College of Charleston
Graduate Program in Marine Biology

15th ANNUAL
STUDENT RESEARCH COLLOQUIUM

September 23rd – 24th 2011

Fort Johnson Marine Resources Center
Marine Resources Research Institute Auditorium

PROGRAM & ABSTRACTS

PURPOSE AND HISTORY

The Student Research Colloquium of the Graduate Program in Marine Biology (GPMB) was established in 1998, to increase awareness of research activities by students and faculty affiliated with GPMB; to provide graduate students with experience in making scientific presentations; and to promote interactions among faculty and students conducting research in marine biology. The Colloquium Committee looks forward to your comments regarding ways to improve and enhance this annual event, and thanks all the sponsors for their support.

Previous Keynote Speakers

1999 **Dr. Ken Tenore**, Chesapeake Biological Laboratory, University of Maryland
2000 **Dr. John Pearse**, Institute of Marine Science, Univ. of California, Santa Cruz
2001 **Dr. Lauren Mullineaux**, Woods Hole Oceanographic Institute
2002 **Dr. Larry Crowder**, Duke Marine Laboratory, Duke University
2003 **Dr. Walter Boynton**, Chesapeake Biological Laboratory, Univ. of Maryland
2004 **Dr. Malcolm Shick**, School of Marine Sciences, University of Maine
2005 **Dr. Margaret McFall-Ngai**, University of Wisconsin-Madison Medical School
2006 **Dr. Jeffrey Levinton**, State University of New York at Stony Brook
2007 **Dr. Peter Wainwright**, University of California, Davis
2008 **Dr. James T. Carlton**, Williams College & Williams-Mystic Program
2009 (Feb.) **Dr. Steve Palumbi**, Hopkins Marine Station & Stanford University
2009 (Sep.) **Dr. Erik Sotka** CofC & **Dr. Geoff Scott**, Hollings Marine Laboratory
2010 **Dr. Win Watson**, University of New Hampshire

SPONSORS OF THE STUDENT RESEARCH COLLOQUIUM, FALL 2011

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City Lights Coffee

STUDENT RESEARCH COLLOQUIUM FALL 2011 PROGRAM

Oral presentations will be held at the South Carolina Department of Natural Resources (SCDNR) Marine Resources Research Institute (MRRI), at Fort Johnson. The Friday evening Poster Session and Social, and the Lowcountry Boil on Saturday will take place in the SCDNR Outdoor Classroom adjacent to the Marshlands House.

Posters will be displayed in the hallways of MRRI, prior to the poster session, beginning at 12 noon on Wednesday September 21st and will be moved to the SCDNR Outdoor Classroom by 3:00 p.m. on Friday. Poster presenters will attend their posters in one of two shifts (from 5:15pm to 6:15pm and 6:15pm to 7:15 pm) on Friday September 23rd.

FRIDAY SEPTEMBER 23rd

Noon – 3:00 Students hang posters; should be completed by 3:00pm.

4:00 Opening Remarks
Dr. Jaap Hillenius, Chair
Department of Biology, College of Charleston

4:05 Introduction of Keynote Speaker
Dr. Erik Sotka
Grice Marine Laboratory, College of Charleston

4:10 Keynote Address
Dr. John Bruno, University of North Carolina, Dept. of Marine Sciences
"Changes in Caribbean reef communities: patterns, causes and mitigation."

5:15 – 7:15 Poster Session & Social
Presenters of odd-numbered posters should be at their posters from 5:15-6:15pm and presenters of even-numbered posters from 6:15-7:15pm.

SATURDAY SEPTEMBER 24th

9:30 Introduction
Dr. Peter Kingsley-Smith
Marine Resources Research Institute,
South Carolina Department of Natural Resources

ORAL PRESENTATIONS

SESSION 1 Moderator: Karen Burnett (College of Charleston)

9:45 TOXIC DINOGLAGELLATES AND THEIR ASSOCIATED MICROBIAL COMMUNITY: PRELIMINARY EVIDENCE THAT ALGICIDAL BACTERIA INTERFERE WITH THE AL-2 QUORUM SENSING SYSTEM.
Blair, W. (GPMB, College of Charleston) and Doucette, G. (Marine Biotoxins Program, NOAA/NOS).

10:00 MYXOZOAN PARASITES OF THE SPOTTED SEATROUT: DO THEY WEAKEN THE HEALTH OF THEIR HOSTS?
Cosmann, P. (GPMB, College of Charleston), Arnott, S. (SCDNR), de Buron, I. (College of Charleston), Roumillat, W.A. (SCDNR) and Strand, A. (College of Charleston).

10:15 POPULATION STRUCTURE OF SPOT (*LEIOSTOMUS XANTHURUS*) IN SOUTH CAROLINA.
Johnson, J. (MES, College of Charleston), Arnott, S. (SCDNR), Roumillat, W.A. (SCDNR), Whitaker, D. (SCDNR), Ballenger, J. (SCDNR) and McDonough, C. (SCDNR).

10:30 COMPARATIVE EFFECTS OF *IN VITRO* PFOS AND DE-71 EXPOSURE ON BOTTLENOSE DOLPHIN AND MURINE IMMUNE FUNCTION.
Wirth, J.R. (GPMB, College of Charleston), Peden-Adams, M.M. (University of Nevada), Henry, N. (NOAA/NOS/CCEHBR) and Fair, P.A. (NOAA/NOS/CCEHBR).

10:45 – 11:00 Break

SESSION 2 Moderator: Karen Burnett (College of Charleston)

11:00 QUANTIFICATION OF THE INTERACTION BETWEEN BOTTLENOSE DOLPHINS AND THE ATLANTIC BLUE CRAB FISHERY IN CHARLESTON, SC.
Duquette, A. (GPMB, College of Charleston), Kracker, L. (NOAA/NOS/CCEHBR) and McFee W. (NOAA/NOS/CCEHBR).

11:15 THE ROLE OF NANOG IN MAINTAINING LUNG HEALTH IN THE BOTTLENOSE DOLPHIN, *TURSIOPS TRUNCATUS.*
Glade, L. (GPMB, College of Charleston) and Baatz, J.E. (Department of Pediatrics, MBES, MUSC).

11:30 ANTAGONISTIC INTERACTIONS AMOUNG BACTERIAL POPULATIONS OF MARINE INTERTIDAL SEDIMENTS.
Hook, W. (GPMB, College of Charleston) and Plante, C. (College of Charleston).

11:45 – 1:15 Lunch

SESSION 3 Moderator: Rob Dillon (College of Charleston)

1:15 A LATITUDINAL BODY SIZE CLINE IN A MARINE ISOPOD REFLECTS LOCAL ADAPTATION TO SEAWATER TEMEPERATURE AND PREDATOR RISK.
Manyak, A. (GPMB, College of Charleston), Bell, T. (College of Charleston) and Sotka, E. (College of Charleston).

1:30 IMPACT OF TEMPERATURE-INDUCED VIRAL RESISTANCE ON DIMETHYLATED SULFUR COMPOUNDS IN THE COCCOLITHOPHORID, *EMILIANIA HUXLEYI.* Kendrick, J.B. (GPMB, College of Charleston) and DiTullio, J. (College of Charleston).

1:45 RECOVERY FROM HYPOXIA AND HYPERCAPNIC HYPOXIA: IMPACTS ON THE TRANSCRIPTION OF KEY ANTIOXIDANT GENES IN THE SHRIMP *LITOPENAEUS VANNAMEI.*
Darling, C. (GPMB, College of Charleston), Burnett, K. (College of Charleston) and Burnett, L. (College of Charleston, Hollings Marine Laboratory).

2:00 THE INFLUENCE OF ENVIRONMENTAL pH / HYPERCAPNIA ON THE SHELL STRENGTH OF THE EASTERN OYSTER, *CRASSOSTREA VIRGINICA*.
Sherer, E. (MES, College of Charleston) and Burnett, L. (College of Charleston).

2:15 – 2:30 Break

SESSION 4 Moderator: Rob Dillon (College of Charleston)

2:30 EFFECT OF SEDIMENT ON THE ANTIMICROBIAL ACTIVITY OF *MELANOCHLAMYS DIOMEDEA* AMONG DIFFERENT HABITATS.
Smoot, S. (GPMB, College of Charleston), Plante, C. (College of Charleston) and Podolsky, R.D. (College of Charleston).

2:45 PERFORMANCE CHANGES WHEN EXPOSED TO VARYING OXYGEN LEVELS IN THE ATLANTIC BLUE CRAB, *CALLINECTES SAPIDUS* RATHBUN.
Stover, K. (GPMB, College of Charleston), Burnett, L. (College of Charleston), McElroy, E. (College of Charleston) and Burnett, K. (College of Charleston).

