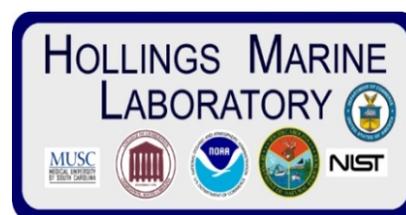


2012 HML Research Projects

HML's research highlights for 2012 were showcased in the Annual Report and included projects that advanced NOAA's National Centers for Coastal Ocean Science's (NCCOS) three priorities: pollution, harmful algal blooms (HABS), and climate change. Other projects addressed emerging issues or specific needs of the institutional partners, which are represented in the emerging and mission based (EMB) group.



More directed research foci at HML include wildlife epidemiology and health assessments for sentinel species such as marine mammals, molecular diagnostic tools, toxin discovery, and human dimensions of coastal ecosystems. HML researchers focus on sentinel species and sentinel habitats with a goal of establishing early warning signals for environmental threats, which can then be incorporated into management decisions. By supporting management decisions with new information, innovative tools and techniques, HML is well positioned to serve as a liaison that promotes the protection, restoration and sustainability of marine animals, ecosystems and human communities.

The following pages provide descriptions and points of contact for the 96 research projects occurring at HML in 2012.

I. Acronyms

AMNH	American Museum of Natural History
BIA	Bureau of Indian Affairs, DOI
CDC	Centers for Disease Control and Prevention
CofC	College of Charleston
CSIRO	Commonwealth Scientific and Industrial Research Organisation, Australia
CZS	Chicago Zoological Society
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
EPA	U.S. Environmental Protection Agency
FDA	U.S. Food and Drug Administration
FL FWC	Florida Fish and Wildlife Conservation Commission
GA DNR	Georgia Department of Natural Resources
HUPO	Human Proteome Organisation
LANL	Los Alamos National Laboratory
MSU	Michigan State University
MUSC	Medical University of South Carolina
NASA	National Aeronautics and Space Administration
NAVFAC	Naval Facilities Engineering Command, DOD
NCDENR	North Carolina Department of Environment and Natural Resources
NCI	National Cancer Institute

NERR	National Estuarine Research Reserve
NIBB-Japan	National Institute for Basic Biology
NIH	National Institutes of Health
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NRDA	National Resource Damage Assessment
NSF	National Science Foundation
OHHI	Oceans and Human Health Initiative, NOAA
SCAEL	South Carolina Algal Ecology Laboratory, HML
SCCWRP	Southern California Coastal Water Research Project
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCSG	South Carolina Sea Grant Consortium
SFEI	San Francisco Estuary Institute
TAMU-CC	Texas A&M University Corpus Christi
UC	University of California
USC	University of South Carolina
USF	University of South Florida
USFWS	U.S. Fish and Wildlife Service, DOI
USGS	U.S. Geological Survey, DOI
UT	University of Texas

II. Thematic Area: Pollution

Title: South Carolina Estuarine and Coastal Assessment Program (SCECAP).

Lead PI: Bob Van Dolah 843-953-9819 VanDolahR@dnr.sc.gov

Agencies Involved: SCDNR, SCDHEC, NOAA, USFWS, EPA

Scope: Program was initiated in 1999 to conduct annual state-wide survey of estuarine habitat condition using a probability based sampling design. Major components include multiple water quality measures (Water Quality Index), multiple measures of sediment quality (Sediment Quality Index) and multiple measures of biological condition (only Benthic IBI used in scoring process). All Indices then integrated into overall Habitat Quality Index (HQI). Program has been used for many different pollution related research initiatives (e.g. effects of upland development on water and sediment quality at large and small scales, identification of pollution hot spots, and comparative data for assessment of conditions in specific areas of interest).

Project Duration: 1999 - Continuing

Title: Development of Monitoring and Assessment Tools for Nitrogen and Phosphorus in South Carolina Wetlands.

Lead PI: Dianne Greenfield 843-725-4823 GreenfieldD@dnr.sc.gov

Agencies Involved: SCDNR, USC, SCDHEC, EPA

Scope: Project is designed to provide regulatory agencies with information on biological responses to elevated N and P levels. Research includes comparison of different methodologies to measure N and P, field monitoring of conditions using different methodologies, field experiments to determine phytoplankton responses to nutrient

loading, laboratory experiments to determine the effects of altered nutrient ratios on phytoplankton growth, agency outreach of findings.

Project Duration: 2011 – 2014

Title: Metabolic and transcriptomic responses in crustaceans exposed to environmental bacteria

Lead PI: Lou Burnett 843-953-9170 BurnettL@cofc.edu

Agencies Involved: CofC, NIST, SCDNR, NOAA, MUSC

Scope: In crustaceans, the act of mounting an immune response against common bacteria also interferes with their ability to respire. In this project, we test whether this impaired respiration has metabolic consequences at the level of the metabolome and the transcriptome of the Pacific white leg shrimp, *Litopenaeus vanamei*.

Project Duration: 2007-2012

Title: Impaired performance in crustaceans exposed to hypoxia and hypercapnic hypoxia.

Lead PI: Lou Burnett 843-953-9170 BurnettL@cofc.edu

Agencies Involved: CofC

Scope: These experiments are designed to test the idea that exposure to sublethal levels of hypoxia and/or hypercapnia interferes with the ability of shrimp and crabs to engage in normal activities, such as predator avoidance, acquiring prey, migration and reproduction. Animals engage in a bout of walking on a treadmill under the designated test conditions; test variables include avoidance behaviours, fatigue and changes in gait.

Project Duration: 2009-2012

Title: Aerobic capacity and metabolic costs associated with chronic hypoxia and hypercapnic hypoxia exposure in crustaceans.

Lead PI: Lou Burnett 843-953-9170 BurnettL@cofc.edu

Agencies Involved: CofC, MUSC

Scope: These studies assess the time course over which *L. vannamei* acclimate to chronic hypoxia exposure and the extent to which they can resume normal functioning relative compared to controls held in normoxia. Indicators of acclimation include changes in the concentration of the oxygen transport protein hemocyanin, measurements of aerobic capacity and rates of protein synthesis in muscle and hepatopancreas.

Project Duration: 2010-2013

Title: Characterizing the role of key antioxidants and ROS production in the Pacific whiteleg shrimp, *Litopenaeus vannamei*, during recovery from hypoxia and hypercapnic hypoxia.

Lead PI: Lou Burnett 843-953-9170 BurnettL@cofc.edu

Agencies Involved: CofC

Scope: The aim of the proposed study is to characterize the changes in RNA abundance, protein abundance of antioxidant enzymes, and enzyme activity of key antioxidant generating enzymes in shrimp during recovery from exposure to hypoxia and hypercapnic hypoxia.

Project Duration: 2009-2012

Title: The Wildlife-Human Connection: Contaminants and Epigenetic Modification Resulting in Birth Defects of the Vertebrate Reproductive System

Lead PI: Lou Guillette 843-725-4818 lou.guillette@gmail.com

Agencies Involved: MUSC, NASA, NIST, NIBB-Japan, FL FWC

Scope: It is now well established that various contaminants can alter endocrine signaling during embryonic development in wildlife and humans. This is an ongoing study to establish, for the first time in a wildlife sentinel species, the mechanisms by which altered gene expression occurs following embryonic exposure to contaminants. The principle research organism is the American alligator.

Project Duration: 2010-2014

Title: The Genomics and Lipodomies of Infertility

Lead PI: Lou Guillette 843-725-4818 lou.guillette@gmail.com

Agencies Involved: MUSC, NIST, SCDNR

Scope: In recent years, the number of couples seeking treatment for infertility has dramatically increased. Current estimates of infertility suggest more than 2 million U.S. couples are unable to conceive after one year of unprotected intercourse. Various reasons have been hypothesized for this increased rate, including environmental contaminants as a potential major factor. Although numerous occupational exposures have been demonstrated to impair fertility (e.g., heavy metals, pesticides, and solvents) in humans, the overall contribution of environmental exposures to infertility is currently unknown. However, a growing scientific database suggests that environmental exposures can have a dramatic effect on future fertility in an array of species. Linkages between environmental contaminant exposure and reduced fertility will be examined in these series of studies using wildlife (alligator and fish models) as well as samples from humans.

Project Duration: 2011-2014

Title: Integrating Microbial Biostimulation and Electrolytic Aeration to Degrade POPs.

Lead PI: Hal May 843-725-4865 hmay2357@gmail.com

Agencies Involved: MUSC, NIH, NOAA, University of Maryland

Scope: Project is a determination of how microbial degradation of persistent organic pollutants (e.g. PCBs) in Superfund sediments may be stimulated through bioaugmentation and electrochemistry.

