professional Address	E-mail
772-242-2538	Harbor Branch Oceanographic Institute	jvoss2@hboi.fau.edu
305-588-0732	Florida Atlantic University	**Websites:**
	5600 US 1 N.	vosslab.weebly.com
	Fort Pierce, FL 34946	fau.edu/hboi/meh/crme

Joshua Voss is an early career researcher in the fields of coral reef ecology and marine molecular ecology. His primary areas of focus include shallow and mesophotic coral reef ecology, coral health, and the environmental factors that influence coral degradation worldwide. His current research integrates experimental and field monitoring approaches with advanced molecular techniques to understand the short- and long-term effects of stress and disease on coral physiology and ecology. In addition, he has developed and adapted molecular techniques to investigate the roles of symbiotic microbes in coral health. He has contributed 11 peer-reviewed manuscript publications, delivered 32 first author conference presentations, has completed over 1300 scientific dives, and has lead more than 30 scientific cruises and expeditions primarily in the Bahamas, Florida Keys, and Gulf of Mexico with additional investigations in Panama, Curacao, Bonaire, Dominica, USVI, and St. Eustatius.

Education

Florida International University, Miami, FL
* PhD in Biological Sciences, 2006
* Dissertation: *Coral disease dynamics and environmental drivers in the Northern Florida Keys and Lee Stocking Island, Bahamas*, advisor Dr. Laurie Richardson
* GPA: 3.82

Elon University, Elon, NC
* Bachelor of Science, Magna Cum Laude, 2001
* Major: Biology, Minors: Chemistry, Philosophy, and Sociology
* Completed Honors and Sciences Fellows Programs
* Study Abroad: Tropical Field Biology in Belize, 2000
* Senior Thesis: *Artificial reef design and ecological impacts: stories of success and failure* Thesis advisor Dr. Michael Kingston
* GPA: 3.74

Duke University Marine Laboratory, Beaufort, NC
* 1999 Summer Session, Marine Ecology Course

Appointments

2009-present	Assistant Research Professor, Harbor Branch Oceanographic Institute at Florida Atlantic University
2007-2009	Postdoctoral Research Associate, Harbor Branch Oceanographic Institute at Florida Atlantic University
2006-2007	Visiting Assistant Professor, Eckerd College
2006	Instructor, Science Under Sail
2004	Research fellow, Smithsonian Tropical Research Institute
2001-2006	Research fellow (summers), Perry Institute for Marine Science, NOAA Caribbean Marine Research Center
2001-2005	Teaching Assistant, Florida International University
1999-2000	Laboratory Teaching Assistant, Elon University
1999	Research Assistant, Duke University Marine Lab, supervisors Dr. Larry Crowder and Dr. Will Figueira

Research Experience

2010-present	Estuarine impacts on coral health and benthic communities at St. Lucie Reef, FL
2010-present	Oil and dispersant impacts on coral reef communities and coral pathogenesis
2009-present	NOAA Cooperative Institute sponsored exporation and health assessment of mesophotic coral reef ecosystems in the Gulf of Mexico, South Florida, and Puerto Rico

* Lead on coral health and connectivity projects
* Coral Reef Conservation Program - Flower Garden Banks Habitat Assessment

2007-present Assessment of healthy and diseased *Montastraea cavernosa* bacterial communities and gene expression in the Lower Florida Keys and Bahamas

2007-2010 NOAA Florida Keys National Marine Sanctuary Coral Health Assessment Cruise
* Extensive surveys and sampling to support the monitoring and resource management in the Florida Keys and Dry Tortugas

2001-2006 An integrative analysis of environmental factors, coral population and community structure, and microbial community composition associated with coral diseases near Lee Stocking Island, Bahamas, and the Florida Keys

2008 Rapid assessment of Caribbean coral reefs and management approaches in Dominica, Bonaire, Curacao, St. Eustatius, and Saba with University of Rhode Island

2004 Coral disease surveys at the Smithsonian Tropical Research Institute, Bocas del Toro, Panama

2003 Ecological characterization of benthic habitats from Key West to Dry Tortougas National Park

2001 An analysis of artificial reef design and ecological impact

2000 Coral disease abundance and species susceptibility near Lee Stocking Island, Bahamas
* Two month internship at Caribbean Marine Research Center

2000 Diel variation in the near-shore fish community of San Pedro, Belize

1999 Duke University Marine Laboratory Research Assistant
* Independent lab work removing and processing otoliths and gonads from damselfish

1999 Physical analysis, phytoplankton density, and water quality studies in Pamlico Sound, NC

Publications

Refereed Journal Articles

Klepac CN, Beal J, Kenkel CD, Sproles A Polinski J, Williams M, Matz M, Voss JD. 2015. Seasonal stability of coral-Symbiodinium associations in the subtropical coral habitat of St. Lucie Reef, Florida. *Marine Ecology Progress Series* 532:137-151

Voss JD, Mills DK, Remily ER, Myers JL, Richardson LL. 2007. Black band disease microbial community variation on corals in three regions of the Wider Caribbean. *Microbial Ecology* 54:730-739

Richardson LL, Sekar R, Myers JL, Gantar M, Voss JD, Kaczmarsky L, Remily ER, Boyer GL, Zimba PV. 2007. The presence of the cyanobacterial toxin microcystin in black band disease of corals. *FEMS Microbiology Letters* 272: 182–187

Voss JD, Richardson LL. 2006. Nutrient enrichment enhances black band disease progression in corals. *Coral Reefs* 25: 569-576

Mills DK, Entry JA, Voss JD, Gillevet PM, Mathee K. 2006. An assessment of the hypervariable domains of the 16S rRNA genes for their value in determining microbial community diversity: the paradox of traditional ecological indices. *FEMS Microbiology Ecology* 57: 496-503

Sekar R, Mills DK, Remily ER, Voss JD, Richardson LL. 2006. Microbial communities in the surface mucopolysaccharide layer and the black band microbial mat of black band diseased *Siderastrea siderea*. *Applied and Environmental Microbiology* 72:5963-5973

Voss JD, Richardson LL. 2006. Coral diseases near Lee Stocking Island, Bahamas: patterns and potential drivers. *Diseases of Aquatic Organisms* 69:33-40