3:00 DETERMINING FACTORS THAT INFLUENCE THE MOLECULAR QUANTIFICATION OF THE HARMFUL RAPHIDOPHYTE, *HETEROSIGMA AKASHIWO,* USING A SANDWICH HYBRIDIZATION ASSAY (SHA).
Doll, C. (GPMB, College of Charleston) and Greenfield, D. (University of South Carolina & SCDNR).

3:15 – 4:00 Break

4:00 Closing address
Dr. John Bruno, University of North Carolina, Dept. of Marine Sciences
"The impacts of climate change on ocean ecosystems."

5:00 Closing remarks and award presentation
Dr. Craig Plante, Grice Marine Laboratory, College of Charleston

5:30 Lowcountry Boil and introduction of new students
SCDNR Outdoor Classroom

POSTER PRESENTATIONS

#1 **COMMUNITY STRUCTURE OF TEMPERATE REEF FISH AS A FUNCTION OF REEF AGE: CASE STUDY USING LOW-RELIEF ARTIFICIAL AND NATURAL REEFS.**
Altizer, C. (GPMB, College of Charleston), Reichert, M. (SCDNR), Ballenger, J. (SCDNR), Sancho, G. (College of Charleston) and Martore, R. (SCDNR).

#2 **SPATIAL AND TEMPORAL GENETIC DIFFERENCES IN STRIPED BASS, *MORONE SAXATILIS*, IN FOUR SOUTH CAROLINA WATERSHEDS.**
Anderson, A. (GPMB, College of Charleston).

#3 **LOW-TEMPERATURE TOLERANCE OF AGE-0 SPOTTED SEATROUT, *CYNOSCION NEBULOSUS*, IN SOUTH CAROLINA.**
Anweiler, K. (GPMB, College of Charleston) and Denson, M. (SCDNR).

#4 **DIET AND FEEDING SELECTIVITY OF ESTUARINE GOBIES OF SOUTH CAROLINA.**
D'Aguillo, M. (GPMB, College of Charleston) and Harold, A. (College of Charleston).

#5 **FEEDING ECOLOGY AND REPOPULATION RATES OF LIONFISH ON SOUTH CAROLINA ARTIFICIAL REEFS.**
Doty, S. (GPMB, College of Charleston) and Sancho, G. (College of Charleston).

#6 **CHARACTERIZATION OF THE *SYMBIODINIUM MICROADRIATICUM* SPLICED LEADER RNA AND THE EFFECT OF HEAT AND CHEMICAL SHOCK ON THE RNA *TRANS*-SPLICING MECHANISM.**
Feltman, P. (GPMB, College of Charleston) and Van Dolah, F. (NOAA/NOS/CCEHBR).

#7 **PREDICTING IMPACTS OF GLOBAL CLIMATE CHANGE ON THE NORTHWEST ATLANTIC LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*) POPULATION: LOCOMOTOR RESPONSES OF HATCHLINGS TO DIFFERING INCUBATION TEMPERATURES.**
Fisher, L. (GPMB, College of Charleston) and Owens, D. (College of Charleston).

#8 **EFFECTS OF HYPOXIA AND LOW pH ON MOSQUITO CONTROL PESTICIDE TOXICITY IN TWO COMMERCIAL SHELLFISH SPECIES.**
Garcia, R. (GPMB, College of Charleston) and DeLorenzo, M. (NOAA).

#9 **COMPARATIVE IMPACT OF THE INVASIVE PARASITIC SPECIES, *ANGUILLICOLOIDES CRASSUS* ON THE AMERICAN EEL POPULATIONS BETWEEN THE ACE BASIN AND NORTH INLET NERRS AND THE COOPER RIVER.**
Hein, J. (MES Program, College of Charleston), Arnott, S. (SCDNR), de Buron, I. (College of Charleston), Roumillat, W.A. (SCDNR) and Upchurch, S. (SCDNR).

#10 **DISTRIBUTION AND HEALTH ASSESSMENT OF RED DRUM, *SCIAENOPS OCELLATUS*, EXHIBITING EXTERNAL LESIONS WITHIN SOUTH CAROLINA ESTUARIES.**
Meadors, W. (GPMB, College of Charleston) and Arnott, S. (SCDNR).

#11 **SPATIAL AND TEMPORAL VARIATION OF GENETIC DIVERSITY IN RED PORGY, *PAGRUS PAGRUS*, IN THE SOUTH ATLANTIC BIGHT.**
Murray, D.C. (GPMB, College of Charleston).

#12 **ASSESSMENT OF POPULATION GENETIC STRUCTURE IN THE SPOTTED EAGLE RAY (*AETOBATUS NARINARI*) FOUND SEASONALLY OFF COASTAL SARASOTA, FL.**
Newby, J. (GPMB, College of Charleston) and Shedlock, A. (College of Charleston).

#13 **CHARACTERIZING THE GENETIC POPULATION STRUCTURE AND GENETIC INFLUENCES OF WINTER-KILL EVENTS IN SPOTTED SEATROUT (*CYNOSCION NEBULOSUS*) IN SOUTH CAROLINA.**
O'Donnell, T. (GPMB, College of Charleston).

#14 **DIETARY NICHE OVERLAP OF AN ESTUARINE PREDATOR COMMUNITY IN SOUTH CAROLINA.**
Shaw, A. (GPMB, College of Charleston), Sancho, G. (College of Charleston) and Frazier, B. (SCDNR).

#15 **EFFECTS OF LIGHT IRRADIANCE LEVELS ON THE EXPRESSION AND ABUNDANCE OF ICE-BINDING PROTEINS IN THE SEA ICE DIATOM, *FRAGILARIOPSIS CYLINDRUS.***
Smith, J. (GPMB, College of Charleston), Janech, M. (MUSC), DiTullio, J. (College of Charleston), Lee, P. (College of Charleston) and Byrum, C. (College of Charleston).

#16 **EFFECTIVENESS AND COSTS OF HYPOXIA ACCLIMATION IN PACIFIC WHITE SHRIMP, *LITOPENAEUS VANNAMEI*.**
Tommerdahl, A. (GPMB, College of Charleston), Burnett, L. (College of Charleston) and Burnett, K. (College of Charleston).

#17 **GROWTH, DISTRIBUTION, AND SKELETAL STRUCTURE OF DEEP-WATER SCLERACTINIAN CORALS UNDER 'ACIDIFIED' OCEAN CONDITIONS IN THE SOUTHERN CALIFORNIA BIGHT.**
Wickes, L. (GPMB, College of Charleston) and Etnoyer, P. (NOAA).

Keynote Speaker

Dr. John Bruno

Associate Professor of Marine Science
Department of Marine Sciences
University of North Carolina, Chapel-Hill

John Bruno is a marine ecologist and Associate Professor at The University of North Carolina at Chapel Hill. His research is focused on marine biodiversity, coral reef ecology and conservation and the impacts of climate change on marine ecosystems. John earned his Ph.D. from Brown University in Ecology and Evolutionary Biology and was a postdoctoral fellow at Cornell University in disease ecology. He is currently working primarily in Belize, the Bahamas, Cuba and the Galapagos Islands.

John blogs about the ocean, having co-developed the oceans web site SeaMonster (www.theseamonster.net). He also is developing a blue carbon offsetting company (The Blue Carbon Project - http://www.thebluecarbonproject.com) that is restoring mangroves in northern coastal Ecuador. In his spare time he bikes, surfs, kite surfs and mountain bike racing.

Websites:
www.johnfbruno.com
The Bruno Lab: http://www.brunolab.net/

KEYNOTE ADDRESS ABSTRACT — FRIDAY SEPTEMBER 23rd @ 4:10 PM

Changes in Caribbean reef communities: patterns, causes and mitigation.

Caribbean coral reefs have changed dramatically since I was in high school. One thing that fascinates me about Caribbean reef change is how quickly an ecosystem can be transformed across a huge regional scale. I also constantly wonder how much of this change can be attributed to people and how much is natural. I will discuss the spatio-temporal patterns in coral reef change, primarily in terms of coral and fish loss and macroalgal increase. Despite broad agreement by reef scientists about the degree of change, there is an ongoing debate about when, where, and why reefs have changed, and even about whether they are currently locked in an "Alternative Stable State". I will also address some of the main explanations for changes in coral reef benthic communities and the potential for local management actions, such as the implementation of marine reserves, to mitigate coral loss by increasing "reef resilience".