Project Duration: 2008-2012

Title: Electroalcoholgenesis: Bioelectrochemical Reduction of CO₂ to Butanol.

Lead PI: Hal May 843-725-4865 hmay2357@gmail.com

Agencies Involved: MUSC, DOE, NOAA, USC, Clemson University

Scope: Project is a determination of how carbon dioxide may be converted to liquid fuels by microbes operating in an electrochemical cell in the absence of light. Any sustainable, non-fossil based electrical source serves as the energy source for the system.

Project Duration: 2010-2013

Title: Remote Bioelectrochemical Treatment of Marine Pollutants in Coastal.

Lead PI: Hal May 843-725-4865 hmay2357@gmail.com

Agencies Involved: MUSC, NIH, NOAA

Scope: Project is a determination of microbial electrochemical systems that may influence the transformation of mixtures of marine pollutants. This is to be done in collaboration with two other proposed research projects that aim at determining the effect of the pollutant mixtures on developmental and neural toxicity.

Project Duration: 2012-2017

Title: Contaminant measurements & analytical reference materials

Lead PI: Steven Christopher 843-725-4872 Steven.Christopher@noaa.gov

Agencies Involved: NIST, NOAA, EPA, CDC

Scope: For other agency programs, NIST routinely measures concentrations of trace elements, speciated trace elements, and legacy and emerging organic contaminants from a wide variety of matrices, including sediments and animal tissues. This work is leveraged through the NIST program to develop reference methods and reference materials for measuring analyses in many kinds of environmental, clinical, and botanical matrices.

Project Duration: 1971 – continuing

Title: Production of reference materials for contaminant measurements

Lead PI: Rebecca Pugh 843-762-8952 Rebecca.Pugh@noaa.gov

Agencies Involved: NIST, NOAA, USGS, USFWS, CDC, FDA

Scope: NIST produces fresh-frozen and freeze-dried reference materials for chemical measurements, including contaminants measurements, at the HML Reference Material Production Facility. Control materials are produced and distributed for use in-house or with collaborating analytical chemists. Standard Reference Materials (SRMs) are produced in-house and distributed by NIST Gaithersburg.

Project Duration: 2009 – continuing

Title: Quality control of chemical measurements on marine samples

Lead PI: John Kucklick 843-725-4816 John.Kucklick@noaa.gov

Agencies Involved: NIST, NOAA

Scope: This goal of this program is to improve the comparability of chemical data produced by different laboratories on samples from the marine environment. NIST routinely performs inter laboratory comparison exercises for legacy organohalogen compounds, polycyclic aromatic hydrocarbons, chemicals of emerging concern, and trace elements in marine samples. Additional inter laboratory comparison exercises have been organized and led by the NIST NMR staff for researchers conducting NMR-based metabolomics research.

Project Duration: 1987 - continuing

Title: Mercury isotopes as environmental tracers

Lead PI: Rusty Day 843-762-8904 russell.day@noaa.gov

Agencies Involved: NIST, NOAA, University of Pau, Laboratoire des Mécanismes et Transferts en Géologie (LMTG)

Scope: NIST is developing methods and associated reference materials to underpin the use of mercury isotopic fingerprinting to identify source patterns and to better understand the biogeochemical cycling of mercury in the environment, by improving our understanding of fractionation of mercury in the environment.

Project Duration: 2007 – continuing

Title: Environmental specimen banking for retrospective research and quality assurance

Lead PI: Rebecca Pugh 843-762-8952 Rebecca.Pugh@noaa.gov

Agencies Involved: NIST, NOAA, USFWS, SFEI, The Marine Mammal Center, Alaska SeaLife Center, Hubbs-SeaWorld Research Institute, St. Paul Island Aleut Community, Kawerak, Inc., North Slope Borough, Hawaii Pacific University

Scope: The Marine Environmental Specimen Bank is maintained by NIST at the HML as a part of contaminant monitoring and research programs of other agencies and organizations. Specimens (i.e. marine mammal tissues, seabird eggs, peregrine falcon eggs and feathers, shellfish, finfish, sea turtle tissues, and marine sediments) are archived under cryogenic conditions for future research purposes.

Project Duration: 1985 - continuing

Title: Alaska Marine Mammal Tissue Archival Project (AMMTAP)

Lead PI: Paul Becker 843-725-4815 Paul.Becker@noaa.gov

Agencies Involved: NIST, NOAA, USFWS, USGS, Alaska SeaLife Center, University of Alaska, North Slope Borough, Kawerak, Inc., St. Paul Island Aleut Community, various Alaska Native natural resource organizations

Scope: This project consists of collection, long-term archival, and chemical analysis of marine mammal tissues to determine temporal and geographic trends in exposure of Alaska marine mammals (an important Alaska Native subsistence resource) to environmental contaminants.

Project Duration: 1987 - continuing

Title: Seabird Tissue Archival and Monitoring Project (STAMP)

Lead PI: Paul Becker 843-725-4815 Paul.Becker@noaa.gov

Agencies Involved: NIST, USFWS, BIA, Kawerak, Inc., University of Alaska, North Pacific Research Board, Hawaii Pacific University, US Air Force, NAVFAC, Pacific Rim Conservation

Scope: This project consists of collection, long-term archival, and chemical analysis of seabird eggs to determine temporal and geographic trends in environmental contaminants and exposure of seabirds to these contaminants in the U.S. Arctic and Pacific regions.

Project Duration: 1999 - continuing

Title: Contaminant exposure measurements for marine animal health assessments

Lead PI: Stacy Vander Pol 843-762-8994 stacy.vanderpol@noaa.gov

Agencies Involved: NIST, NOAA, MUSC, SCDNR, CofC, Mote Marine Laboratory, The Chicago Zoological Society, USGS, Dolphin Quest, Hawaii Pacific University

Scope: NIST supports marine animal health research projects, such as the bottlenose dolphin health assessment, sea turtle health assessments, and pygmy sperm whale cardiomyopathy study, by assisting in the development of sampling/collection protocols, banking of samples, and analytical measurements to determine chemical contaminant exposures. NIST also applies NMR-based metabolomics methods for assessing response of biota to chemical and physical stresses, such as for corals, and crustaceans.

Project Duration: 2002 - continuing

Title: NMR-based metabolomics for research on metabolic responses to pollution

Lead PI: Dan Bearden 843-762-8865 dan.bearden@noaa.gov

Agencies Involved: NIST, NOAA, MUSC, SCDNR, CofC

Scope: Development of NMR-based metabolomics for research on metabolomic responses to physical changes in the environment (e.g. temperature, pH, or salinity) and exposures to contaminants. This involves the use of case studies for developing non-model organism response fingerprints, developing lab and field testing protocols, and developing metabolite inventories for each species.

Project Duration: 2001 – continuing

Title: Untargeted screening of environmental samples for new pollutants

Lead PI: John Kucklick 843-725-4816 John.Kucklick@noaa.gov

Agencies Involved: NIST, SFEI, Southern California Coastal Water Research Project, San Diego State University

Scope: Identify unrecognized pollutants in marine samples using multidimensional chromatography/mass spectrometry. This project is being undertaken to (1) inform the California Water Board about the presence of unregulated pollutants in marine samples and (2) to improve the understanding of how many pollutants are present in environmental samples.

Project duration: 2010 – continuing

Title: Estuarine bottlenose dolphin assessments in response to the Deepwater Horizon oil spill incident.

Lead PI: Lori Schwacke 843-725-4821 Lori.Schwacke@noaa.gov

Agencies Involved: NOAA, NIST

Scope: Bottlenose dolphins reside in bays, sounds and estuaries in the northern Gulf of Mexico where they were exposed to oil and associated chemicals from the Deepwater Horizon incident.

This study is investigating the potential health impacts on northern Gulf of Mexico stocks of bottlenose dolphins specifically targeting stocks along the Mississippi and Louisiana coasts as part of the National Resource Damage Assessment (NRDA). The study includes (1) photo-identification to monitor changes in abundance, survival and reproductive rates, and (2) remote biopsy sampling to obtain tissue samples for analysis of exposure and effect biomarkers, and (3) capture-release sampling to assess health impacts associated with chronic oil exposure.

Project Duration: Continuing

Title: Assessment of extent and impacts of point-source pollution along Georgia coast. (OHHI)

Lead PI: Lori Schwacke 843-725-4821 Lori.Schwacke@noaa.gov

Agencies Involved: NOAA, NIST, SCDNR, GA DNR

Scope: This project is investigating the transport of PCBs, Hg and other chemical contaminant from a Superfund site (LCP) near Brunswick, Georgia. Sampling has focused on dolphins as a top-level predator, as well as fish and sediments. Sampling has been conducted in the immediate Brunswick vicinity, as well as near the Sapelo Island National Estuarine Research Reserve (NERR), approximately 20 miles northeast of Brunswick. Ongoing studies are sampling and analyzing tissues from both fish and dolphins further north in the ACE Basin NERR, and will also conduct sampling further south near Jacksonville, Florida. The primary objectives of the study are to 1)

investigate the extent of pollutant transport from the LCP site, 2) understand the impacts on dolphin populations which will contribute to the Natural Resource Damage Assessment, and 3) assess risks to human consumers of local seafood.