Richardson LL, Mills DK, Remily ER, Voss JD. 2005. Development and field application of a molecular probe for the primary pathogen of the coral disease white plague type II. *Revista de Biologia Tropical* 53:1-10

Richardson LL, Voss JD. 2005. Changes in a coral population on reefs of the northern Florida Keys following a coral disease epizootic. *Marine Ecology Progress Series* 297:147-156

Book chapters

Voss JD, Williams M, Reed J, Clark R. 2014. Chapter 5: Benthic and fish communities in the middle and lower mesophotic zone of the Flower Garden Banks National Marine Sanctuary in R. Clark, J.C. Taylor, C.A. Buckel, and L.M. Kracker (eds). Fish and benthic communities of the Flower Garden Banks National Marine Sanctuary: science to support sanctuary management. NOAA NOS NCCOS 179. Silver Spring, MD. 317 pp

Rogers C, Voss JD, and 23 others. 2008. Coral Reefs of the U.S. Virgin Islands. In: Riegl B, Dodge R (eds) Coral Reefs of the United States of America. Springer, Berlin.

Teaching Experience

2007-present Florida Atlantic University, Harbor Branch Oceanographic Institution

- Regular undergraduate courses developed and taught:
  - Marine Biodiversity and Lab (OCB 4032, OCB 4032L)
    - Offered Spring 2008-present, co-taught with Drs. Dennis Hanisak and Jim Masterson, 44% of course teaching load
  - Marine Microbial and Molecular Biology and Lab (OCB 4525, OCB 4525L)
    - Offered Spring 2008-2015, co-taught with Dr. Peter McCarthy, et al., 38% of course teaching load
  - Field Studies in Marine Science and Lab (BSC 4930, BSC 4930L)
    - Offered Summer 2014-present, co-taught with Dr. Dennis Hanisak, 50% of course teaching load
- Regular graduate courses developed and taught:
  - Coral Reef Ecosystems and Lab (OCB 6266, OCB 6266L)
    - New course, offered Spring 2015, to be offered in odd years going forward, 100% of teaching load
  - Marine Molecular Ecology (BSC6936)
    - New course, offered Spring 2008, 2010, 100% of teaching load
  - Ocean Exploration (BSC 6936)
    - New course, offered Fall 2015, co-taught with Hanisak, Reed, and Pomponi, 25% of course teaching load
  - Marine Molecular Biology (BSC 6465)
    - New course, To be offered Spring 2016, and even years thereafter, 100% of teaching load
- Directed Independent Studies courses developed and taught:
  - Next Generation Sequencing Approaches (BSC 6905)
  - Impacts of LBSPs on Coral Reefs (BSC 6905)
  - Coral Mesocosm Techniques (BSC 6905)
  - Deep Sea Coral Communities (BSC 6905)
  - Evaluating Estuary Water Quality (BSC 6905)
  - Realtime PCR Techniques (BSC 6905)
  - Coral Health Research (BSC 6905)
  - Molecular Methods in Coral Ecology (BSC 4905)
  - Techniques in Coral Conservation (BSC 4905)
- Thesis, Dissertation, and research courses advised:
  - Masters Thesis (BSC 6971)
  - Masters Proposal (BSC 6905)
  - Masters Defense (BSC 6905)
  - Dissertation (BSC 7980)
  - Advanced Research in Int Bio (BSC 7978)
- Organizer and Instructor for Florida Sea Grant sponsored "Advance Molecular Technologies for Quantifying Coral Health: a Workshop for Florida's Reef Researchers," week long workshop offered at FAU Harbor Branch in 2008
- PCR and Gel Imaging Workshops for the Lincoln Park Academy and the Westwood Marine and Oceanographic Academy
  - 2 day workshops for 50-75 high school students offered annually

2006-2007 Eckerd College, Department of Marine Science

- Courses developed and taught, one semester each:
  - Marine Invertebrate Biology and Lab (MS189, MS189L)
  - Biological Oceanography (MS 209)
  - Coral Reef Ecosystems (MS 318; new course)
  - Senion Seimnar: Threats to Marine Ecosystems and Species (MS 410)
  - Florida's Barrier Islands (WT2E; new course)

Independent Research course developed and taught:
Coral Restoration (BI 430)

2006-2007 Science Under Sail, Inc.:
Assistant instructor on a three week marine science and sailing education program in the Sea of Abaco, Bahamas

2001- 2005 Florida International University
Courses taught: Marine Biology and Oceanography Lab, General Microbiology Lab, Introductory Microbiology Lab

2005, 2007 NOAA Caribbean Marine Research Center, Lee Stocking Island, Bahamas
Coral species and disease identification workshop instructor

1999 -2000 Elon University, Biology Department
Assistant instructor: Zoology Laboartory (3 semesters)

Graduate Students Supervised

Danielle Dodge, 2015-present, FAU Biology Masters student. *Comparative field and molecular studies of coral health on freshwater impacted reef.*

Alycia Shatters, 2014-present, FAU Biology Masters student. *Effects of Estuarine Discharge Water and Temperature on Corals and their Symbionts.*

Jennifer Polinksi, 2014-present, FAU Biology Masters Student. *Investigating Algal Symbionts in Mesophotic and Shallow Corals,* also 2013 and 2014 HBOI Summer Intern.

Michael Studivan, 2012-present, FAU Integrative Biology PhD student. *Connectivity and Plasticity of Mesophotic Corals in the Gulf of Mexico.*

Courtney Klepac, 2012-2014, FAU Biology Masters student. *Characterization of Symbiotic Algae, Genus Symbiodinium, in Corals at St. Lucie Reef, FL*

Graduate Student Committee Work

Carlie Perricone, 2015-present, FAU MS Biology student

Megan Conkling, 2014-present, FAU MS Biology student

Lucas Jennings, 2012-2015, FAU MS student

Joshua Filina, 2010-2014, FAU MS student

Nitzan Soffer, 2010-2011, Florida International University PhD student, transferred to Oregon State University

Undergraduate Students Supervised

Ali Courtemanche, 2014, FAU undergraduate thesis and DIS student, *Microscopic analysis of coral zooxanthellae*

Samantha Johnston, 2014-2015, FAU Honors Thesis Student. *Morphometric assessment of shallow water and mesophotic scleractinian coral,* Montastraea cavernosa

Amanda Alker, 2013-2015, FAU Honors Thesis Student and HBOI Summer Intern. *Assessing in coral microbial communities on mesophotic reefs and sewage impacted shores of Bermuda.*

Jennifer Polinksi, 2013 and 2014, Albion College, HBOI Summer Intern. *Algal Symbionts in Corals From St. Lucie Reef, Florida*.