CLOSING ADDRESS ABSTRACT — SATURDAY SEPTEMBER 24th @ 4:00 PM

Impacts of climate change on ocean ecosystems

That Anthropogenic Climate Change (ACC) is changing ocean ecosystems will surprise nobody at an ocean sciences conference. Yet there are still some interesting surprises about the realized and predicted impacts of ACC. For example, in some systems, warming could drive an increase in species richness via range shifts. In other systems, warming will facilitate the development of new biogenic habitats or change species composition to such a degree that we have no idea what the resulting community will look like or how it will function. There are also underappreciated temperature-dependent biological and ecological processes (e.g., metabolism) that will be affected, greatly altering how ecosystems function. Finally, the seemingly obvious negative impacts of warming can be exceedingly difficult to reliably attribute to ACC when placed in a rigorous empirical context, particularly when following the guidelines of the IPCC. Take home message: there are still plenty of surprises out there and studying the effects of ACC is a lot more interesting – and challenging – than simply documenting animals dying by overheating.

PRESENTATION AWARD(S)

Presentations will be judged on 1) scientific content based on the articulation of the problem, soundness of hypothesis testing, methodologies, and analyses; 2) oral and visual quality of the delivery; and 3) demonstration of confidence and depth of understanding of the material.

A panel of awards judges will be appointed before the Colloquium. For each presentation, the judges will complete a narrative evaluation form; these evaluation forms will be given to presenters after the Colloquium. Following the final presentation, judges will meet to discuss their evaluations and select the award recipient.

Additional narrative evaluation forms will be made available to audience members during the sessions so that presenters will be provided with additional feedback, but this feedback will not be considered in selecting the award recipient.

Following the colloquium, each award winner will receive a personalized certificate of recognition and a cash award (sponsored by Sigma Xi, The Scientific Research Society, Charleston Chapter), which will be presented by Dr. Rob Dillon on behalf of Sigma Xi.

Oral Presentation Award Winners:

2010 David Shiffman
2009 (Sep.) Melanie Hedgespeth
2009 (Feb.): Megan Kent
2008: Tom Baird
2007: Courtney Arthur
2006: Deb Zdankiewicz
2005: Eric Pante
2004: Stephanie Brunelle
2003: David Couillard
2002: Bob Grant

Poster Presentation Awards

2010 Cameron Doll
2009 Lindsey Parent & Joy Gerhard

Proposal Poster Awards

2009 Ryan Joyce & Tessa Bricker

POSTER PRESENTATION ABSTRACTS

#1

COMMUNITY STRUCTURE OF TEMPERATE REEF FISH AS A FUNCTION OF REEF AGE: CASE STUDY USING LOW-RELIEF ARTIFICIAL AND NATURAL REEFS.

Altizer, C. (GPMB, College of Charleston), Reichert, M. (SCDNR), Ballenger, J. (SCDNR), Sancho, G. (College of Charleston) and Martore, R. (SCDNR).

Artificial reefs are used to enhance fish populations, provide new fishing opportunities, and mitigate habitat loss. Research has not determined conclusively, however, whether low-relief artificial reefs can mimic the fish communities of low-relief natural reefs or how long this process takes. This study will measure fish species richness, diversity, evenness, and abundance at three artificial reefs of differing ages (0 years, 4 years, and 14 years since deployment) and two neighboring live-bottom natural reefs in Charleston, South Carolina. Fish surveys will be conducted once per month on each reef from September-November 2011 and March-November 2012 using SCUBA and video point-counts. Species richness, diversity, evenness, and abundance will be analyzed using regressions and analyses of variance (ANOVA). Fish communities will be compared statistically using analyses of similarity (ANOSIM). The study predicts that species richness, diversity, evenness, and abundance increases with reef age and that the fish community of the 14-year old reef will be most similar to the natural reefs. This project will build on previous studies comparing artificial and natural reefs and expand the present knowledge of the effects of reef age on fish communities. This research has fisheries conservation and management implications. It is important to determine how long artificial reefs must be established before their fish communities resemble those of neighboring natural reefs to utilize them most effectively for habitat mitigation.

#2

SPATIAL AND TEMPORAL GENETIC DIFFERENCES IN STRIPED BASS, *MORONE SAXATILIS*, IN FOUR SOUTH CAROLINA WATERSHEDS.

Anderson, A. (GPMB, College of Charleston).

In order to properly manage a species over a large geographic area, it is necessary to understand the genetic connectivity both among and within river systems in order to identify appropriate management units. South Carolina's striped bass populations, while native, have been supportively stocked since 1984. Previous studies provided some evidence of genetic differentiation within the Santee-Cooper system and between South Carolina watersheds and in response, State managers stopped stocking the ACE and Pee Dee systems and only currently stock striped bass in the Santee-Cooper system. While the previous studies did detect genetic differentiation, more powerful microsatellites have since been developed for striped bass and may provide greater resolution to our understanding of gene flow and diversity in striped bass populations than was previously available. My proposal will determine if the four watersheds of South Carolina currently contain genetically distinct striped bass populations; if there are currently distinct within-watershed populations in the Santee-Cooper drainage; and if these relationships have changed over time. Striped bass samples will be evaluated

across three time periods: contemporary (2006-2011), recent historic (1999), historic (1990-1995). Populations will be compared across watersheds, across sections, and across time periods to determine patterns of genetic connectivity and the changes these populations have undergone. The project results will increase our understanding of striped bass population dynamics across South Carolina at multiple spatial scales, allowing improved management and restoration efforts for striped bass.

#3
LOW-TEMPERATURE TOLERANCE OF AGE-0 SPOTTED SEATROUT, *CYNOSCION NEBULOSUS*, IN SOUTH CAROLINA.
Anweiler, K. (GPMB, College of Charleston) and Denson, M. (SCDNR).

Mortality due to low temperatures impacts population dynamics by reducing total stock size, influencing recruitment, and differentially weakening annual cohort strength. In South Carolina, spotted seatrout are periodically affected by rapid changes in temperature during the winter. Spotted seatrout are vulnerable to winter kills when air temperature drops, causing the shallow water to chill rapidly. In these conditions, temperature changes are so sudden that fish may be immobilized and killed due to osmotic imbalance before they are able to escape the cold. Significant population declines have been observed in South Carolina following extreme low temperatures in the winter. In this study I will evaluate the effects of rate of temperature decline and exposure time on survival of age-0 spotted seatrout. The first experiment will use the chronic lethal method (CLM) to determine the upper and lower bounds of low temperatures that result in 100% survival and 0% survival by subjecting spotted seatrout to a -1˚ C/day change in temperature. The range of temperatures found to affect seatrout survival will determine the test temperatures to be used in subsequent experiments. Experiment 2 will use the acclimated chronic exposure (ACE) method to determine the relationship between exposure time and survival at three different test temperatures representing varying winter severities. Experiment 3 will repeat experiment 2 at a slower rate of decline.

#4
DIET AND FEEDING SELECTIVITY OF ESTUARINE GOBIES OF SOUTH CAROLINA.
D'Aguillo, M. (GPMB, College of Charleston) and Harold, A. (College of Charleston).

We propose to examine the diet of the naked goby (*Gobiosoma bosc* Lacepède, 1800) and other goby species encountered in Charleston harbor and vicinity, and investigate if selective feeding behavior occurs. Many benthic gobies feed by engulfing sand and filtering it with the gill rakers in search of potential food items. This behavior has been demonstrated to occur even in the absence of prey items, suggesting that gobies may be feeding indiscriminately on any potential food items available. Gobies also feed as visual predators of invertebrates. We will investigate whether *G. bosc* is targeting preferred food items while foraging, or feeding equally on all potential food items encountered in the environment. Feeding selectivity will be determined by comparing the relative abundance of identified items in the diet with that of the surrounding environment. *G. bosc* prefers structurally complex habitat such as oyster reefs, but is

frequently encountered on soft bottom habitat as well. Therefore, *G. bosc* will be collected from a variety of habitat types, including both soft and hard-bottom substratum, to investigate variation in feeding selectivity. We also propose to investigate if diet and feeding selectivity vary ontogenetically, and if diet and feeding selectivity change in the presence of other goby species sharing the habitat.

#5
FEEDING ECOLOGY AND REPOPULATION RATES OF LIONFISH ON SOUTH CAROLINA ARTIFICIAL REEFS.
Doty, S. (GPMB, College of Charleston) and Sancho, G. (College of Charleston).