Project Duration: Continuing

Title: Sentinel habitat monitoring and assessment. (OHHI)

Lead PI: Anne Blair 843-762-8992 anne.blair@noaa.gov

Agencies Involved: NOAA, SCSG, SCDNR, SCDHEC

Scope: The effects of land-based development on estuarine condition and public health have been the focus of research conducted by the OHHI Center at HML. In particular, the research is focused on tidal creeks as a sentinel habitat to provide Health Early Warning Systems (HEWS) of coastal development. Results of these studies indicate that the amount and type of watershed development are linked to degradation in environmental quality, impairment to fish and shellfish populations, increased human health risk, and an increased vulnerability of coastal development to flooding from storm water runoff. Most recently, OHHI research effort has been coupled with an analysis of pathogen and nutrient loadings into Long Bay from tidal creeks and other sources draining the greater Myrtle Beach, SC tourist area. Pathogens are a particular concern in Long Bay given the large number of tidal creeks either on the 303(d) list or listed as a “Water of Concern” for fecal indicator bacteria (FIB) contamination. The latter indicates these waters will be added to the 303(d) list and hence TMDLs will soon be required for all of the tidal creeks. Many local management decisions have focused on bacterial contamination of the tidal creeks and coastal ocean because these regulatory listings and beach swimming advisories hurt tourism. This is the only area of South Carolina that has continuous posting of swimming advisories due to the elevated bacterial levels in the surf zone.

Project Duration: Continuing

Title: Portable assays for the detection of zoonotic pathogens. (OHHI)

Lead PI: David Wu 843-762-8940 David.Wu@noaa.gov

Agencies Involved: NOAA, UC Davis

Scope: This project is developing assays and rapid detection portable equipment to identify infectious zoonotic agents, both terrestrial and aquatic in nature, present in clinical samples (body fluids/mucus/fecal) from marine mammals. Real time PCR assays have been developed for *Leptospira*, *Cryptosporidium parvum*, *Giardia lamblia*, *Toxoplasma gondii* and *Brucella sp.* and field samples are currently being tested. Next steps include the development of extraction methods for field sampling and identification of hand-held technology for rigorous field applications.

Project Duration: Continuing

Title: Tools for detection of ocean health risks using cetaceans as marine biosensors. (OHHI)

Lead PI: Lori Schwacke 843-725-4821 Lori.Schwacke@noaa.gov

Agencies Involved: NOAA, MUSC, NIST, CZS

Scope: Bottlenose dolphins are valuable sentinels for the coastal marine environment. They are top-level predators exposed to high concentrations of chemical contaminants that biomagnify through the food chain. In addition, dolphins and other marine mammal species are often the first indicators for the presence of marine toxins in the food web. Bottlenose dolphins are broadly distributed, and as mammals are susceptible to many of

the same diseases and pathogens as humans. The same coastal waters that people use for fishing and recreation are inhabited by bottlenose dolphins 24/7. They therefore have the potential to be used as robust and cost-effective biosensors to provide early warning of health risks across most of the U.S. coast. This project is developing tools and assays that will expand the utility of blubber/skin samples obtained from dolphins using remote biopsy methods and will support the use of coastal dolphins as marine sensors to provide early warning of emerging health risks along the U.S. coast. The project is comprised of two primary tasks: (1) Develop steroid hormone radioimmunoassay and explore use of LC/MS to measure stress, reproductive and thyroid hormones in cetacean blubber; (2) Identify gene expression profiles in blood and blubber in relation to chemical contaminant (PCB, PAH) exposure.

Project Duration: Continuing

Title: Changes in Health and Well-being in Communities Affected by the Deepwater Horizon Disaster

Lead PI: Susan Lovelace 843-762-8933 susan.lovelace@noaa.gov

Agencies Involved: NOAA, MS-AL Sea Grant, US Census Bureau, EPA, US Forest Service, academic partners

Scope: We are exploring changes in the health and well-being of residents as they relate to changes in environmental health and the provision of ecosystem services. To do this we are developing a method that will use indicators which were identified in collaboration with other federal, state and academic programs. These will help us understand the links between the general health and well-being of communities and changing environmental conditions. We are focusing on twenty counties and parishes along Gulf of Mexico in Alabama, Florida, Louisiana and Mississippi that were directly affected by oil contaminated shorelines, as well as a selection of comparison counties. Using statistical techniques including regression analysis and structural modeling, we will examine changes in well-being over time, focusing on changes associated with the Deepwater Horizon disaster and other large scale environmental events during the study period (2000-2010).

Project Duration: 2011 – 2013

Title: Coastal Livelihoods and the Local Sense of Place: Assessing Social-Ecological Relationships and Environmental Values in the Face of Demographic Changes in Mount Pleasant, Awendaw, and McClellanville, South Carolina

Lead PI: Susan Lovelace 843-762-8933 susan.lovelace@noaa.gov

Agencies Involved: NOAA, CofC

Scope: Research in political ecology has demonstrated that as people “make a living,” they are also “making” their identities (Robbins 2007, 2004); therefore, the notion of “community” seems to be problematic at larger scales of planning and decision-making, scales at which conflict between economic livelihoods becomes most visible. However, research in other locations indicates that environmental conflict does not necessarily cleave along lines of identity politics (Robbins 2006; Walker and Hurley 2004). So while the first two objectives of this study aim to articulate differences among constituencies, in this third objective we aim to understand commonalities between constituencies, as well as develop common measures of community well-being related to changes in environmental health or ecosystem services.

Project Duration: 2012 – 2014

Title: Infectious disease investigations for coastal marine animals

Lead PI: Lori Schwacke 843-725-4821 Lori.Schwacke@noaa.gov

Agencies Involved: NOAA

Scope: Coastal marine animals serve as key indicators not only for chemical contaminants but also for infectious pathogens in the near shore environment. In the past year, three unusual mortality events (UME) involving marine mammals from the U.S. coast initiated epidemiological investigations into the causes of morbidity and mortality, at least two of which have been related to zoonotic pathogens with potential implications for human health. This project supports marine outbreak investigations by examining 1) susceptibility of affected populations; 2) characterization of pathologies and syndrome; 3) evaluation of etiology; and 4) planning surveillance for additional cases. As many diseases affecting marine animals, and particularly marine mammals, are zoonotic or closely related to terrestrial strains, understanding the pathogens to which near shore marine mammals are exposed provides an early warning of infectious disease threats for other marine wildlife and human users of coastal environments.

Project Duration: 2012 – continuing

Title: Application of a toxicogenomic endpoint for improved speed and specificity of regulatory coastal sediment toxicity testing

Lead PI: Fran Van Dolah 843-725-4864 Fran.Vandolah@noaa.gov

Agencies Involved: NOAA, SCCWRP

Scope: Contaminants from urbanized coastlines make their way into coastal waters through various routes that ultimately result in significant deposition into sediments, which serve as the source of organisms that support marine food webs. Current Toxicity Identification Evaluation (TIE) procedures for the analysis of sediment contaminants entails serial LD50 tests that can take weeks to complete, preventing timely actions. In collaboration with the Southern California Coastal Water Research Project, this project is evaluating the suitability of toxicogenomics, the global analysis of gene transcripts responding to intoxicants, for discriminating among discrete contaminant classes. For this pilot project, the transcriptome responses to copper and cyfluthrin are being examined and the optimum timecourse of exposures for transcriptome responses are being assessed. If successful, this biosensor approach to identification of contaminants will save time and is expected to improve specificity compared to traditional techniques.

Project Duration: Continuing

Title: Effects of Crude Oil and Dispersants on Saltmarsh Ecosystems

Lead PI: Michael Fulton 843-762-8576 Mike.Fulton@noaa.gov

Agencies Involved: NOAA, NIST

Scope: This research is focused on using laboratory and mesocosm scale experiments to assess the fate and bioeffects of crude oil, dispersants, and dispersed oil on estuarine ecosystems. Both lethal and sublethal endpoints are being evaluated.