Ashley Sproles, 2012, Florida Institute of Technology, HBOI Summer Intern. *Zooxanthellae and chlorophyll abundance in the corals Montastraea cavernosa and Diploria clivosa at St. Lucie Reef, FL.*

Miguel Martini, 2012-2013, FAU Honors Thesis Student. *Disease resistance, resilience, and susceptibility in the star coral* Orbicella faveolata

Elizabeth Fahsbender, 2011, University of South Florida, HBOI Summer Intern, *Effects of oil and dispersant on disease and coral mucus bacterial community structure in the coral* Montastraea faveolata

Maureen Williams, 2010 and 2011, University of Notre Dame, HBOI Summer Intern, *Oil, Dispersant, and Hypoxia effects on the model cnidarian Aiptasia pallida*

Daniel Rowan, 2009-2010, FAU, HBOI and NSF URM Intern, *Temperature and light effects on black band disease severity and microbial community structure*

Jessie Drechsel, 2006-2007, Eckerd College, Senior Thesis, *Chemically induced bleaching of the hard coral* Madracis mirabilis

Jennifer Jordan, 2006-2007, Eckerd College, Senior Thesis, *Shipping impacts on reefs near Port Everglades: response, restoration, and recovery*

CURRICULUM VITAE

David Lewis Warburton

Date of Birth: 10 August 1947

Place of Birth: Hackensack, New Jersey

Address:

Business Address: Department of Geosciences
Florida Atlantic University
777 Glades Road
Boca Raton, Florida
33431

Home Address: 264 N.E. Third Court
Boca Raton, Florida
33432

Marital Status: Married

Area of Professional Specialization: Geochemistry

Education: Undergraduate Study - UNIVERSITY OF CALIFORNIA, San Diego, California - B.A. degree awarded June, 1969.
Major: Chemistry Minor: History of Science/Economics

Graduate Study: UNIVERSITY OF CHICAGO, Chicago, Illinois - Ph.D. degree awarded June, 1978.
Major: Geochemistry
Major Professor: Professor Stefan Hafner

Short Courses Attended: "Mathematical Crystallography", Mineralogical Society of America, Orlando, Florida, 1985.

"Contaminant Hydrogeology: Practical Monitoring, Protection, and Cleanup", Geological Society of America, Dallas, Texas, 1990.

Societies:

American Association for the Advancement of Science
American Geophysical Union
American Women in Geoscience
American Water Resource Association
Florida Association of Professional Geologists (Founding member)
Geological Society of America
Mineralogical Society of America
National Association of Geoscience Teachers
Society of Sigma Xi, Treasurer, Florida Atlantic Chapter

Professional Service:

Webmaster, Limnogeology Division, Geological Society of America - http://rock.geosociety.org/limno/index.html

Planning committee for the 6th International Limnogeology Conference, to be held in Reno, Nevada, June 15th to 19th, 2015

Honors:

Award for Excellence in Undergraduate Teaching, College of Science, Florida Atlantic University, 1987.
Summer Research Fellowship, Florida Atlantic University, 1988.
Elected Danforth Associate, 1989.
Teaching Incentive Program (TIP) award, Florida Atlantic University, 1994
Distinguished Teacher of the Year, COS nominee, 2004

Research and Teaching Experience

Analytical Radiochemical Laboratory, General Electric Company, Vallecitos Nuclear Center, Pleasonton, California. June 1968 to September 1968, and June 1969 to September, 1969.

Teaching Assistant, Research Assistant, Laboratory Assistant, UNIVERSITY OF CHICAGO, Chicago, Illinois, September 1969 to March, 1973 and June 1974 to September 1975.

Technical Assistant, Geochemistry research, PHILLIPS UNIVERSITÄT, Marburg/Lahn, Germany
April 1973 to April 1974.

Assistant Professor of Geology, FLORIDA ATLANTIC UNIVERSITY, Boca Raton, Florida, September 1975 - August, 1991.

Associate Professor of Geology, FLORIDA ATLANTIC UNIVERSITY, Boca Raton, Florida, August, 1991 - present.

Graduate Program Director, Department of Geosciences, FLORIDA ATLANTIC UNIVERSITY, Boca Raton, Florida, 2003-2004.

Acting Assistant Dean, College of Science, FLORIDA ATLANTIC UNIVERSITY, October - November, 1993, filling in for a colleague felled by illness.

Assistant Chairperson, Department of Geosciences, FLORIDA ATLANTIC UNIVERSITY, Boca Raton, Florida, January 2005 - present.

Professional License:

Registered Professional Geologist, State of Florida, 1989 - present, License # 1074.

Publications: Hafner, S.S., Virgo, D., and Warburton, D.L. (1971A) Cation cooling history of clinopyroxenes from Oceanus Procellarum, Proc. Second Lunar Science Conf., *Geochem Cosmochim. Acta* Suppl. 2, Vol. **1**, 91-108, M.I.T. Press.

_____ (1971B) Oxidation state of iron in plagioclase from lunar basalts, *Earth and Planetary Science Letters* **12**, 159-166.

_____, Fernandez-Moran H., Ohtsuki M., and Hibino A. (1971) Sub-solidus cooling-history of coarse grained lunar basalt from Oceanus Procellarum, *Nature Phys. Sci*. **261**, 79.

Finger, L.W., Hafner, S.S., Schürman, K.U., Virgo, D., and Warburton, D.L. (1972) Distinct cooling histories and reheating of Apollo 14 rocks, in Lunar Science - III (ed. C. Watkins), Lunar Science Institute Contribution No. **88**.

Warburton, D.L., (1985) Book review of Ionization Potentials: Some Variations, Implications, and Applications by L.H. Ahrens, *Organic Geochemistry*, **8**, p. 233.

Carraher, Charles E. Jr., Warburton, David L., and Sterling, Dorothy, (1991) Mössbauer Spectroscopy, Polymer News, **16**, 240-243.