The Indo-Pacific lionfish is an invasive fish that has become established in the Caribbean Sea, Gulf of Mexico, and western North Atlantic Ocean along the southeast coast of the United States within the last two decades. These prolific reef fishes have the potential of wreaking havoc on Atlantic fish populations and ecosystems. Previous studies have shown that lionfish are voracious, opportunistic predators, and can increase the mortality of groupers and snappers. Additionally, their long venomous spines along their dorsal, pelvic, and anal fins serve as a defense against predators. Though several studies have investigated the effects of the invasion on tropical reef systems in the Caribbean and Gulf of Mexico, fewer studies have examined the ecological impacts of these invaders along the southeast U.S. coast. The bottom topography along the southeast coast of the U.S. is largely comprised of flat, sandy bottom spotted with rocky outcroppings and shelf ledges, where lionfish are found. To increase recreational and commercial fish recruitment, the South Carolina Department of Natural Resources (SCDNR) has created several artificial reefs along the South Carolina continental shelf. Lionfish have recruited on these reefs and commonly inhabit them. This study will attempt to first determine the diet of lionfish found in artificial reefs. Secondly, through a lionfish removal experiment, the repopulation dynamics of lionfish to artificial reefs will be measured. These data will help understand the ecology of lionfish on artificial reefs and provide valuable information for future management decisions regarding this invasive species in South Carolina waters.

#6
CHARACTERIZATION OF THE *SYMBIODINIUM MICROADRIATICUM* SPLICED LEADER RNA AND THE EFFECT OF HEAT AND CHEMICAL SHOCK ON THE RNA *TRANS*-SPLICING MECHANISM.
Feltman, P. (GPMB, College of Charleston) and Van Dolah, F. (NOAA/NOS/CCEHBR).

Spliced leader (SL) mediated RNA trans-splicing has been identified in diverse dinoflagellate species, including the coral symbiont, *Symbiodinium microadriaticum*. During SL trans-splicing, first described in trypanosomes, all RNA messages are *trans*-spliced with an identical leader sequence at their 5' end, donated by an hnRNA called the spliced leader RNA. Under conditions of severe stress, trypanosome cells shut off transcription of the SL gene, a response termed spliced leader silencing (SLS). SLS leads to a reduction of SL *trans*-splicing and therefore, mRNA maturation and overall protein synthesis. This study sought to determine whether SLS is part of the stress

response in dinoflagellates, using *Symbiodinium* as a model species. To characterize the SL RNA in *Symbiodinium*, the full-length SL transcript was amplified from total RNA using a multi-step approach, cloned, and sequenced. The *Symbiodinium* SL RNA is 58 nt in length, has a GC content of 50%, and 67% identity with published dinoflagellate SL RNA sequences. Modeling of the *Symbiodinium* SL RNA secondary structure revealed several unique characteristics that are shared among dinoflagellate SL RNAs, but unusual for SL RNAs in general. To identify if SLS occurs in *Symbiodinium,* a qPCR-based assay was developed to quantify SL expression. Using this assay, SL RNA levels were not significantly different between control cultures and cultures exposed to either sublethal heat shock (up to 48 hr exposure to 34° C) or sublethal reductive chemical stress (exposure to 4mM DTT). These results suggest that SLS is not a major contributor to stress responses in dinoflagellates.

#7

PREDICTING IMPACTS OF GLOBAL CLIMATE CHANGE ON THE NORTHWEST ATLANTIC LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*) POPULATION: LOCOMOTOR RESPONSES OF HATCHLINGS TO DIFFERING INCUBATION TEMPERATURES.

Fisher, L. (GPMB, College of Charleston) and Owens, D. (College of Charleston).

Sea turtles have a temperature-based sex determination system. For the Atlantic loggerhead sea turtle (*Caretta caretta)*, a major concern of rapid climate change is that increasing sand temperatures on nesting beaches are female-skewing the hatchling sex ratio. Apparent population-wide female-biased hatchling sex ratios contrast with observations of juvenile populations, where sex ratios have remained constantly female-biased at about 2 to 1 over the past 30 years. It has been suggested that some unknown factor is affecting loggerhead survival resulting in an unexplained differential loss of ~60% of female hatchlings per year. The principle theory to explain this hatchling mortality is that incubation temperature affects traits that influence survival. Previous studies on hatchling performance have not tested the upper or lower limits of incubation temperature, and fitness consequences remain untested or unconfirmed. In this study, laboratory experiments will be conducted to test for an effect of incubation temperature on performance of loggerhead hatchlings. The initial hatchling dispersal period will be simulated in a controlled laboratory setting, and various performance and locomotor variables will be tested over a 24-hour period. Differences in performance that may be seen from hatchlings incubated at high temperatures are important in light of increased sand temperatures, and could indicate increased mortality from incubation temperature effects. Preliminary performance data will be presented. By conducting controlled laboratory experiments on hatchlings, the results will support or refute incubation temperature as a significant variable affecting loggerhead hatchling survival.

#8

EFFECTS OF HYPOXIA AND LOW pH ON MOSQUITO CONTROL PESTICIDE TOXICITY IN TWO COMMERCIAL SHELLFISH SPECIES.

Garcia, R. (GPMB, College of Charleston) and DeLorenzo, M. (NOAA).

Pesticides are a commonly used agent against disease-carrying mosquitoes. Mosquito control pesticides are classified by the target life stage (larvicides and adulticides) and their chemical class (commonly organophosphates and pyrethroids). Pyrethroids are the most widely used class today for mosquitoes and other pests. Concerns surrounding the outdoor use of pyrethroid pesticides for mosquito control include known toxicity to fishes and marine invertebrates, contamination of aquatic areas via pesticide spraying, and the lack of knowledge on the combined effects of pyrethroids and estuarine stressors. To determine the effects of pyrethroids on commercial shellfish species, the median lethal concentration (LC50) will be determined in the larval and juvenile stages of the Eastern oyster, *Crassostrea virginica*, and the hard clam, *Mercenaria mercenaria*, using the pyrethroids resmethrin and permethrin. Sublethal effects of these pesticides on growth will be determined in juvenile clams and oysters. This study will also examine the multistressor effects of hypoxia, low pH, and a combination of the two with and without pesticide exposure to determine interactive effects on shellfish survival. Preliminary work has determined that the 96 h LC50 for resmethrin and larval oysters is within the range of 100-1000 µg/L. A 96 h LC50 of 1924 µg/L (95% confidence interval (CI) = 1543-2400 µg/L) was determined for resmethrin with larval clams. The results of this study will be used to assess whether shellfish early life stages are at risk from pesticide applications, and whether abiotic stressors such as pH and oxygen modify pesticide toxicity.

#9

COMPARATIVE IMPACT OF THE INVASIVE PARASITIC SPECIES, *ANGUILLICOLOIDES CRASSUS* ON THE AMERICAN EEL POPULATIONS BETWEEN THE ACE BASIN AND NORTH INLET NERRS AND THE COOPER RIVER.

Hein, J. (MES Program, College of Charleston), Arnott, S. (SCDNR), de Buron, I. (College of Charleston), Roumillat, W.A. (SCDNR) and Upchurch, S. (SCDNR).

Reports of eel populations in South Carolina (SC) estuaries have shown a decline since at least 2001. The invasive swimbladder parasite, *Anguillicoloides* (*Anguillicola*) *crassus*, is considered one potential reason for this decline. Since contaminants are known to negatively affect the ability of eels to resist infection by this parasite, we hypothesized that American eels from the ACE and North Inlet-Winyah Bay NERRs will be less infected than those from a heavily polluted habitat (Cooper River). During this study, prevalence, intensities, and abundances of *A. crassus* over one year (Jan-Dec 2011) will be recorded to determine spatial and temporal variations of this infection in these three populations of eels. Results will be mapped using GIS. Investigations to determine if infection by *A. crassus* is associated with eel health will be made using splenosomatic and hepatosomatic indices. The validity of a noninvasive diagnostic tool (vent color) will be evaluated to determine infection levels. Preliminary results from 79

eels showed 52% prevalence of infection overall (North Inlet-Winyah Bay NERR 50%, N= 40, Cooper River 58%, N=33 and the ACE Basin NERR 33%, N=6). Results also indicate that the percent infection is highest in the summer (72%, N=25), followed by spring (55%, N=29) and winter (43%, N=23).

#10
DISTRIBUTION AND HEALTH ASSESSMENT OF RED DRUM, *SCIAENOPS OCELLATUS*, EXHIBITING EXTERNAL LESIONS WITHIN SOUTH CAROLINA ESTUARIES.
Meadors, W. (GPMB, College of Charleston) and Arnott, S. (SCDNR).