Project Duration: Continuing

Title: Development of Screening Assays for Endocrine Disrupting Chemicals in Marine Invertebrates

Lead PI: Michael Fulton 843-762-8576 Mike.Fulton@noaa.gov

Agencies Involved: NOAA, EPA

Scope: The risks associated with endocrine disrupting compounds in the marine/estuarine environment have not been well characterized. One important area of research requires the development of assays to identify the effects of endocrine disrupting chemicals in estuarine/marine invertebrates. This project is focused on the development and validation of a multi-generational assay with the mysid, *Americamysis bahia* using a flow through proportional dilutor system.

Project Duration: Continuing

Title: Environmental Contaminant Chemistry

Lead PI: Ed Wirth 843-762-8903 Ed.Wirth@noaa.gov

Agencies Involved: NOAA, SCDNR, NIST, CofC

Scope: Urbanized estuaries are well documented to have elevated contaminant levels in their sediments, water and associated biota. Many contaminants entering estuaries are not included in routine monitoring programs due to a lack of robust methods for their detection and quantification. The goal of this project is to develop, maintain, and utilize analytical capabilities for the measurement of legacy and emerging contaminants in the estuarine environment.

Project Duration: On-going

III. Thematic Area: Climate Change

Title: Potential mechanism of global warming impacts on striped bass

Lead PI: Tanya Darden 843-725-4876 dardent@dnr.sc.gov

Agencies Involved: SCDNR, NOAA

Scope: Determine high temperature effects on the rate of telomere loss in striped bass (*Morone saxatilis*), a species that experiences thermal stress during the summer. Examine associated effects on life span and other life history characters (e.g. age at maturity, fecundity).

Project Duration: 2009 - 2013

Title: Quantifying the Effects of Iron and Light on the Growth of Diatoms from the Ross Sea, Antarctica

Lead PI: Jack DiTullio 843-953-9196 ditullioj@cofc.edu

Agencies Involved: CofC, MUSC, NSF

Scope: This grant focused on the effects that climate change is projected to have in the Southern Ocean. Increased stratification of the water column will result in changes to both the irradiance field and the bioavailability of iron. This research focuses on the interactive effects of light and iron on diatom physiology.

Project Duration: 2008 - 2012

Title: The impacts of Global Climate Change on the Reproductive Biology of Endangered and Protected Sea Turtles

Lead PI: Dave Owens owensd@cofc.edu

Agencies Involved: CofC, SCDNR, NOAA, MUSC, FL FWC

Scope: This collaborative project focusses on projected changes on sea turtle sex ratios and reproductive fitness caused by global climate change and involves field work with

foraging ground populations of juveniles and adults of three species in Florida Bay, Bermuda, Panama and off the southeast coast of the US.

Project Duration: 2008 – 2012

Title: Climate – Microclimate Influences on the Development of Species with Environmental Sex Determination

Lead PI: Lou Guillette 843-725-4818 lou.guillette@gmail.com

Agencies Involved: MUSC, NIST, SCDNR, NOAA, MUSC, NASA, NIBB-Japan

Scope: The American alligator is a top predator exhibiting environmental sex determination; that is, incubation temperature during a narrow window of time influences the sex determination process. Using in-nest recording thermistors, we have begun to establish nest temperature profiles relative to regional climate and microclimate data. Position is plotted in the nest, matched with nest temperature profiles and then related to genetic markers related to masculine or feminine phenotypes. Use of such data will allow us to examine similar data over the reproductive activity range of the American alligator (South FL to northern South Carolina). Modeling can then establish parameters where the population(s) are at risk.

Project Duration: 2011-2015

Title: Quantification of greenhouse gases

Lead PI: Clay Davis 843-725-4868 clay.davis@nist.gov

Agencies Involved: NIST, NOAA, World Metrology Organization

Scope: The NIST Gas Metrology Group (Gaithersburg) and Inorganic Chemical Metrology Group (HML) are collaborating to develop improved analytical methods and primary standards for the measurement of carbon dioxide, methane, carbon monoxide, nitrous oxide, sulfur hexafluoride, and hydrocarbons at atmospheric levels.

Project Duration: 2011 – On-going

Title: Seawater pH Quantification

Lead PI: Kenneth Pratt

Agencies Involved: NIST, Scripps, U. of Miami, European National Metrology Institutes

Scope: NIST staff is working to improve analytical methods and traceability of the measurement of pH in seawater by developing certified standards specific to seawater pH measurement and refining the assignment of uncertainties.

Project Duration: 2011 – On-going

Title: Boron isotope pH proxy

Lead PI: Rusty Day 843-762-8904 russell.day@noaa.gov

Agencies Involved: NIST, CofC, NOAA

Scope: The ratio of boron isotopes preserved in the calcified skeletons of marine organisms can be used as a proxy for past and present seawater pH. NIST has core analytical capabilities that will greatly improve the existing methods in this area and allow us to more accurately apply this method to corals or other organisms in order to document changes in ocean pH resulting from fossil fuel combustion.

Project Duration: 2012 – On-going

Title: Investigating Climate Change and Land Use Impacts on Stormwater Runoff

Lead PI: Anne Blair 843-762-8992 anne.blair@noaa.gov

Agencies Involved: NOAA, SC Sea Grant Consortium

Scope: Use the Small Water Runoff Modeling system (SWARM) we developed to (1) quantify impacts of climate change and land use on stormwater runoff, (2) use modeling results to predict pollutant loadings from runoff, (3) develop 'user friendly' tools for scientific research, coastal resource management and decision making, and community science education. SWARM is tested for the Southeast specifically and can be applied to other regions by recalibrating parameters.

Project Duration: On-going

IV. Thematic Area: Harmful Algal Blooms (HABs)

Title: Promising Investigator Research Award: Elucidating the environmental factors regulating the population structure of toxic cyanobacteria blooms in coastal South Carolina waters.

Lead PI: Dianne Greenfield 843-725-4823 GreenfieldD@dnr.sc.gov

Agencies Involved: SCDNR, USC

Scope: Microcystin is a potentially lethal hepatotoxin produced by cyanobacteria species common to SC. The population structure of cyanobacteria blooms and associated environmental factors are poorly understood, particularly for brackish systems characteristic of coastal SC (e.g., detention ponds). This pilot study will determine the population structure of microcystin-producing cyanobacteria blooms in brackish detention ponds at a molecular level & relate population structure to ambient environmental conditions. Results could help infer environmental factors regulating bloom development.

Project Duration: 2010 - 2012

Title: HAB Identification Tools I and II: Investigating Sources and Vectors for Domoic Acid in the South Atlantic Bight.

Lead PI: Dianne Greenfield 843-725-4823 GreenfieldD@dnr.sc.gov

Agencies Involved: SCDNR, USC, NOAA, CofC

Scope: Domoic acid (DA) is a neurotoxin produced by certain species of the diatom genus *Pseudo-nitzshia* (PN) and has been linked to marine mammal & bird strandings and amnesic shellfish poisoning. The ecology/oceanography of PN has been well-studied elsewhere, but is poorly understood in the southeast, but emerging evidence suggests that DA may be a regional concern. This project elucidates the geographic distribution of PN in the southeast and associated environmental (T, S, location) correlates from opportunistic sampling. Results showed that toxic PN are present in the southeast.

Project Duration: 2010 – 2015

Title: MERHAB: Comparative analysis of quantitative detection methods for enumeration of HAB species: Applications for resource management.

Lead PI: Dianne Greenfield 843-725-4823 GreenfieldD@dnr.sc.gov

Agencies Involved: SCDNR, USC, CofC, NOAA, U. Delaware

Scope: Molecular approaches for identifying and quantifying HABs are becoming increasingly utilized to maximize sample throughput and accuracy. Sandwich hybridization assay (SHA) and quantitative PCR (QPCR) are 2 examples of molecular approaches employed for HAB research and monitoring, but they have yet to be rigorously compared. This

project is a methods ‘bake-off’ assessing SHA and QPCR according to a variety of criteria using the ichthyotoxic raphidophyte *Heterosigma akashiwo* as our study organism. Results will have broad implications for future molecular-based HAB monitoring and research.

Project Duration: 2010 – 2014

Title: Utilizing HABISS to document, analyze, and interpret the impacts of harmful algal blooms.

Lead PI: Rick DeVoe Rick.Devoe@scseagrant.org

Agencies Involved: SCDNR, CDC, SCSG, USC, NOAA, SCDHEC

Scope: Determining relationships between HAB events and adverse wildlife and human health events is a key concern both regionally and nationally. The CDC has created a national database (HABISS) as a repository wherein participating states can contribute environmental and health information. Our group’s role is to contribute to this growing database by monitoring HAB events in coastal SC, responding to fish kills, and coordinating with state health professionals in the event of a health event.

Project Duration: 2008 - 2013

Title: Evaluation of harmful algal species and water quality in brackish and freshwater detention ponds on Kiawah Island, South Carolina.