Curriculum Vitae

PAUL S. WILLS

Professional Preparation

University of Southwestern Louisiana	Aquatic/Fisheries Biology	B.S.	1987
Southern Illinois University	Zoology	M.S.	1991
Southern Illinois University	Zoology	Ph.D.	1998
Southern Illinois University	Zoology	Postdoc	1999 - 2003

Appointments

2014-present	Associate Director for Research, Harbor Branch Oceanographic Institute at Florida Atlantic University (HBOI-FAU)
2015-present	Research Professor, HBOI-FAU
2009-2015	Associate Research Professor, HBOI-FAU
2007-2009	Assistant Research Professor, HBOI-FAU
2006- 2007	Assistant Research Scientist, Harbor Branch Oceanographic Institution
2006-present	Adjunct Instructor, Indian River State College
2002-2012	Adjunct Assistant Professor, Fisheries and Illinois Aquaculture Center, Department of Zoology, SIUC
2001-2006	Manager, Logan Hollow Fish Farm
1999-2003	Researcher III/ Postdoc, Fisheries and Illinois Aquaculture Center, SIUC
1995-1998	Researcher II, Cooperative Fisheries Research Laboratory, SIUC
1989-1995	Researcher I, Cooperative Fisheries Research Laboratory, SIUC
1987-1989	Research Assistant, Cooperative Fisheries Research Laboratory, SIUC
1986-1987	Toxicology Laboratory Technician, Weintritt Testing Laboratories
1986	Researcher, Crawfish Research and Demonstration Center, University of Southwestern Louisiana

Selected Publications

Wills, P.S., T. Pfeiffer, R. Baptiste, and B. Watten. 2016. Application of a fluidized bed reactor charged with aragonite for control of alkalinity, pH and carbon dioxide in marine recirculating aquaculture systems. Aquacultural Engineering 70:81-85.

Lu, J., C.P. Wilson, and P.S. Wills. 2015. Trace Analysis of Off-flavor/Odor Compounds in Water Using Liquid-Liquid Microextraction Coupled with Gas Chromatography - Positive Chemical Ionization-Tandem Mass Spectrometry. Frontiers of Environmental Science and Engineering. DOI 10.1007/s11783-015-0820-z

Reading, B.J., P.S. Wills, R.C. Heidinger, and E.J. Heist. 2015. Genetic Variability in Meiotic Gynogenetic Muskellunge, Esox masquinongy (Mitchell), Estimated From Segregation of Microsatellite Alleles. Aquaculture Research 2015:1-11.

Sims, D.W., A.M. Kelly, and P.S. Wills. 2013. Effects of different feed habituation methods on survival and feed habituation success of largemouth bass, Micropterus salmoides, in a recirculating aquaculture system. Journal of The World Aquaculture Society 44:743-749.

Riche, M.A., P.S. Wills, R.M. Baptiste, and C.R.Weirich. 2013. Effect of culture density on production characteristics and body composition of market size cobia, Rachycentron

canadum, reared in recirculating aquaculture systems. Journal of the World Aquaculture Society 44:259-266.
Wills. P.S., C.R. Weirich, R. M. Baptiste, and M.A. Riche. 2013. Evaluation of Commercial Marine Fish Feeds for Production of Juvenile Cobia Rachycentron canadum in Recirculating Aquaculture Systems. North American Journal of Aquaculture 75:178-185.
Robinson, R.B., P.S. Wills, M.A Riche, D.L. Straus. 2013. Tissue-specific copper concentrations in Red Drum after long-term exposure to sublethal levels of waterborne copper and a 21 day withdrawal. North American Journal of Aquaculture 75:1-6.
Pfeiffer, T.J., and P.S. Wills. 2011. Evaluation of three types of structured floating plastic media in moving bed biofilters for total ammonia nitrogen removal in a low salinity hatchery recirculating aquaculture system. Aquaculture Engineering 45:51-59.
Weirich, C.R., P.S. Wills, R.M. Baptiste, P.N. Woodward, and M.A. Riche. 2010. Production characteristics and body composition of juvenile cobia fed three different commercial diets in recirculating aquaculture systems, North American Journal of Aquaculture, 72:43-49.
Pfeiffer, T.J., P.S. Wills. 2009. A Low-Head Saltwater Recirculating Aquaculture System Utilized for Juvenile Red Drum Production. International Journal of Recirculating Aquaculture 10:1-24. (Invited paper)
Weirich, C.R., P.S. Wills, R.M. Baptiste, P.N. Woodward and M.A. Riche. 2009. Production characteristics and body composition of Florida pompano reared to market size at two different densities in low-salinity recirculating aquaculture systems, North American Journal of Aquaculture, 71:165-173.
Colombo, R.E., J.E. Garvey and P.S. Wills. 2007. Gonadal development of the shovelnose sturgeon and sex specific demographics in the middle Mississippi river, Journal of Applied Ichthyology, 23:420-427.
Colombo, R.E., P.S. Wills and J.E Garvey. 2004. Use of ultrasound imaging to determine sex of shovelnose sturgeon, North American Journal of Fisheries Management, 24:322-326.
Wills, P.S., R.J. Sheehan, R.C. Heidinger, B.L. Sloss and R. Clevenstein. 2002. Differentiation of pallid sturgeon and shovelnose sturgeon using an index based on meristics and morphometrics, Pages 249-258 In: W. Van Winkle, P.J. Anders, D.H. Secor and D.A. Dixon (eds.), Biology, management and protection of North American sturgeon, American Fisheries Society, Symposium 28, Bethesda, Maryland.

Synergistic Activities

Member of Production Work Group for the Florida Marine Fisheries Enhancement Initiative, 2007- present
Member of Board of Directors for the Florida Aquaculture Association, 2009-present.
Past-Member of Board of Directors for the Illinois Aquaculture Industry Association.
Past-Editor, AFS Fisheries Management Section Newsletter.
Provide peer reviews for: (Journal Articles) Transaction of the American Fisheries Society, North American Journal of Aquaculture (The Progressive Fish Culturist), Journal Northwest Science, Journal of the World Aquaculture Society; (Books) Tissue & Cell; (Grant Proposals) National Fish & Wildlife Foundation, North Central Regional Aquaculture Center.
Outreach and teaching activities include two semester courses for Indian River State College: Water Quality, Systems, and Operations and Principles of Finfish Aquaculture. Developed

curriculum and delivered lectures for an annual 3 day industry workshop, Fish Culture Techniques, 2008-present.