Over the last decade a high prevalence of severe skin lesions has been observed on red drum, *Sciaenops ocellatus*, in Winyah Bay, SC primarily during the winter months. Positive identification of the causative agent is difficult due to the known association of multiple pathogens with fish skin lesions and a high degree of secondary infection by opportunistic pathogens. The extent to which the red drum lesions affect their overall health is unknown, although several studies on other species have reported an inverse relationship between lesion occurrence and health parameters, particularly in contaminated habitats such as Winyah Bay. This study aims to determine the spatial and temporal distribution of symptomatic red drum throughout SC estuaries. The presence and identity of putative pathogens will be explored by histological examination and by microbial culture of lesion biopsy samples. Hematology and blood chemistry will be used to assess general health parameters and make comparisons between (i) condition of fish with and without lesions, (ii) fish captured in a contaminated location (Winyah Bay) vs. fish from an uncontaminated location (ACE Basin), and (iii) fish caught in different seasons.

#11
SPATIAL AND TEMPORAL VARIATION OF GENETIC DIVERSITY IN RED PORGY, *PAGRUS PAGRUS*, IN THE SOUTH ATLANTIC BIGHT.
Murray, D.C. (GPMB, College of Charleston).

Red porgy, *Pagrus pagrus,* is a protogynous hermaphrodite reef fish that associates with hard-bottom habitats in temperate waters. Red porgy has been a recreational and commercially important species over the past 30 years, and is managed as a single species under the SAFMC S/G complex. During the early 1980s, increased fishing pressure began to significantly reduce the population in the South Atlantic Bight (Cape Hatteras, NC to Cape Canaveral, FL) resulting in a moratorium being enacted in 1999 due to a combination of low population size and high fishing mortality. The aim of this study is to determine how fishing pressure over the past 30 years has affected the genetic diversity of the population in the South Atlantic Bight. Nuclear DNA will be extracted from historical samples, otoliths and fin clips, and genotyped using 12 microsatellite loci. An initial spatial evaluation of genetic diversity within the South Atlantic Bight will be used to verify the previously identified lack of genetic structure using more robust sampling and marker designs. Genetic data coupled with life history data will allow for a temporal comparison of allelic diversity, heterozygosity, and

effective population size. The results of this study should provide fisheries managers with critical information to allow for better preservation of genetic diversity of populations undergoing overfishing, as well as realistic considerations for rebuilding a population that is overfished.

#12
ASSESSMENT OF POPULATION GENETIC STRUCTURE IN THE SPOTTED EAGLE RAY (*AETOBATUS NARINARI*) FOUND SEASONALLY OFF COASTAL SARASOTA, FL.
Newby, J. (GPMB, College of Charleston) and Shedlock, A. (College of Charleston).

Recent global declines in chondrichthyan populations have risen as a major concern due to amplified pressure from fisheries. The spotted eagle ray, *Aetobatus narinari*, is a cosmopolitan myliobatoid recognized as near-threatened by the World Conservation Union, however, is not protected in U.S. federal waters (IUCN 2010). A decreasing population trend, K-selected life history and primarily inshore, coastal habitat renders this species particularly susceptible to over-exploitation by targeted fisheries, drift netting, and capture as bycatch. Since 2009 large seasonal aggregations have been observed in the nearshore, Gulf waters of Sarasota, FL. Modest baseline ecological and/or demographic information is available on *A. narinari* but almost no studies of fine-scale genetic structure exist. My aim is to investigate the genetic and social structure of this *A. narinari* population using fin clips collected through Mote Marine Lab, FL from Apr-Aug 2011. Genotypes of allele frequencies for up to 10 independent eagle ray-specific microsatellite loci will be employed to resolve the population genetic architecture in a sample of 50 individuals. Tests for Hardy-Weinberg Equilibrium, null alleles and linkage disequilibrium, as well as population-specific patterns (STRUCTURE) and allelic migration (MIGRATE), will help further characterize the genetic variation present. Mating success and social structure will be evaluated through paternity analysis (CERVUS) and estimates of relatedness among pairs (Kinship). Synthesis of baseline molecular data from the present study and comparisons of Sarasota material to subpopulations in the Central Atlantic are expected to advance our understanding of *A. narinari* vulnerabilities.

#13
CHARACTERIZING THE GENETIC POPULATION STRUCTURE AND GENETIC INFLUENCES OF WINTER-KILL EVENTS IN SPOTTED SEATROUT (*CYNOSCION NEBULOSUS*) IN SOUTH CAROLINA.
O'Donnell, T. (GPMB, College of Charleston).

Spotted seatrout are recreationally important fish that have been harvested in South Carolina for centuries. Spotted seatrout have recently suffered substantial population declines during the cold winters of 2000, 2009, and 2010 when water temperatures dropped below their tolerance threshold. These winter-kills appear to result in population bottlenecks and their repetitive occurrence over a short time scale has prompted the South Carolina Department of Natural Resources (SCDNR) to consider a stock enhancement program. Prior to implementation of any management tactics, a full

understanding of the population structure and how spotted seatrout populations are genetically influenced by winter-kills must be acquired. The first goal of my research is to determine the genetic population structure across three estuaries in South Carolina: Cape Romain, Charleston Harbor, and the ACE Basin using a suite of 15 microsatellite markers. Additionally, the diversity and effective population size of spotted seatrout from Charleston Harbor will be evaluated both before and after the recent winter-kill events. Spotted seatrout samples for genetic isolation have been provided by SCDNR's trammel net survey and recreational anglers. The use of a powerful suite of markers will allow higher detection capability to assess the population structure of spotted seatrout in the Atlantic and calculate the first ever estimate of effective population size for any spotted seatrout population. The results of my research can be applied to all future management of spotted seatrout in South Carolina by justifying stocking strategies and providing a framework for how spotted seatrout may respond to climate variability.

#14
DIETARY NICHE OVERLAP OF AN ESTUARINE PREDATOR COMMUNITY IN SOUTH CAROLINA.
Shaw, A. (GPMB, College of Charleston), Sancho, G. (College of Charleston) and Frazier, B. (SCDNR).

Estuaries serve as habitats and nurseries for many recreationally and commercially important fishes. Understanding the trophic ecology of the fish populations within estuarine communities is essential to effectively managing these species under an ecosystem-based management scheme. Upper-level predatory fish are among the most sought-after fisheries species by commercial and recreational fishers in this highly productive ecosystem. Determining the trophic ecology and dietary niches of predatory species is important to infer interspecific competition, relationships among the estuarine fish community and niche partitioning. Dietary niche overlap of the predator community in the Cape Romain National Wildlife Refuge (specifically Bulls Bay and its surrounding tidal creeks) will be assessed using stable isotope analysis of muscle tissues. Fishes of up to 10 species will be collected via trammel nets, gillnets and longlines in the channels and along the banks of the estuary with cooperation of SCDNR. All fishes will sampled and then released unharmed. Tissue samples (approximately 60 mg) will be taken from the dorsal musculature with a 4 mm biopsy punch and frozen until analysis. Comparison of C and N isotopes will allow us to infer potential prey items, trophic level, and trophic niches of the analyzed species. Results may have implications for ecosystem-based management of the Cape Romain estuarine system that can be applicable to other estuaries in South Carolina.

#15

EFFECTS OF LIGHT IRRADIANCE LEVELS ON THE EXPRESSION AND ABUNDANCE OF ICE-BINDING PROTEINS IN THE SEA ICE DIATOM, *FRAGILARIOPSIS CYLINDRUS.*

Smith, J. (GPMB, College of Charleston), Janech, M. (MUSC), DiTullio, J. (College of Charleston), Lee, P. (College of Charleston) and Byrum, C. (College of Charleston)

Ice-binding proteins, which have been found in every unialgal population of Antarctic and Arctic ice-diatoms examined to date, have been shown to bind ice and have ice-pitting activity. Furthermore, these ice-binding proteins (IBPs) strongly inhibit the recrystallization of ice by inhibiting the growth of large crystal grains of ice in favor of smaller grains. The activity of these proteins favors both the growth of columnar ice, which itself can lead to an increased depth of the field of light extending into ice, and the retention of brine channels that act as the main scattering center for light in sea ice. Lowered light levels, indicative of increased ice cover, may act as a stimulus to the increased expression and abundance of these proteins in sea-ice diatoms and in particular in *Fragilariopsis cylindrus*. Previous studies have examined the roles of salinity, temperature or both on the expression of these proteins but have ignored light as an environmental stimulus. To investigate this possibility, ten ice-binding genes have been selected to determine the role low light levels (5 μEinsteins/m^2/s) play in the expression and abundance of IBPs. It is hypothesized that low light stimulates an increase in mRNA levels as wells as an increase in the abundance of IBPs. Initial aims will investigate this possibility using quantitative PCR and tandem mass spectrometry with future studies looking at the possible role of light as an environmental cofactor in conjunction with lowered temperature.