Lead PI: Dianne Greenfield 843-725-4823 GreenfieldD@dnr.sc.gov

Agencies Involved: SCDNR, USC, Kiawah Island Community Association

Scope: This is the SC Algal Ecology Laboratory’s (SCAEL) flagship long-term monitoring and research effort focusing on detention ponds at Kiawah Island. The SCAEL has a database with ~11 years worth of phytoplankton and environmental data on a variety of systems, including blooms, fish kills, and related projects. The goal of this project is to continue to monitor water quality and algal community composition for HAB events in coastal detention ponds at Kiawah Island, a well-known ‘hot spot’ for potentially toxic blooms.

Project Duration: 2001 – Continuing

Title: Harmful algal blooms: Marine organisms as vectors of domoic acid

Lead PI: Lou Burnett 843-953-9170 BurnettL@cofc.edu

Agencies Involved: CofC, NOAA

Scope: The purpose of this project is to determine whether *Litopenaeus vannamei* and other marine crustaceans commonly consumed by humans, marine mammals and other marine organisms can serve as vectors of domoic acid to humans and the marine food web. Experiments test the extent to which domoic acid is taken up and retained in the tissues of *L. vannamei*, and whether this toxin exposure can alter muscle activity in the shrimp.

Project Duration: 2010 – 2012

Title: Effects of Brevetoxins on Lung Inflammation in Dolphins and Humans

Lead PI: John Baatz baatzje@musc.edu

Agencies Involved: MUSC, CofC, NOAA

Scope: Brevetoxins, produced by Florida red tides, effect human and marine animal health through both ingestion and inhalation exposure. Although aerosolized brevetoxins are known to be rapidly-acting respiratory toxins, the toxin-induced changes leading to impaired lung cell function as well as the mechanisms of action from direct inhalation

have yet to be elucidated. The goal of this project is to delineate the changes in alveolar cell function and identify the mechanisms leading to lung inflammation and altered lung function.

Title: Investigation of the transcriptomic response to ciguatera poisoning in humans.

Lead PI: Fran Van Dolah 843-725-4864 Fran.Vandolah@noaa.gov

Agencies Involved: NOAA

Scope: Over 100,000 people annually experience ciguatera poisoning from consuming toxic fish and to date, no reliable tests exist to identify ciguatera fish poisoning in humans and no reliable therapies have been developed. This study characterized a consistent transcriptomic response in the blood of chronic ciguatera patients using a whole genome human microarray that may yield potential biomarkers for ciguatera exposure, and also may shed light on pathologic mechanisms responsible for the development of chronic ciguatera following acute ciguatera exposure in a subset of susceptible patients.

Title: The Occurrence and Source of Domoic Acid in the Southeastern U.S., its Presence in Marine Mammals and Potential Transfer to Humans.

Lead PI: Fran Van Dolah 843-725-4864 Fran.Vandolah@noaa.gov

Agencies Involved: NOAA, CofC, SCDNR

Scope: Domoic acid (DA) causes annual mortalities of marine mammals on the U.S. west coast. DA has more recently been documented in bottlenose dolphins in the southeastern U.S. and it is hypothesized that DA exposure may be associated with eosinophilia in the Florida panhandle dolphin population. A link between DA and mortalities of pygmy sperm whale has also been suggested along the eastern U.S. coast. This toxin had not previously been documented in southeastern U.S. coastal waters. This two-year project documented coastal and offshore *Pseudo-nitzschia* species in the South Atlantic Bight, assessed their toxicity, developed DNA probes for their detection, and examined the possible trophic transfer of DA to sentinel species and humans through shrimp.

Title: Development of hand-held, field deployable array biosensors to distinguish among multiple species of *Karenia* and *Pseudo-nitzschia* in the Gulf of Mexico.

Lead PI: Fran Van Dolah 843-725-4864 Fran.Vandolah@noaa.gov

Agencies Involved: NOAA, USF

Scope: *Karenia brevis* is known as the most problematic HAB species in the Gulf of Mexico. However, five morphologically similar species of *Karenia* are now recognized in the Gulf of Mexico whose distribution and toxicity are poorly understood. Similarly, multiple species of diatoms *Pseudo-nitzschia* occur in the Gulf of Mexico that can be distinguished only by electron microscopy. This project funded by the NOAA Biosensor Program is to develop lateral flow microarrays capable of distinguishing between closely related species, using gene probes for *rbcL* and *CoI*, in a hand-held, field appropriate format.

Title: Transcriptional profiling of whole blood and serum protein analysis for biomarker development to assess exposure and disease states in California sea lions.

Lead P.I.: J. Ryan

Agencies involved: NOAA, MUSC, SCDNR, CofC, The Marine Mammal Center

Scope: California sea lions are a protected marine mammal species that suffers extensive dieoffs annually due to the algal neurotoxin domoic acid and debilitating kidney disease due to leptospirosis. This study assessed the utility of microarrays to identify changes in gene expression predictive of health status, using minimally invasive blood sampling. In the absence of sea lion genome sequence data, cross-species hybridization was carried out using a dog microarray. RNA was analyzed from 73 sea lions with known health status. Both traditional classifying techniques and artificial neural network approaches correctly classified sea lions with respect to health status, primarily distinguishing between leptospirosis infection and domoic acid exposure. The study showed that this approach holds promise for disease identification and assessment of health status in protected species, using samples obtained in a minimally invasive manner.

IV. Thematic Area: Emerging and Mission Based (EMB)

Title: Effects of overwinter mortality on population genetic diversity.

Lead PI: Tanya Darden 843-725-4876 DardenT@dnr.sc.gov

Agencies Involved: SCDNR, CofC

Scope: Examine the effects of extreme winter kills on the genetic diversity and adaptive potential of spotted seatrout by examining genetic responses to past winter bottlenecks and subsequent population recoveries.

Project Duration: 2011 - 2013

Title: Genetic Risk Assessment Modeling for Offshore Marine Aquaculture Operations: Cobia

Lead PI: Tanya Darden 843-725-4876 DardenT@dnr.sc.gov

Agencies Involved: SCDNR, CofC

Scope: The goal of this research project is to develop a model to assess potential genetic risks associated with offshore marine aquaculture operations for cobia based on sound life history and population genetic science.

Project Duration: 2011 - 2013

Title: Genetic Influences of Overfishing

Lead PI: Tanya Darden 843-725-4876 DardenT@dnr.sc.gov

Agencies Involved: SCDNR, CofC

Scope: The goal of this research is to increase our understanding of changes in the genetic diversity of overfished populations by evaluating long-term diversity trends in five economically important reef fish species that inhabit the South Atlantic Bight.

Project Duration: 2011 - 2013

Title: Genetic Characterization of Robust Redhorse: Implications for Conservation

Lead PI: Tanya Darden 843-725-4876 DardenT@dnr.sc.gov

Agencies Involved: SCDNR, NC Museum of Natural Sciences, USFWS

Scope: The goal of the genetic work for our project is to develop baseline data for the Savannah River and Pee Dee River populations of robust redhorse, conduct genetic forecasting for conservation management, and build the foundation for future evaluation of ongoing re-establishment within the Santee River system.

Project Duration: 2011 – 2012

Title: Genetic Tool Development for Cobia and Red Drum

Lead PI: Tanya Darden 843-725-4876 DardenT@dnr.sc.gov

Agencies Involved: SCDNR

Scope: The goal of this research project will be to develop and test non-invasive methods for aging and sexing two species of recreationally important fishes that inhabit estuarine and offshore waters of South Carolina.

Project Duration: 2009 - 2012

Title: Non-lethal Aging Tool Development for Two Species of Sturgeon

Lead PI: Tanya Darden 843-725-4876 DardenT@dnr.sc.gov

Agencies Involved: SCDNR, NCDENR

Scope: The goal of our portion of this project is to develop and apply non-invasive methods for aging two species of protected sturgeon that inhabit freshwater, estuarine and offshore waters of the southeastern U.S.

Project Duration: 2010 - 2013

Title: Weakfish Genetic Identification

Lead PI: Tanya Darden 843-725-4876 DardenT@dnr.sc.gov

Agencies Involved: SCDNR

Scope: The goals of this research project are test and apply genetic tools to verify morphological identification of all four local *Cynoscion* species as well as characterize any ongoing intra-generic hybridization.

Project Duration: 2011 - 2013

Title: Genetic Characterization and Population Recovery of American Shad in the Edisto River

Lead PI: Tanya Darden 843-725-4876 DardenT@dnr.sc.gov

Agencies Involved: SCDNR, Bear's Bluff National Fish Hatchery

Scope: The goal of this research is to optimize genetic markers to evaluate stocking effectiveness for American shad as well as genetically characterize the Edisto River population; both aimed at meeting objectives of restoring anadromous fish populations in the Edisto River.