Collaborators and Other Affiliations

Collaborators

Robert Colombo EIU; Megan Davis HBOI-FAU; Roy Heidinger, SIU-C (emeritus); Anita Kelly, UAPB; Kevin Main, Mote Marine Lab; Cortney Ohs, UF; Timothy Pfeiffer USDA-ARS; Marty Riche HBOI-FAU; Don Freeman USDA-ARS; Charles Weirich, NC Seagrant. (Formerly USDA-ARS); Chris Young FL-FWC SERF.

Thesis Advisor and Postgraduate-Scholar Sponsor

Graduate Committee Service: Neil Jackson, M.S. (completed, SIU-C); Robert Colombo, M.S. (completed, SIU-C); Benjamin Reading, M.S. (completed, SIU-C); Derek Sims, M.S. (completed, SIU-C); Christopher Green, Ph.D. (completed, SIU-C); Clifford O'Neil, Ph.D. (completed, SIU-C); Amber Garr, Ph.D. (completed, FAU); Lindsay Harris, M.S. (completed, FAU); Richard Mulroy, M.S. (active, FAU, Advisee); Steve Burton, M.S. (active, FAU, Advisee); Alesia Shatters, M.S. (active, FAU); Scott Jones, Ph.D. (inactive, UAPB)

Selected Grants and Contacts

Wills, P.S. , A. Dalgleish, and M. Jiang.Supplement: An Initiative to Design and Demonstrate a Prototype Integrated Multi-Trophic Aquaculture System for Sustainable Land-Based Aquaculture. Florida Aquaculture Specialty License Plate Fund. $100,000. July 2015-June 2016.

Wills, P.S. , A. Dalgleish, and M. Jiang. Supplement: An Initiative to Design and Demonstrate a Prototype Integrated Multi-Trophic Aquaculture System for Sustainable Land-Based Aquaculture. Florida Aquaculture Specialty License Plate Fund. $100,079 July 2014-June 2015.

Hanisak, M.D. and P.S. Wills. Culture of the Aquatic Plant *Egeria densa* in a Closed System. Florida Aquaculture Research Council, Florida Department of Agriculture and Consumer Services. $129,000. July 2014-June 2015.

Wills, P.S. Collaborative Research Project to Advance IMTA Research and Technology in Support of a Viable Environmentally Sustainable Aquaculture Industry. Amy's Island Seafood, LLC. $76,800. October 2014-August 2015.

Wills, P.S., Anni Dalgleish. Supplement: An Initiative to Design and Demonstrate a Prototype Integrated Multi-Trophic Aquaculture System for Sustainable Land-Based Aquaculture. Florida Aquaculture Specialty License Plate Fund, $150,000, July 2013-June 2014.

Wills, P.S. Commercialization of Florida Pompano Production in Inland Recirculating Systems, Florida Aquaculture Research Council, Florida Department of Agriculture and Consumer Services. July 2012-June 2013. $129,000

Wills, P.S. Pilot-Scale Comparison of Three Methods for Controlling Off-Flavor in Recirculating Aquaculture Systems for Food Fish Production, Florida Aquaculture Research Council, Florida Department of Agriculture and Consumer Services. July 2012-June 2013. $70,000

Wills, P.S. Supplement: An Initiative to Design and Demonstrate a Prototype Integrated Multi-Trophic Aquaculture System for Sustainable Land-Based Aquaculture. Florida Aquaculture Specialty License Plate Fund, $150,000, July 2013-June 2014.

Jeanette Wyneken

Department of Biological Sciences
Florida Atlantic University
777 Glades Road
Boca Raton, Florida 33431-0991USA http://www.science.fau.edu/biology/faculty/wyneken.html

Office Phone: (561) 297-0146
Fax: (561) 297-2749
E-mail: jwyneken@fau.edu

a. Professional Preparation

Institution	Major	Degree	Year
Illinois Wesleyan University	Biology	B.A.	1978
University of Illinois	Biology	Ph.D.	1988

b. Appointments

2014 - present Professor, Dept. of Biological Sciences, Florida Atlantic University, Boca Raton, FL
2006-2014: Assoc. Prof., Dept. of Biological Sciences, Florida Atlantic University, Boca Raton, FL
2000-2006: Assist. Prof., Dept. of Biological Sciences, Florida Atlantic University, Boca Raton, FL
2002-2005: Graduate Research Faculty, Duke University Marine Laboratory, Beaufort, NC
1996-2000: Res. Assist. Prof., Dept. of Biological Sciences, Florida Atlantic Univ., Boca Raton, FL

c. Products

Peer-Refereed Publications 55 papers published †: student coauthor

RECENT PEER-REVIEWED PUBLICATIONS

[1] Salmon M, J Wyneken, M Hamann & S Whiting. *In press*. Anti-predator morphology and behaviour in juvenile marine turtles: comparisons between flatbacks (*Natator depressus*) and green turtles (*Chelonia mydas*) Mar & Freshwater Behav Physiol

[2] Salmon, M, Higgins, B, Stewart, J Wyneken, J. 2015, The ontogeny of morphological defenses in Kemp's ridley (*Lepidochelys kempii*) and loggerhead (*Caretta caretta*) sea turtles. J. Morphol.. doi: 10.1002/jmor.20390

[3] Lolavar, A† & J Wyneken. 2015. Effect of rainfall on loggerhead turtle nest temperatures, sand temperatures and hatchling sex. *Endangered Species Research*, *28*(3), pp.235-247.

[4] Wyneken J, Lolavar A†. 2015. Loggerhead sea turtle environmental sex determination: Implications of moisture and temperature for climate change based predictions for species survival. J. Exp. Zool. (Mol. Dev. Evol.) 324B:295–314.