#16

EFFECTIVENESS AND COSTS OF HYPOXIA ACCLIMATION IN PACIFIC WHITE SHRIMP, *LITOPENAEUS VANNAMEI*.

Tommerdahl, A. (GPMB, College of Charleston), Burnett, L. (College of Charleston) and Burnett, K. (College of Charleston).

As the size, intensity, and frequency of hypoxic zones continues to increase in nearshore marine habitats worldwide, it is important to understand the potential effects this will have on marine organisms, especially those of commercial importance. *Litopenaeus vannamei* provides a good model organism to study these effects, as it inhabits near shore habitats and is one of the most economically important shrimp species. Others have shown a 5-6% day^{-1} increase in hemocyanin concentration in the brown shrimp, *Crangon crangon* over two weeks in mild hypoxia. Work in our lab demonstrated a significant decrease in protein synthesis levels in muscle, but not hepatopancreas, tissue following 24 hour exposure to severe hypoxia (20% air saturation), but no later time points were tested. I will use performance as a quantifying measure of the extent to which this estuarine crustacean can acclimate to hypoxia, and how this acclimation interferes with normal metabolic function, as indicated by muscle and hepatopancreas protein synthesis rates. Specifically, goals of the study will be: 1) to quantify acclimation of *L. vannamei* after 96 hour hypoxia exposure; 2) to determine

whether oxygen levels are a limiting factor in performance; and 3) to use protein synthesis rates to assess the metabolic costs of hypoxia acclimation.

#17
GROWTH, DISTRIBUTION, AND SKELETAL STRUCTURE OF DEEP-WATER SCLERACTINIAN CORALS UNDER 'ACIDIFIED' OCEAN CONDITIONS IN THE SOUTHERN CALIFORNIA BIGHT.
Wickes, L. (GPMB, College of Charleston) and Etnoyer, P. (NOAA).

Deep-water scleractinian corals on seamounts in the Southern California Bight are likely exposed to corrosive upwelled water as the aragonite saturation horizon (ASH) shoals closer to the surface with increased anthropogenic CO_2. The ASH has been found to be as shallow as 60-100 m in this region, which suggests corals at 200 m on these seamounts are at or below the saturation horizon. The primary objective of this study will be to conduct quantitative surveys to assess the distribution and condition of scleractinian corals in these acidified conditions. Surveys will use a remotely operated vehicle (ROV) rated to 500 m depth. Environmental parameters, including aragonite saturation, will be collected and analyzed using a CTD-O mounted on the ROV. The data will help to assess habitat preference with respect to coral health, abundance, size and diversity. These environmental parameters will also be used as a baseline for manipulative laboratory experiments to examine skeletal dissolution in acidified water. Collected coral samples will be used to analyze skeletal dissolution rates, morphology and composition and compared with samples from regions saturated with respect to aragonite (e.g. South Atlantic Bight). These sites also afford a unique opportunity to characterize habitat both within and outside a Cowcod Conservation Area (CCA). As an additional objective, this study will document lost fishing gear and its co-occurrence with corals to infer potential fisheries impacts. These data could contribute to the establishment of essential fish habitat with the potential to extend the boundaries of the CCA.

ORAL PRESENTATION ABSTRACTS

TOXIC DINOGLAGELLATES AND THEIR ASSOCIATED MICROBIAL COMMUNITY: PRELIMINARY EVIDENCE THAT ALGICIDAL BACTERIA INTERFERE WITH THE AL-2 QUORUM SENSING SYSTEM.

Blair, W. (GPMB, College of Charleston) and Doucette, G. (Marine Biotoxins Program, NOAA/NOS).

The development of harmful algal blooms that impact coastal zones worldwide is regulated by a wide range of biophysical factors. Marine bacteria, although often overlooked, serve important ecological functions in a variety of microhabitats, including delivery of trace metals, vitamins, and limiting nutrients, as well as algicidal assaults. How the complex microbial community coordinates to conduct these influential activities is a rapidly growing research area. Discovered only in the last few decades, quorum sensing (QS) systems allow synchronization of density-dependent behaviors, such as biofilm formation and bioluminescence, sometimes eliciting chemical interference from eukaryotic hosts. Involvement of *Karenia* spp. and their associated bacteria, including algicidal taxa, in QS systems would introduce a new paradigm for understanding biotic regulation of bloom dynamics. The Autoinducer-2 (AI-2) QS system in particular is utilized by a wide variety of bacterial taxa and is inhibited by a number of biological and synthetic antimicrobial compounds. Preliminary data suggest that several algicidal bacterial strains isolated from harmful algal blooms may interfere with this important AI-2 system. Using a bioluminescent reporter strain of *Vibrio harveyi* stimulated by exogenous AI-2, algicidal and non-algicidal bacterial strains were screened for inhibitory activity. Incubation with sterile filtrate taken from late-exponential algicidal cultures significantly reduced sensor luminescence (ANOVA, $p < 0.05$), whereas incubation with non-algicidal filtrate did not reduce luminescence. While additional work will be required, this preliminary report provides the first evidence that the widespread AI-2 quorum sensing system may be inhibited by bacterial activity.

MYXOZOAN PARASITES OF THE SPOTTED SEATROUT: DO THEY WEAKEN THE HEALTH OF THEIR HOSTS?

Cosmann, P. (GPMB, College of Charleston), Arnott, S. (SCDNR), de Buron, I. (College of Charleston), Roumillat, W. A. (SCDNR) and Strand, A. (College of Charleston).

Preliminary studies into the parasite community in the spotted seatrout, *Cynoscion nebulosus,* have revealed infection by particularly pathogenic parasites: *Kudoa inornata* in the skeletal muscle, and *Henneguya* sp. in the bulbus arteriosus. I hypothesized that these two parasite species negatively affect of the health of infected spotted seatrout. To examine this, I quantified the intensity of parasite infection in wild-caught seatrout via histology and assessed fish health in terms of somatic, splenosomatic and hepatosomatic indices. After controlling for variation in fish size (using an analysis of covariance), fish that were infected with *K. inornata* were shown to have significantly lower liver and spleen weights compared to those that were not infected. Preliminary results show liver weight but not spleen weight correlated negatively with the intensity of *K. inornata* infection. There was no correlation detected between the presence of

Henneguya sp. and liver and spleen weights. Since liver mass is a proxy for energy storage, these results imply that *K. inornata* imposes a substantial energy burden on seatrout, and that infected fish have less energy available for metabolically expensive processes, such as overwinter survival and reproduction.

RECOVERY FROM HYPOXIA AND HYPERCAPNIC HYPOXIA: IMPACTS ON THE TRANSCRIPTION OF KEY ANTIOXIDANT GENES IN THE SHRIMP *LITOPENAEUS VANNAMEI.*

Darling, C. (GPMB, College of Charleston), Burnett, K (College of Charleston) and Burnett, L. (College of Charleston).

The Pacific whiteleg shrimp, *Litopenaeus vannamei*, inhabits coastal estuarine waters which are prone to intermittent bouts of low oxygen (hypoxia) and high CO_2 (hypercapnia) followed by a return, or recovery, to fully air-saturated levels of oxygen and CO_2 (normoxia). Hypoxia (H) and hypercapnic hypoxia (HH) can cause oxidative stress which induces production of reactive oxygen species (ROS) that damage surrounding cells and tissues. In vertebrates, sudden rises in oxygen levels also increase ROS production. Cellular production of antioxidants, which convert ROS into non-toxic molecules, can prevent cell damage. Here we examine antioxidant production in the hepatopancreas of *L.vannamei* after recovery from H or HH. Prior studies revealed that transcription of antioxidants thioredoxin-2 (TRX-2) and glutathione-s-transferase (GST) was significantly upregulated (2.7; 2.9-fold, respectively) after 4 h exposure to H. Only GST was significantly upregulated (3.9-fold) after 4 h in HH; neither antioxidant was upregulated after 24 h in H or HH. In the current study we exposed shrimp to H or HH for 4 or 24 h. Shrimp subsequently recovered in normoxia for 1, 6, or 24 h. Transcriptional changes of TRX-2, GST, and other antioxidant-related genes are currently being quantified by qRT-PCR. Based on prior studies detailed above, we expect that transcription of antioxidant-related genes will further increase in response to increases in oxygen during recovery from 4 h H or HH, but that this increase will not occur during recovery from 24 h H or HH, leaving these animals susceptible to oxidative damage as tissue oxygenation returns to normal levels.