Project Duration: 2009 - 2012

Title: Population Genetic Structure of Adult Red Drum along the Southeastern U.S.

Lead PI: Tanya Darden 843-725-4876 DardenT@dnr.sc.gov

Agencies Involved: SCDNR

Scope: The goal of this research project is increase our understanding of adult red drum population structure along the southeastern U.S. to improve our management capabilities for this recreationally important fishery.

Project Duration: 2011 - 2013

Title: Genetic Characterization of Spotted Seatrout along the Southeastern U.S.

Lead PI: Tanya Darden 843-725-4876 DardenT@dnr.sc.gov

Agencies Involved: SCDNR, CofC

Scope: The goals of this research are to examine the spatial and temporal genetic characteristics of spotted seatrout along the southeastern U.S. Atlantic coast. Knowing whether fish from these estuaries show signs of admixture or are isolated populations is key to the current and future management of spotted seatrout in South Carolina.

Project Duration: 2011 - 2013

Title: Evaluation of Habitat Utilization, Recruitment Bottlenecks and Movement of Coastal Striped Bass Population(s)

Lead PI: Tanya Darden 843-725-4876 DardenT@dnr.sc.gov

Agencies Involved: SCDNR, CofC

Scope: The goal of this research project is to build a conceptual restoration model for striped bass by improving our understanding of their life history, habitat usage and population dynamics in coastal rivers in the southeast Atlantic.

Project Duration: 2007 - 2013

Title: South Carolina DNR Marine Turtle Conservation Program

Lead PI: Dubose Griffin

Agencies Involved: SCDNR, NOAA, USFWS

Scope: Program was initiated in 1978 to establish a sea turtle stranding network to provide statewide information on sea turtle strandings, and later to assess the effectiveness of the Turtle Excluder Device regulations. The program further developed in the early 1980s to include research, management, monitoring, and educational activities. Program data is used in a variety of applications including the development of beach management and species recovery plans, and the review of permit applications for beach and in-water construction/maintenance activities. One component of the program involves the necropsy of fresh-dead sea turtles at a laboratory in HML.

Project Duration: 1978 – Continuing

Title: Jaws and Backbone: Chondrichthyan Phylogeny and a Spine for the Vertebrate Tree of Life

Lead PI: Gavin Naylor 843-725-4806 gjpnaylor@gmail.com

Agencies Involved: CofC, MUSC, NSF, CSIRO, AMNH

Scope: Development of methods co-opting high throughput sequencing to provide a few sequences of interest across several hundred organisms simultaneously based on cross-species gene capture. We will use these data to provide a phylogenetic framework to explore evolutionary change in vertebrates.

Project Duration: 2010 - 2015

Title: Global Elasmobranch Species Diversity project

Lead PI: Gavin Naylor 843-725-4806 gjpnaylor@gmail.com

Agencies Involved: CofC, MUSC, NSF, CSIRO

Scope: Work is aimed at documenting global elasmobranch diversity at the species level based on comparative anatomy and DNA sequence variation.

Project Duration: 2012 - 2015

Title: Breathing new life into old specimens
Lead PI: Gavin Naylor 843-725-4806 gnaylor@fsu.edu
Agencies Involved: CofC, MUSC, NSF, CSIRO, Shanghai Ocean University
Scope: Gene capture approaches developed to obtain DNA sequence data from museum specimens where standard PCR based approaches have failed.
Project Duration: 2012 - 2015

Title: Sharks, Rays and Chimaeras of the world.
Lead PI: Gavin Naylor 843-725-4806 gjpnaylor@gmail.com
Agencies Involved: CofC, CSIRO, AMNH, NSF
Scope: An interactive web site to document the diversity of elasmobranch fishes. The site will feature the current taxonomy, interactive species range maps, scientific illustrations and biological descriptions for 1230 species of elasmobranchs. The site will include a 3-D interactive comparative anatomy component based on CT scan data and an estimate of phylogenetic relationships based on DNA sequence data.
Project Duration: 2011 - 2015

Title: Comparative development of sharks skates and rays
Lead PI: Gavin Naylor 843-725-4806 gjpnaylor@gmail.com
Agencies Involved: MUSC, CofC
Scope: A survey of microRNA gene expression in chondrichthyan fishes to provide insight into the development and deployment of sensory systems in vertebrates
Project Duration: 2012 – 2016

Title: MRI-Consortium: Acquisition of a Shipboard Sorting Flow Cytometer for Biogeochemical Research and Education
Lead PI: Jack Ditullio 843-953-9196 ditullioj@cofc.edu
Agencies Involved: NSF, CofC, NOAA
Scope: This NSF grant allowed the acquisition of a an ocean going laboratory van, flow cytometer, gas chromatograph and various other pieces of equipment that are housed at HML.
Project Duration: 09/01/2009 – 07/31/2012

Title: Lipid lubrication of oceanic carbon and sulphur biogeochemistry via a host-virus chemical arms race.
Lead PI: Jack Ditullio 843-953-9196 ditullioj@cofc.edu
Agencies Involved: NSF, CofC, MUSC
Scope: This grant will have both laboratory components (experiments at HML) as well as field cruises to the South Pacific Ocean and the North Atlantic Ocean
Project Duration: 03/01/11 – 02/28/14

Title: The Genomics of Environmental Sex Determination
Lead PI: Satomi Kohno 843-725-4827 kohno@musc.edu
Agencies Involved: MUSC, UC Santa Cruz, SCDNR, NIBB-Japan
Scope: Environmental sex determination is a characteristic of all crocodylians, sea turtles and many fish. Yet the underlying genetic basis of such a major biological phenomenon is

still poorly understood. This project examines the phenomenon in the American alligator using the newly produced alligator genome, modern sequence approaches and experimental manipulation.

Project Duration: 2010 - 2014

Title: Sequencing three crocodylian genomes to illuminate the evolution of archosaurs and amniotes

Lead PI: Satomi Kohno 843-725-4827 kohno@musc.edu

Agencies Involved: MUSC

Scope: The International Crocodylian Genomes Working Group (ICGWG) is in the process of sequencing and assembling the genomes of the American alligator (*Alligator mississippiensis*), the saltwater crocodile (also called the estuarine or Indo-Pacific crocodile; *Crocodylus porosus*), and the Indian gharial (or gavial; *Gavialis gangeticus*). These genomes will be a useful resource to the scientific community for investigating genome evolution in amniotes, as well as the evolution of morphology, physiology, endocrinology, immunology and temperature dependent sex determination in vertebrates. In conjunction with avian genomes, they will also provide information about the ancestral dinosaur genome. Further information about the project and preliminary assemblies can be accessed at <http://crocgenomes.org>.

Project Duration: 2009 – 2012

Title: NexGen Assays for Plasma and Blubber Steroid and Thyroid Hormone Concentrations.

Lead PI: Lou Guillette 843-725-4818 lou.guillette@gmail.com

Agencies Involved: MUSC, NOAA, NIST

Scope: Determining the concentrations of sex and stress steroids as well as thyroid hormones is essential to evaluate health status in wildlife sentinel species. Few validated assay exist for these hormones in marine mammals and none exist using blubber biopsies. This project's goals are to validate extraction procedures and RIAs for an array of sex steroids and thyroid hormones using plasma and blubber from dolphin. Further, we are working on LC-MS/MS approaches that could become the next generation assay approach for doing such evaluations.

Project Duration: 2011 – 2012

Title: Development Of Plasma and Tissue Sampling Approaches for Contaminant and Blood Chemistry Analyses of American Alligators in Estuarine Environments of South Carolina and Florida.

Lead PI: Lou Guillette 843-725-4818 lou.guillette@gmail.com

Agencies Involved: MUSC, SCDNR, NIST

Scope: The use of sentinel species to assess the health of estuarine environments is well established. But many questions remain on the appropriate sampling approaches and whether capture stress or various sample-handling approaches in the field alter the later chemical analyses in the laboratory. This is a two-year project to clarify where variance enters the analytical approach using the American alligator as the sentinel species of interest.

Project Duration: 2011 - 2013

Title: The Genomics and Lipodomies of Ovarian Cancer

Lead PI: Lou Guillette 843-725-4818 lou.guillette@gmail.com

Agencies Involved: MUSC, NIST, SCDNR

Scope: Ovarian cancer is the fifth leading cause of death among women in the United States and the leading cause of death from a gynecologic malignancy. In 2011, an estimated 21,880 women were diagnosed with ovarian cancer with over 13,850 deaths. The high mortality with ovarian cancer is largely due to the advanced stage of the disease at presentation; approximately 75% of patients are stage III-IV at diagnosis. Thus, there is a critical need for early detection. Our goal is to determine if ovarian cancers are associated with altered expression of genetic or lipid agents that help resolve inflammation, and to put that information into the context of a wider network of genes and lipid products. This approach tests specific hypotheses, and the ANN and ROC analyses allow the generation of hypotheses for further research. The current approach collects information at three levels of biological organization; gene expression profiles (RT-PCR and transcriptomics), lipid products (lipidomics) and the cancer status (specific pathological information on the tumors or tissue state) of the individual. These data can lead directly to the development of biomarker candidates for early detection of ovarian cancers.