[5] Dudley P N, Bonazza R, Jones, TT**,** Wyneken J, Porter WP. 2014. Leatherbacks swimming in silico: Modeling and verifying their momentum and heat balance using computational fluid dynamics: E110701. PLoS One, 9(10) doi:10.1371/journal.pone.0110701

[6] Stacy B. A., C. J. Innis, P.-Y. Daoust, **J. Wyneken**, M. Miller, H. Harris, M. C. James, E. F. Christiansen, A. Foley. 2014. Solitary Large Intestinal Diverticulitis in Leatherback Turtles (*Dermochelys coriacea*). Vet Pathol. Published online 19 September 2014 DOI: 10.1177/0300985814549211

[7] Mansfield, K.L., **Wyneken, J**., Porter, W.P., Luo, J., 2014. First satellite tracks of neonate sea turtles redefine the "lost years" oceanic niche. Proc. R. Soc. B Biol. Sci. 281: 20133039. http://dx.doi.org/10.1098/rspb.2013.3039

[8] Bovery CM, **J Wyneken**. 2013. Sea Turtles in Florida's Atlantic Waters. Marine Fisheries Review. 75(3):1-12.

[9] Mansfield KL, **J Wyneken**, D Rittschof, M Walsh, CW Lim, and P Richards. 2012. Satellite tag attachment methods for tracking neonate sea turtles. Marine Ecology Progress Series. 457: 181–192,

OTHER SIGNIFICANT PUBLICATIONS

[1] Rivera ARV, **J Wyneken** and RW Blob. Forelimb kinematics and motor patterns of swimming loggerhead sea turtles (*Caretta caretta*): are motor patterns conserved in the evolution of new locomotor strategies? The Journal of Experimental Biology 214:3314-3323, 2011.

[2] Conrad, JR, **J Wyneken**, JA Garner and S. A. Garner. 2011. Experimental assessment of aggressive dune vegetation impact and its control on leatherback sea turtle (*Dermochelys coriacea*) nest success. Endangered Species Research. 15: 13–27, 2011

[3] Salmon M, M Hamann, and **J Wyneken**. 2010. The development of early diving behavior by juvenile Flatback Sea Turtles (*Natator depressus*). Chelonian Conservation and Biology. 9(1):8-17.

- Sole-authored books (2)

[1] **Wyneken. J.** 2001 Guide to the Anatomy of Sea Turtles. NMFS Tech. Publication. NOAA Tech., Memo NMFS-SEFSC-470. 172 pp. (Black & White book and color CD)**.**

[2] **Wyneken. J.** 2004 Indique a la Anatomía de las Tortugas Marinas. NMFS Tech. Publication. NOAA Tech., Memo NMFS-SEFSC-470. 172 pp. (Black & White book and color CD).

- Co-edited books (3)

[3] **Wyneken J**, KJ Lohmann and J Musick eds. 2013. The Biology of Sea Turtles Volume III. CRC Press/Taylor and Frances Grp. Boca Raton, 457 pp**.**

[4] Lutz PL JA Musick and **J Wyneken**, (Eds). The Biology of Sea Turtles. Vol. II. CRC Press. Boca Raton, FL 496 pages, 2003.

[5] **Wyneken, J**., M. Godfrey, and V. Bels, eds. 2008. The Biology of Turtles. CRC Press/Taylor and Frances Grp. 389 pp.

- Book chapters (peer-reviewed - 9) 3 recent

[6] **Wyneken. J**. 2015**.** The structure and function of the leatherback, *Dermochelys coriacea*. The Biology and Conservation of the Leatherback Sea Turtle J. Spotila and Sa ed., Johns Hopkins University Press.

[7] **Wyneken. J.** 2013. Contemporary Computed Tomography and Magnetic Resonance Imaging of Reptile Anatomy. Chapter 9. *In*. Current Therapy in Reptile Medicine and Surgery. D.R. Mader and S. Divers, eds. Elsevier Health Sciences. St. Louis. Pp 93-106.

[8] **Wyneken, J.** 2013**.** The Skeleton – An In Vivo of Structure, Chapter 4. 79-95, in The Biology of Sea Turtles Volume III. Wyneken J, KJ Lohmann and J. Musick eds. CRC Press/Taylor and Frances Grp. Boca Raton.

d. Synergistic Activities

I have more than a decade of experience as advisor to graduate students (Masters and doctoral advisor) in Biological Sciences, and have served on graduate committees of students in Biological sciences, Integrative Biology, and Environmental Sciences at FAU; I served on a number of thesis and dissertation committees at other major US and foreign institutions, occasionally as co-advisor. I have more than 25 years of experience studying the morphology, ecology, behavior, and physiology of reptiles and particularly, marine turtles. These studies have resulted in a number of very successful collaborations.

I integrate my research into my classes including Biology of Sea Turtles, Marine Biology Seminar, Comparative Vertebrate Morphogenesis, Ecological Developmental Biology, Environmental Sex Determination, and Marine Conservation Biology. Each year I give 4-8 general and professional lectures in reptile anatomy and physiology, sea turtle biology, oceans and climate, marine dispersal, and conservation. I provided my scientific expertise for *Turtle: Incredible Journey*, a feature length film, National Geographic Magazine's feature on leatherback turtles, and *Inside Nature's Giants* (TV4, UK).

3. Thesis Advising

Total graduate students: 27 (1 Ph.D, [3 current Ph.D. candidates], 22 M. Sci. [1 current M. Sci]. Post-doctoral scholars: 2 (1 current sponsored w S. Milton). Recent graduates –Past 5 years: Justin Perrault Ph.D., 2013 (USF and Loggerhead Marinelife Center); Micah Rogers 2013 (Southern Nevada Environmental Inc., Reno, NV); Rachel Welicky M. Sci. 2010 (Ph.D. 2015 Arkansas State University); Erin Dougherty, 2009 (Robeson Community College); Jeremy R. Conrad 2008 (U.S. Fish and Wildlife Service & Ph.D. candidate FAU); Post doctoral associates: Angela Rivera 2011 (Creighton University); Itzel Sifuentes 2015-present.