DETERMINING FACTORS THAT INFLUENCE THE MOLECULAR QUANTIFICATION OF THE HARMFUL RAPHIDOPHYTE, *HETEROSIGMA AKASHIWO,* USING A SANDWICH HYBRIDIZATION ASSAY (SHA).

Doll, C. (GPMB, College of Charleston) and Greenfield, D. (University of South Carolina & SCDNR).

Sandwich Hybridization Assay (SHA) is a molecular technique that enables direct detection of a particular species or taxa using large subunit rRNA-targeted DNA probes. SHA has been adapted to detect and quantify bacteria, invertebrate larva and several harmful algal bloom (HAB) species. In each case, an optical density directly proportional to the amount of rRNA in a sample is used to approximate organism abundance. The extent to which variability in cellular rRNA content may influence SHA results for HAB species, however, remains unclear. This study examines the influence of various factors on the SHA response of *Heterosigma akashiwo*; a globally distributed

HAB species known to produce ichthyotoxic blooms for which SHA capabilities have previously been developed and assessed. Experiments in this study demonstrate variable SHA responses among geographically distinct isolates and changing responses throughout the algae's growth phases and diel cycle. Additional experiments will test the influence of Lugol's iodine preservation and nutrient limitation on SHA response. Results will provide new insights on the influence of these factors on SHA responses and whether observable variations pose important considerations for resource managers interpreting results. Additionally, SHA results will be compared to quantitative PCR data as part of a broader four-year NOAA-MERHAB award to assess the two using criteria such as cost, accuracy, range of detection, speed, etc.

QUANTIFICATION OF THE INTERACTION BETWEEN BOTTLENOSE DOLPHINS AND THE ATLANTIC BLUE CRAB FISHERY IN CHARLESTON, SC.

Duquette, A. (GPMB, College of Charleston), Kracker, L. (NOAA/NOS/CCEHBR) and McFee W. (NOAA/NOS/CCEHBR).

Entanglement in commercial fishery equipment is the number one anthropogenic cause of marine mammal death worldwide. Scientists turned to acoustic methods for monitoring and deterring marine mammals from fishing gear. Despite research efforts, there remains a lack of knowledge about the methods of entanglement. Until those methods are understood, sufficient management is near impossible. The Atlantic blue crab fishery is the number one cause of fishery-related incidents for bottlenose dolphins (*Tursiops truncatus*) in South Carolina. It is hypothesized that the dolphins are attracted to the pots by the bait and possibly the other marine life drawn to the pots. Hydrophones deployed in baited and unbaited crab pots will record dolphin sounds and allow for a quantification of the interaction. If dolphins are attracted by the bait, then they will approach and spend more time around the baited pots than the unbaited pots. There appears to be little difference between the numbers of times dolphins vocalize in the vicinity of the crab pots between the two treatments. There is also no significant difference between the amounts of time dolphins spend around the traps based on treatment. Thus, the presence of bait does not appear to affect how often and for how long dolphins are in the vicinity of crab pots.

THE ROLE OF NANOG IN MAINTAINING LUNG HEALTH IN THE BOTTLENOSE DOLPHIN, *TURSIOPS TRUNCATUS.*

Glade, L. (GPMB, College of Charleston) and Baatz, J.E. (Department of Pediatrics, MBES, MUSC).

Diving marine mammals experience decreased oxygen supplies during periods of breath holding but are well adapted to managing their oxygen stores to survive extended periods of submergence. One of the most important organs that aids in diving is the lung, which is involved in buoyancy control and undergoes progressive collapse with increases in pressure, causing the alveoli to empty gas into the small airways. Although the physiological, anatomical, and behavioral adaptations of marine mammals to limited oxygen supplies have been thoroughly researched, the processes involved in the maintenance and repair of the lung remain to be investigated. This study examines

the role of Nanog, a protein that is associated with pluripotency of stem cells, in directing replenishment of lung cells. Bottlenose dolphin (*Tursiops truncatus*) lung cells were grown in 6-well plates in an incubator for 72 hours under conditions of normoxia (21% O_2) or hypoxia (1.5% O_2). Cells from both treatment groups were collected via lysis buffer and stored at -80°C. Total RNA was extracted from thawed cells and RNA was converted to cDNA. Real-time PCR was then used to analyze cDNA products, and preliminary results indicate that Nanog expression is considerably higher in lung cells exposed to hypoxic conditions relative to lung cells under normoxia. Future research will focus on protein changes in lung cells under hypoxia, and inhibitory RNA will also be used to initiate downregulation of Nanog and determine if lung cells are able to differentiate.

ANTAGONISTIC INTERACTIONS AMONG BACTERIAL POPULATIONS OF MARINE INTERTIDAL SEDIMENTS.

Hook, W. (GPMB, College of Charleston) and Plante, C. (College of Charleston).

Most sedimentary bacteria live in biofilms attached to sediment grains. High densities and diversity of these bacteria implicate inter-specific competition as a likely force in structuring communities. A common means of competition exhibited by both free-living and substrate-associated bacteria is the secretion of antimicrobial compounds, serving to inhibit growth or cause cell death of nearby bacteria. Samples collected from the intertidal zone at Breach Inlet, South Carolina were separated into sediment and porewater fractions. A disc-diffusion assay was use to detect antagonistic activity in bacterial isolates. Of the sediment-derived isolates, 40% displayed the ability to produce inhibitory compounds whereas significantly fewer porewater-associated bacteria (25%) produced antimicrobials. The higher frequency of antagonism assumed by surface-attached bacteria likely reflects a more effective means of antimicrobial conveyance by attached bacteria. Compounds secreted by free-living bacteria are dispersed into the water column whereas secretions of surface-associated producers are sequestered in biofilms and on surfaces, where the antimicrobials remain and can affect surrounding microbes. In order to establish relative *in situ* abundances of the isolated antimicrobial-producing bacteria and designated target strains, denaturating gradient gel electrophoresis (DGGE) was used to compare DNA bands from whole-community environmental samples to the banding patterns of individual isolates. Sequencing of a region of the 16S rRNA gene was used to confirm presence/absence of the model bacteria within the sediment communities. These environmentally relevant bacteria will be employed in microcosm experiments to elucidate the role of pre-emptive and interference competition in benthic microbial communities.

POPULATION STRUCTURE OF SPOT (*LEIOSTOMUS XANTHURUS*) IN SOUTH CAROLINA.

Johnson, J. (MES, College of Charleston), Arnott, S. (SCDNR), Roumillat, W.A. (SCDNR), Whitaker, D. (SCDNR), Ballenger, J. (SCDNR) and McDonough, C. (SCDNR).

Spot is a commercially and recreationally important fish species along the Atlantic and Gulf of Mexico coastlines. To date, no coast-wide stock assessment has been performed for the species due to a lack of biological and fisheries data. In particular, poor information exists on the age structure of the population, the size at which fish mature, and the age and size structure of harvested fish. The purpose of this study is to address these needs by, first, validating the timing and frequency of annulus deposition in spot otoliths, which are used for ageing them. With this information, I will then age spot caught in a long-term fishery-independent survey (SCDNR trammel net survey) and a fishery-dependent survey (recreationally harvested fish). I will also determine the sex of each fish and histologically examine their gonads to determine their maturity. These data will be used to model the relationships between size and age, size and maturity and age and maturity. The models will then be applied to the size data that are routinely collected during the surveys in order to infer the age and maturity structure of the population. The findings from this study will provide essential life history information that is needed for stock assessment purposes.

IMPACT OF TEMPERATURE-INDUCED VIRAL RESISTANCE ON DIMETHYLATED SULFUR COMPOUNDS IN THE COCCOLITHOPHORID, *EMILIANIA HUXLEYI.*

Kendrick, J.B. (College of Charleston, GPMB) and DiTullio, J. (College of Charleston).