Project Duration: 2011 – 2014

Title: The Evolution of the Vertebrate Sex and Stress Steroid Receptors: Cloning, Sequencing and Characterization.

Lead PI: Lou Guillette 843-725-4818 lou.guillette@gmail.com

Agencies Involved: MUSC, NIBB-Japan, NOAA, Virginia Tech U., Stellenbosch University

Scope: As many known endocrine disrupting chemicals (EDC) affect signaling through the vertebrates' nuclear receptor family, that includes all the nuclear sex and stress steroid hormone receptors, we have an ongoing project to characterize these receptors from key evolutionary species or species of special concern due to their role as environmental sentinels. Current species under study are: the bottlenose dolphin, pygmy sperm whale, hellbender (large North American salamander), the Great White Shark and Diamondback Terrapin. Additional species are added to the project each year.

Project Duration: 2005 - 2014

Title: Biology and Ecotoxicology of the American Alligator at Kennedy Space Center.

Lead PI: Lou Guillette 843-725-4818 lou.guillette@gmail.com

Agencies Involved: MUSC, NIBB-Japan, NIST, NASA, Ehime University-Japan, Tottori University – Japan

Scope: This is an assessment of the biology of the American alligator at Kennedy Space Center (KSC) in collaboration with NOAA. The goal is the use of the alligator as a sentinel species of KSC and the surrounding Merritt Island National Wildlife Refuge. Project involves water and tissue analyses for contaminants as well as the development and use of plasma and gene based biomarkers to assess health.

Project Duration: 2006 – 2014

Title: Adipogenesis in Deep Diving Marine Mammals and Estuarine Vertebrates: Adaptation, Exposure and Implications for Human Disease.

Lead PI: Demetri D. Spyropoulos 843-725-4827 Demetri.Spyropoulos@noaa.gov

Agencies Involved: MUSC, NOAA, NIH

Scope: Human and animal model studies have confirmed the concept that adult diseases (including obesity, diabetes and insulin-resistance syndrome, etc.) stem from fetal exposure to detrimental agents. Unfortunately, these studies are notoriously time-consuming (multigenerational) and expensive, making the rigorous analysis of environmental agents impossible. Further limiting animal model studies, the concept of single-agent single-dose exposure has given way to chronic low-dose exposure of mixtures. Environmentally relevant mixtures include a combination of diet, climate change (temperature, salinity and carbon dioxide/oxygen levels), groundwater runoff (fertilizers and pesticides), and domestic/industrial wastewaters; the latter two of which make estuarine sentinel species especially useful. The innovation of our work is that we will use stem cells, representative of (but not coming from) human and aquatic animal fetuses, as the models and thereby create a high-throughput platform on which to rapidly identify and rigorously study the impacts of a large number of mixtures. Human stem cells already exist and we have established stem cells from other mammals (mice, deep diving whales and the evolutionarily linked pig). We have used these stem cells to show that limiting oxygen, severely limits fat cell generation (adipogenesis) in land mammal, but not in deep diving whale stem cells. This indicates that the whale has a different mechanism that may be associated with it adapting to long periods without taking a breath. Differences in such mechanisms between species can change the susceptibility to mixtures, but may also provide clues to develop new therapies for people with diseases.

Title: Lung Adaptations of Deep Diving Marine Mammals: Lung Repair Mechanisms and Potential Deleterious Effects of Sonar and Toxins.

Lead PI: John E. Baatz baatzje@musc.edu

Agencies Involved: MUSC, NOAA

Scope: Their abilities to tolerate extreme pressure and maintain health in low-oxygen environments associated with deep dives and associated forced lung collapse prior to deep dives make diving marine mammals ideal for scientific investigation. The U.S. Navy is currently interested in the bottlenose dolphin, the beaked whale, and the California sea lion. Identification of underlying adaptations of deep diving marine mammals to extended periods of low oxygen tension (hypoxia associated with lung collapse), or physiological impacts of sonar or toxin exposure, would significantly impact development of potential treatments for lung injury in marine mammals. Progress in these areas have been considerably obstructed by the lack of reliable models that mimics either the physiology of deep diving marine mammals or effects of acute (or chronic) sonar and toxin exposures. We propose to gain understanding into lung cellular and molecular mechanisms in marine mammals that protect against hypoxic injury. These studies will have applications in the areas of 1) marine mammal health 2) submarine warfare, 3) sentinel exposure to dangerous conditions/toxins and 4) decompression sickness & other breathing disorders. For our study we will meld cutting edge cellular and molecular technologies that do not yet exist in other laboratories. These include 1) Cryopreservation techniques to salvage/store live tissues from stranded marine mammals; 2) Primary and stem cell cultures; and 3) Gene Expression Arrays and Proteomic tools for elucidating effects of sonar on a variety of cells of diving marine mammals. Products of this study include molecular diagnostics for the establishment of safety standards for sonar use in the SOFAR channel or optimal sonar frequency ranges to minimize effects on marine mammal health. In addition, the methodology developed

herein will also be capable of determining effects of toxins or environmental stressors on marine mammals and potential therapeutic development for treatments thereof.

Project Duration: Continuing

Title: NMR-based metabolomics for animal health research

Lead PI: Dan Bearden 843-762-8865 dan.bearden@noaa.gov,

Agencies Involved: NIST, NOAA, MUSC, SCDNR, CofC

Scope: Development of NMR-based metabolomics for research on metabolomic responses to physical changes in the environment, stress, exposure to toxins, and disease. This involves the use of case studies for developing non-model organism response fingerprints, developing lab and field testing protocols, and developing metabolite inventories for each species.

Project Duration: 2001 – continuing

Title: NMR application for structural biology

Lead PI: Dan Bearden 843-762-8865 dan.bearden@noaa.gov

Agencies Involved: NIST, NOAA, MUSC

Scope: NIST provides infrastructure and support for HML partner efforts in structural biology based on NMR spectroscopy. This includes application in pharmacology, disease investigations, and natural products research.

Project Duration: 2006 – continuing

Title: Aquaculture application of NMR-based metabolomics

Lead PI: Dan Bearden 843-762-8865 dan.bearden@noaa.gov

Agencies Involved: NIST, SCDNR

Scope: NMR-based metabolomics procedures are being developed for optimizing aquaculture production through dietary and physical condition studies and for understanding the effects of stressors on important commercial species, such as cobia and shrimp.

Project Duration: 2010 - continuing

Title: Clinical measurements & analytical reference materials

Lead PI: Clay Davis 843-725-4868 clay.davis@noaa.gov

Agencies Involved: NIST, CDC, NIH, NY State Dept of Public Health

Scope: Reference measurement procedures and Standard Reference Materials (SRMs) developed by NIST help ensure accuracy and comparability of routine clinical assays. NIST continually updates its portfolio of SRMs for clinical diagnostics to meet the needs of the clinical chemistry community, including SRMs for the analysis of vitamins, minerals, trace elements, metabolites, proteins, hormones and biomarkers in a variety of matrices (e.g. blood, serum, plasma, and urine).

Project Duration: 2001 – continuing

Title: Metallomics

Lead PI: Clay Davis 843-725-4868 clay.davis@noaa.gov

Agencies Involved: NIST, MUSC

Scope: The emerging science of “metallomics,” which involves the detection, mapping, and/or quantification of trace elements in biological systems at organ, cell, and subcellular levels, requires the development of versatile measurement tools allowing for trace detection, identification, and quantification of metals associated with proteins. The goal

of this project is to improve the state of the practice for protein metrology through development of analytical methods for separation, detection and quantification of proteins in biological tissues and fluids.

Project Duration: 2006 – continuing

Title: Dietary supplement measurements & analytical reference materials

Lead PI: Steven Christopher 843-7254872 Steven.Christopher@noaa.gov

Agencies Involved: NIST, NIH, FDA

Scope: There are occasional reports of inaccurate labeling, adulteration, contamination (with pesticides, heavy metals, or toxic botanicals), and drug interactions associated with botanical dietary supplements. NIST is producing standard reference materials with assigned values for concentrations of active and/or marker compounds, pesticides, and toxic elements to assist in the verification of manufacturers' label claims and for use in quality control during the manufacturing process.