CAIYUN ZHANG
Associate Professor, Department of Geosciences, Florida Atlantic University
777 Glades Road, Boca Raton, Florida 33431
Phone: 561-297-2648; Email: czhang3@fau.edu; web: http://home.fau.edu/czhang3/web/

Professional Preparation

Ocean University of China	Marine Geology	B.S.	1998
Ocean University of China	Marine Geology	M.S.	2003
Ocean University of China	Ocean Remote Sensing	Ph.D.	2007
University of Texas at Dallas	Geospatial Information Sciences	Ph.D.	2010

Appointments

2016.01 - present	Associate Professor, Florida Atlantic University (FAU), USA
2011.01 - 2016.08	Assistant Professor, FAU, USA
2010.08 - 2010.12	Instructor, FAU, USA
2010.01 - 2010.06	Satellite Oceanographer, NODC/NOAA, USA
2007.01 - 2009.12	Teaching Assistant, Program of GIS, University of Texas at Dallas, USA
2005.07 - 2006.06	Visiting Scholar, IPRC, University of Hawaii at Manoa, USA
1998.09 - 2000.08	Instructor, Zhejiang Ocean University, China

Selected Peer-reviewed Publications

1) **Zhang, C**., 2016. Multiscale Quantification of Urban Composition from EO-1/Hyperion Data Using Object-based Spectral Unmixing. *International Journal of Applied Earth Observation and Geoinformation*, 47, 153-162.
2) **Zhang, C**., D. Selch, and H. Cooper, 2016. A Framework to Combine Three Remotely Sensed Data Sources for Vegetation Mapping in the Central Florida Everglades. *Wetlands*, 36, 201-213.
3) **Zhang, C**., Y. Zhou, and F. Qiu, 2015. Individual Tree Segmentation from LiDAR Point Clouds for Urban Forest Inventory. *Remote Sensing*, 7, 7892-7913.
4) **Zhang, C**., 2015. Applying Data Fusion Techniques for Benthic Habitat Mapping and Monitoring in a Coral Reef Ecosystem. *ISPRS Journal of Photogrammetry and Remote Sensing*, 104, 213-223.
5) **Zhang, C**., 2014. Combining Hyperspectral and LiDAR Data for Vegetation Mapping in the Florida Everglades. *Photogrammetric Engineering & Remote Sensing*, 80, 733-743.
6) **Zhang, C**., and Z. Xie, 2014. Data Fusion and Classifier Ensemble Techniques for Vegetation Mapping in the Coastal Everglades. *Geocarto International*, 29, 228-243.
7) **Zhang, C**., and Z. Xie, 2013. Object-based Vegetation Mapping in the Kissimmee River Watershed Using HyMap Data and Machine Learning Techniques. *Wetlands*, 33, 233-244.
8) **Zhang, C**., D. Selch, Z. Xie, C. Roberts, H. Cooper, and G. Chen, 2013. Object-based Benthic Habitat Mapping in the Florida Keys from Hyperspectral Imagery. *Estuarine, Coastal and Shelf Science*, 134, 88-97.
9) **Zhang, C**., and Z. Xie, 2012. Combining Object-based Texture Measures with a Neural Network for Vegetation Mapping in the Everglades from Hyperspectral Imagery. *Remote Sensing of Environment*, 124, 310-320.
10) **Zhang, C**., and F. Qiu, 2012. Mapping Individual Tree Species in an Urban Forest Using Airborne LiDAR Data and Hyperspectral Imagery. *Photogrammetric Engineering & Remote Sensing*, 78, 1079-1087.

Synergistic Activities

- I have been involved in the research and education of remote sensing since 2003. Over the last 10 years, I have been actively developing expertise in remote sensing of vegetation and ocean climate, as well as spatial modeling and analysis. I have developed new algorithms and innovative frameworks to combine multiple remote sensing data sources for vegetation mapping

in urban areas and the Florida Everglades. I also developed a new algorithm to solve difficult areal interpolation problems.

- Since joining FAU, I have published 18 peer-reviewed journal articles (3 single authored, 12 first authored, and 4 co-authored). I have been awarded the First Place of 2013 ERDAS Award for Best Scientific Paper in Remote Sensing from the American Society for Photogrammetry and Remote Sensing (ASPRS), 2012 Early Career Paper Award by the Remote Sensing Specialty Group (RSSG) of Association of American Geographers (AAG), and the First Place of 2010 Student Honors Paper Competition by the RSSG of AAG.
- I finished my first Ph.D. in ocean remote sensing at the Ocean University of China (OUC). My dissertation research identified and simulated low-frequency variations and interactions in the air-sea system using remote sensing data. My dissertation won the Best Doctoral Dissertation Award in 2008. Serving as the principle investigator, my research was funded by the Natural Science Foundation of China (NSFC) during 2008-2010. In 2009, I won the National Natural Science Award (First Prize) honored by the Ministry of Education in China to recognize my significant contributions in another NSFC sponsored project entitled "Multi-sensors remote sensing the boundary of the ocean and atmosphere: theories and methods". I have published 11 peer-reviewed papers in ocean remote sensing, many of which are in internationally prestigious journals, such as *Journal of Geophysical Research*, and *Geophysical Research Letters*.
- Currently I serve as the PI for a FAU internally funding projects to investigate remote sensing of water quality in the Florida Everglades, and the Co-PI for a project funded by the U.S. Geological Survey to model water salinity in the Everglades using remote sensing.
- I am the Member of AAG and ASPRS. I have served as the reviewer for NSF and many international journals, the judge for the Student Honors Paper Competition of RSSG at AAG, and a session organizer for the 2013 AAG annual conference. I have also participated in various services at FAU. I also serve as the committee member of 6 Ph.D. students at FAU. I have been acting as the Assistant Director of the Center for Geo-Information Science at FAU since August 2013.

Collaborators & Other Affiliations

Collaborators and Co-Editors: Dr. Fang Qiu (University of Texas at Dallas); Dr. Ge Chen (Ocean University of China); Dr. Leonard Berry (CES of FAU); Dr. Marguerite Koch (Biology, FAU); Dr. Zhixiao Xie (FAU).

Graduate Advisor: Prof. Fang Qiu (University of Texas at Dallas); Prof. Ge Chen (Ocean University of China); Prof. Zuosheng Yang (Ocean University of China, retired).

Thesis Advisor and Postgraduate-Scholar Sponsor: Aaron Evens (co-advisor, Ph.D., graduated Summer 2014); Donna Selch (Ph. D., graduated Summer 2016); Hannah Cooper (Ph. D., ongoing); Nicole Gamboa (M. A., graduated Spring 2016); Sara Denka (Ph.D., ongoing); Pramod Pandy (Ph.D., ongoing); Molly Smith (Ph.D., ongoing); and Dr. Dezhi Huang (Visiting scholar from Central South University of China).