Emiliania huxleyi (*Ehux*) is a cosmopolitan coccolithophorid which forms very dense blooms annually that impact the global cycles of carbon and sulfur. The blooms are known to be terminated by host-specific viral infection. Until recently the effect of temperature on the success of viral infection has not been addressed. In preliminary work it was found that *Ehux* strain CCMP 374 is resistant to viral infection if incubated at 21°C but susceptible to infection at 18°C. Given that viral infection is known to cause oxidative stress in *Ehux* and that dimethylated sulfur compounds (*e.g.* DMS, DMSP, and DMSO) are involved in *Ehux*'s natural antioxidant cascade, we hypothesized that these compounds helped impart resistance by enhancing the cell's antioxidant defense. The results of this experiment will be presented outlining the interactive effects of elevated temperature and viral infection on several host physiological factors, including the production and release of environmentally important sulfur compounds such as dimethylsulfoniopropionate (DMSP), dimethylsulfoxide (DMSO), and DMS. These findings could indicate significant changes in global biogeochemical cycles if the Earth's temperature continues to rise.

A LATITUDINAL BODY SIZE CLINE IN A MARINE ISOPOD REFLECTS LOCAL ADAPTATION TO SEAWATER TEMPERATURE AND PREDATOR RISK.

Manyak, A. (GPMB, College of Charleston), Bell, T. (College of Charleston) and Sotka E. (College of Charleston).

Organismal body size strongly affects individual fitness, with larger body sizes generally being positively correlated to mating success and fecundity. It has been widely observed that organisms from higher latitudes tend to be larger than their lower latitude counterparts (termed Bergmann's Rule). For most body size clines, however, it remains unclear whether this reflects a genetic or phenotypically-plastic response, nor what evolutionary mechanism(s) maintain the cline. Consistent with Bergmann's rule, field-collected individuals of the marine isopod *Idotea balthica* from northern (Massachusetts) sites are larger than individuals from southern (Virginia) sites. We reared juvenile *I. balthica* from field-collected mothers at a range of temperatures (6°, 12°, 18°, 24°, and 30°C), and measured growth and survivorship for 15 weeks, or until female sexual maturity. Overall, juvenile growth rate increased and time to female maturity decreased with temperature among all populations. Females from the south, however, became mature in less time and at a smaller size than did northern females. For example, southern and northern females became reproductive at ~52 and 71 days (respectively) at 18ºC. Earlier maturation of southern females is predicted by life-history theory to occur within predator-rich environments. We confirmed this prediction using field-tethering experiments in July and August 2011: tethered isopods within southern seagrass beds were 2-3 times more likely to be consumed than were isopods at northern sites. We conclude that the body size cline in *I. balthica* is adaptive, and that both predation risk and temperature may play an important evolutionary force in the development of this cline.

THE INFLUENCE OF PH ON PREDATOR/PREY INTERACTIONS OF THE EASTERN OYSTER, *CRASSOSTREA VIRGINICA* AND THE ATLANTIC BLUE CRAB, *CALLINECTES SAPIDUS*.

Sherer, E. (MES, College of Charleston) and Burnett, L. (College of Charleston).

Estuaries are highly productive areas that, as a result, are subject to large fluctuations in CO_2 and pH. Respired CO_2 results in decreased pH and drives carbonate chemistry reactions away from CO_3^{2-}, the carbon species used by bivalves to form their $CaCO_3$ shells. The result could lead to weaker shells and higher metabolic demands to compensate for acid-base regulation. The threats faced by bivalves in these areas are compounded by "Ocean Acidification", the process by which the anthropogenic CO_2 from the burning of fossil fuels sinks into the water and drives pH even lower. Estuaries are particularly prone to ocean acidification due to their limited buffering capacity. Understanding the threats faced by estuarine bivalves under present day hypercapnia can help us understand what may happen under future ocean acidification regimes. One possibility is that pH induced weakening of shells could result in making them easier for predators, such as crabs, to prey on. In this study I examine the relative shell strengths of Eastern oysters collected from various pH regimes in Charleston estuaries. In addition I am collecting shell size, mass, thickness and density for each organism

tested. If oysters collected from lower pH waters are weaker then it could result in higher predation on these keystone species and dampen the ecosystem services they provide. This field approach also takes into account any long-term adaptation or acclimation to ambient water conditions that cannot be obtained in lab studies.

EFFECT OF SEDIMENT ON THE ANTIMICROBIAL ACTIVITY OF *MELANOCHLAMYS DIOMEDEA* AMONG DIFFERENT HABITATS.

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Gelatinous egg masses are used by several marine invertebrates as a reproductive mode that encapsulates embryos until hatching. The absence of a hard outer covering makes these egg masses particularly susceptible to microbial infection, biofouling, and predation. The mucus and gel matrix surrounding the egg capsules may contain compounds that deter microbial infection. If adults could adjust the level of protection in response to risk, then the amount of antimicrobial activity found within an egg mass should be correlated with the bacterial load of the local environment. We are comparing antimicrobial activity among sites of *Melanochlamys diomedea* egg masses on San Juan Island, WA with the bacterial density and sediment grain size. Egg masses were collected from the field, lyophilized, and extracted with non-polar ethyl acetate (EtOAc) and polar methanol (MeOH). The extracts were then tested and quantified for antimicrobial activity against a marine type culture (*Bacillus subtilis)* in a Burkholder petri dish and 96-well plate assay. Bacterial density was determined using a general bacteria stain and sediment grain size with a RoTap. Differences among sites have been found and continue to be investigated.

PERFORMANCE CHANGES WHEN EXPOSED TO VARYING OXYGEN LEVELS IN THE ATLANTIC BLUE CRAB, *CALLINECTES SAPIDUS* RATHBUN.

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The ability to perform continuous activity and resist fatigue is essential to completing tasks such as obtaining food, avoiding predators and finding a mate, but these abilities may be compromised by environmental stressors. Estuarine organisms face daily and seasonal fluctuations in salinity, temperature, dissolved oxygen and pH. The Atlantic blue crab, *Callinectes sapidus* (Rathbun) is an important commercial and recreational fishing species that resides in the estuarine waters of the Atlantic Ocean and Gulf of Mexico. In this study we tested the effects of 2 levels of hypoxia (4 kPa, 20% air saturation; 10.4 kPa, 50% air saturation) on fatigue during sustained continuous exercise. Fatigue was induced by an exercise trial that entailed continuous sideways hexapedal walking on an underwater treadmill. Fatigue was quantified as the percent decrease in holding performance, which was assessed with a repeated hold force test that mimics the way a male holds a female during mate guarding. Fatigue was defined as a 33% decrease in hold force from pre-exercise values. Fatigue was reached after 6 h of walking for crabs in normoxic seawater, 4 h in 50% air saturation and 2 h in hypoxia. Fatigue-resisting behaviors (180˚ turns, stopping and riding to the end)

increased from the initial time point by 0.910 behaviors per h in normoxia, 4.075 in 50% air saturation, and 13.821 in 20% air saturation. The force and behavioral results indicate that under low oxygen conditions performance is decreased and fatigue is reached more quickly as the level of hypoxia intensifies.

COMPARATIVE EFFECTS OF *IN VITRO* PFOS AND DE-71 EXPOSURE ON BOTTLENOSE DOLPHIN AND MURINE IMMUNE FUNCTION.

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The effects of emerging contaminants on the immune system of mammals are poorly understood, with limited information available about the immunotoxicological effects of perfluorooctane sulfonate (PFOS) and DE-71, a polybrominated diphenyl ether (PBDE) mixture, at environmentally relevant exposures. Due to the challenges of working with dolphins, this study assessed the effects of *in vitro* exposures of PFOS and DE-71 on immune functions in dolphins and mice to determine the predictability of *in vitro* effects to *in vivo* observations as part of a parallelogram approach to assessing risk. Bottlenose dolphin peripheral blood leukocytes and B6C3F1 mouse splenocytes were exposed in culture to PFOS at 0, 0.01, 0.05, 0.1, 0.5, 1.0 or 5.0 µg/mL concentrations or DE-71 at 0, 0.025, 0.05, 0.25, 0.5, 2.5, 5.0, 25 or 50 µg/mL concentrations. The innate and adaptive immune systems were assessed using natural killer (NK) cell activity and lymphocyte proliferation assays. PFOS modulated NK cell activity with significant decreases at 0.01, 0.05, 0.5, and 1.0 µg/mL concentrations and significant increases at 5.0 µg/mL in both species. Mitogen-induced lymphocyte proliferation was significantly decreased in murine cells, but not in dolphin cells exposed to PFOS. DE-71 significantly increased T cell proliferation in bottlenose dolphins at concentrations of 0.5, 2.5, and 5.0 µg/mL, but did not alter B cell proliferation or NK cell activity. DE-71 *in vitro* exposure is currently ongoing with murine cells. Using both dolphin and murine cells provides a comparative approach for evaluating the effects of PFOS and DE-71 on immune functions.