Courses Taught

Hyperspectral Remote Sensing
LiDAR Remote Sensing
Digital Image Analysis
Photogrammetry and Aerial Photography Interpretation
Marine Geology

APPENDIX A

TABLE 4
ANTICIPATED FACULTY PARTICIPATION

Faculty Code	Faculty Name or "New Hire" Highest Degree Held Academic Discipline or Speciality	Rank	Contract Status	Initial Date for Participation in Program	Mos. Contract Year 1	FTE Year 1	% Effort for Prg. Year 1	PY Year 1	Mos. Contract Year 5	FTE Year 5	% Effort for Prg. Year 5	PY Year 5
D	Laurent Cherubin, Ph.D. Marine Science	Assoc. Prof	Non-Tenure	Fall 2017	12	1.00	0.25	0.25	12	1.00	0.25	0.25
D	Mingshun Jiang, Ph.D. Physical Oceanography	Assoc. Prof	Non-Tenure	Spring 2018	12	1.00	0.25	0.25	12	1.00	0.25	0.25
D	James Sullivan, Ph.D. Oceanography	Prof	Non-Tenure	Fall 2017	12	1.00	0.13	0.13	12	1.00	0.13	0.13
D	Peter McCarthy Biochemistry	Prof	Non-Tenure	Fall 2017	12	1.00	0.25	0.25	12	1.00	0.25	0.25
D	M. Dennis Hanisak, Ph.D. Biological Sciences	Prof	Non-Tenure	Fall 2017	12	1.00	0.25	0.25	12	1.00	0.25	0.25
D	Fraser Dalgleish, Ph.D. Engineering	Assoc. Prof	Non-Tenure	Spring 2018	12	1.00	0.25	0.25	12	1.00	0.25	0.25
D	Anni Dalgleish, Ph.D. Engineering	Asst. Prof	Non-Tenure	Spring 2018	12	1.00	0.25	0.25	12	1.00	0.25	0.25
D	Joshua Voss, Ph.D. Biological Sciences	Asst. Prof	Non-Tenure	Spring 2018	12	1.00	0.25	0.25	12	1.00	0.25	0.25

D	Susan Laramore, Ph.D. Biological Sciences	Asst. Prof	Non-Tenure	Spring 2018	12	1.00	0.25	0.25	12	1.00	0.25	0.25
D	Paul Wills, Ph.D. Zoology	Prof	Non-Tenure	Fall 2018	12	0.00	0.00	0.00	0	0.00	0.00	0.00
D	Bing Ouyang, Ph.D. Electrical Engineering	Asst. Prof	Non-Tenure	Fall 2018	12	0.00	0.00	0.00	0	0.00	0.00	0.00
A	Sarah Milton, Ph.D. Marine Biology and Fisheries	Assoc. Prof	Tenured	Fall 2017	9	0.75	0.04	0.03	9	0.75	0.04	0.03
A	Stephen Kajiura, Ph.D. Zoology	Prof	Tenured	Fall 2017	9	0.75	0.04	0.03	9	0.75	0.04	0.03
A	Marguerite Koch-Rose, Ph.D. Biological Science: Marine	Prof	Tenured	Fall 2018	9	0.00	0.00	0.00	0	0.00	0.00	0.00
A	Marianne Porter, Ph.D. Biological Science	Asst. Prof	Tenure Track	Spring 2018	9	0.75	0.04	0.03	9	0.75	0.04	0.03
A	Nathan Dorn, Ph.D. Zoology	Assoc. Prof.	Tenured	Fall 2018	9	0.00	0.00	0.00	9	0.00	0.00	0.00
	Dale Gawlick, Ph.D. Wildlife Science	Prof.	Tenured	Fall 2018	9	0.00	0.00	0.00	9	0.00	0.00	0.00
A	Tanja Godenschwege, Ph.D. Biology	Assoc. Prof.	Tenured	Spring 2017`	9	0.75	0.04	0.03	9	0.75	0.04	0.03
A	Jeanette Wyneken, Ph.D. Biological Science	Prof.	Tenured	Summer 2018	9	0.75	0.04	0.03	9	0.75	0.04	0.03
A	Scott Markwith, Ph.D. Geography	Assoc. Prof	Tenured	Fall 2017	9	0.75	0.04	0.03	9	0.75	0.04	0.03
A	Anton Oleinik, Ph.D. Geology	Assoc. Prof.	Tenured	Fall 2018	9	0.00	0.00	0.00	9	0.00	0.00	0.00
A	Charles Roberts, Ph.D. Geography	Assoc. Prof	Tenured	Spring 2017	9	0.00	0.00	0.00	9	0.00	0.00	0.00

A	Tiffany Roberts Briggs, Ph.D. Geology	Assist. Prof.	Tenure Track	Fall 2017	9	0.75	0.04	0.03	9	0.75	0.04	0.03
A	Tara Root Ph.D. Geology and Geophysics	Assoc. Prof.	Tenured	Spring 2018	9	0.00	0.00	0.00	9	0.00	0.00	0.00
	Caiyun Zhang, Ph.D. Geospatial Information Sciences	Assoc. Prof.	Tenured	Spring 2018	9	0.00	0.00	0.00	9	0.00	0.00	0.00
A	Erik Noonburg, Ph.D. Biological Sciences	Assoc. Prof.	Tenured	Spring 2018	9	0.75	0.04	0.03	9	0.75	0.04	0.03
A	Zhixiao Xie, Ph.D Geography	Prof	Tenured	Fall 2017	9	1.00	0.04	0.04	9	0.75	0.04	0.03
A	David Warburton, Ph.D. Geophysical Sciences	Assoc. Prof.	Tenured	Fall 2017	9	0.75	0.04	0.03	9	0.75	0.04	0.03
	Total Person-Years (PY)							**2.40**				**2.39**

Faculty Code		**Source of Funding**	**PY Workload by Budget Classsification**		
			Year 1		**Year 5**
A	Existing faculty on a regular line	Current Education & General Revenue	0.27		0.26
B	New faculty to be hired on a vacant line	Current Education & General Revenue	0.00		0.00
C	New faculty to be hired on a new line	New Education & General Revenue	0.00		0.00
D	Existing faculty hired on contracts/grants	Contracts/Grants	2.13		2.13
E	New faculty to be hired on contracts/grants	Contracts/Grants	0.00		0.00
		Overall Totals for	**Year 1** 2.40		**Year 5** 2.39