Project Duration: 2001 – continuing

Title: Expansion of environmental specimen banking for marine animal health research and monitoring

Lead PI: Rebecca Pugh 843-762-8952 Rebecca.Pugh@noaa.gov

Agencies Involved: NIST, NOAA

Scope: The Marine Environmental Specimen Bank is maintained by NIST at the HML as a part of contaminant monitoring and research programs of Other Agencies and organizations. A great part of the specimen collection maintained by the bank consists of animal tissues that have been used to investigate exposure of biota to contaminants. A few specimens have also been used for genetics research, animal nutrition studies, and determination of trophic level changes. The mission of this bank is now being expanded to provide a resource for integrative animal health assessment that will include biotoxin exposure, wildlife diseases, genomics research, and development of health biomarkers.

Project Duration: 2010 - continuing

Title: Development and application of shotgun lipidomic profiling techniques to biological samples

Lead PI: John Bowden 843-762-8960 john.bowden@noaa.gov

Agencies Involved: NIST, MUSC

Scope: Analytical methods are being developed for the characterization and quantification of individual lipids, hormones and lipid classes in biological tissues using tandem mass spectrometry techniques. Resulting information will be useful for understanding nutritional, endocrine and inflammatory responses in relationship to, for instance, pollutant stress or carcinogenesis. The methods developed should have broad application across many sample types including marine and human samples.

Project Duration: 2011 - continuing

Title: Toxin Discovery - Identification and molecular characterization of novel toxins associated Hawaiian pufferfish mortality events.

Lead PI: Peter Moeller 843-762-8867 Peter.Moeller@noaa.gov

Agencies Involved: NOAA, USGS

Scope: This research project is focused on identifying and molecularly characterizing a toxin(s) responsible for massive puffer fish mortality events in Hawaiian waters. The events highlighted the potential of a very highly selective agent as only one species (*A. hispidus*) of pufferfish was affected in any significant numbers. Working with our Hawaiian colleagues we ruled out viral or bacterial agents as there was no consistent pathology. MS analysis has already demonstrated the presence of tetrodotoxin (TTX) and a number of congeners but this was to be expected for puffer fish sequester TTX for use as a defense tool. As there were reports of human mortalities in Hawaii from consumption of this fish we have been testing liver, bile, tissue, stomach contents, fecal matter and other tissues from puffer fish that have succumbed to this mystery ailment. Current research is focused on a very polar toxin (water soluble only) with a novel MS/NMR signature. We are developing detection and monitoring tools for this analyte as structural work continues. We are also looking into routes of exposure based on tissue locality of toxic fractions.

Project Duration: Ongoing

Title: Natural Toxin Elucidation: Identification and characterization of Euglenophycin-a pan-global toxin found in certain euglenoids. Anti-Cancer Patent Filed.

Lead PI: Peter Moeller 843-762-8867 Peter.Moeller@noaa.gov

Agencies Involved: NOAA, TAMU-CC, MSU, MUSC

Scope: This research is focused on the characterization and large scale production of the novel emerging toxin euglenophycin. The producing organism found in fresh and saline waters was thought to be benign but was subsequently shown in our labs to be the responsible source of large scale toxic blooms. These blooms have been associated with both fish and mammal die-off events world-wide. To date, using the NMR and MS facilities at NOAA we have fully characterized euglenophycin's molecular structure, identified several congeners and developed sophisticated MS detection and monitoring methods. Lichtenstein Foundation money has been obtained to develop a laboratory synthetic process to enable large scale production of the toxin and its stereoisomers for use as both toxin standards necessary for food safety monitoring; as well as for testing against renal/colon cancer cell lines where it has demonstrated some selective efficacy. Euglenophycin has been patented by the PI's for its commercial development.

Project Duration: On-going

Title: Algae Toxins as a Terror Threat: Identification and Source Mechanisms - Developing a Safe and Sustainable Algal Biofuels Industry.

Lead PI: Peter Moeller 843-762-8867 Peter.Moeller@noaa.gov

Agencies Involved: NOAA, TAMU-CC, LANL, DOE

Scope: This project is focused on the products and safety (risk assessment) associated with algal derived biofuels. Large biofuel raceways and ponds provide a niche for large scale toxin production in the event of genetic alteration of biofuel generating species as well as due to contamination of the oil producing ponds. The focus of this research is to 1) Assess environmental cues associated with algal toxin production in ponds that become toxic. 2) Isolate and identify toxins and source organisms to ensure safety in handling and other occupational risk issues, 3) Identify, isolate and characterize those bioactive metabolites that exhibit commercial potential (i.e. anti-fungal agents, anti-biotics, chemo-therapeutics, food products etc.) in addition to oil production. The research is

carried out in a novel “virtual lab” setting tying the four agencies together utilizing and complementing each other’ facility and expertise strengths focused on common goals. NOAA’s main role is using its state of the art NMR and MS facilities for molecular chemical identification of bioactive compounds especially toxins and novel chemical alternatives for beneficial re-use of process residues.

Project Duration: On-going

Title: Transcriptional profiling of whole blood and serum protein analysis for biomarker development to assess exposure and disease states in California sea lions.

Lead PI: Lori Schwacke 843-725-4821 Lori.Schwacke@noaa.gov

Agencies Involved: NOAA, MUSC, The Marine Mammal Center

Scope: California sea lions are a protected marine mammal species that suffers extensive dieoffs annually due to the algal neurotoxin domoic acid and debilitating kidney disease due to leptospirosis. This study assessed the utility of microarrays to identify changes in gene expression predictive of health status, using minimally invasive blood sampling. In the absence of sea lion genome sequence data, cross-species hybridization was carried out using a dog microarray. RNA was analyzed from 73 sea lions with known health status. Both traditional classifying techniques and artificial neural network approaches correctly classified sea lions with respect to health status, primarily distinguishing between leptospirosis infection and domoic acid exposure. The study showed that this approach holds promise for disease identification and assessment of health status in protected species, using samples obtained in a minimally invasive manner.

Title: Toxin Discovery: Identification and characterization of Euglenophycin-a toxin found in certain euglenoids.

Lead PI: Peter Moeller 843-762-8867 Peter.Moeller@noaa.gov

Agencies Involved: NOAA, TAMU-CC, MSU

Scope: This research is focused on the characterization and large scale production of the novel emerging toxin euglenophycin. The producing organism found in fresh and saline waters was thought to be benign but was subsequently shown in our labs to be the responsible source of large scale toxic blooms. These blooms have been associated with both fish and mammal die-off events world-wide. To date, using the NMR and MS facilities at NOAA we have fully characterized euglenophycin’s molecular structure, identified several congeners and developed sophisticated MS detection and monitoring methods. Lichtenstein Foundation money has been obtained to develop a laboratory synthetic process to enable large scale production of the toxin and its stereoisomers for use as both toxin standards necessary for food safety monitoring; as well as for testing against renal/colon cancer cell lines where it has demonstrated some selective efficacy. Euglenophycin has been patented by the PI’s for its commercial development.

Project Duration: On-going

Title: Toxin Discovery: Identification and molecular characterizatioin of novel toxins associated with *Trichodesmium thiebautii*.

Lead PI: Peter Moeller 843-762-8867 Peter.Moeller@noaa.gov

Agencies Involved: NOAA, UT at Austin

Scope: *Trichodesmium* presents a world-wide problem both in the human health arena as well as for environmental health. For over 500 years of recorded history, it has been known to be a toxin producing organism. It is associated with Tamandare fever and a large

number of uncharacterized ailments reported by those coming into contact with a very large bloom. Huge *Trichodesmium* blooms may be responsible for the demise of large portions of the Great Barrier Reef off Australia's coast, highlighting the necessity to understand this organism and its bioactive agents. *Trichodesmium* blooms can often cover over a thousand miles of water and produce tremendous amounts of toxic substances that are released into the environment ultimately affecting both environmental and human health. Until recently, none of its toxins had been characterized, assessed or had detection tools developed for safety purposes. We have utilized NMR, MS, and HPLC to isolate over 30+ toxins from wild collections of this organism. Two of the toxins are now fully characterized and we are working on a number of others. As toxins are isolated, we are developing analytical chemistry monitoring and detection tools for use by those associated with *Trishodesmium* blooms. We are isolating and characterizing a large number of bioactive compounds that exhibit anti-microbial and anti-fungal activities. Massive quantities of pigments from this organism also present a large potential for commercial development.

Project Duration: On-going

Title: Toxin Discovery: Identification and molecular characterization of novel toxins associated with *Prymesium parvuum*.

Lead PI: Peter Moeller 843-762-8867 Peter.Moeller@noaa.gov

Agencies Involved: NOAA

Scope: The golden alga *Prymnesium parvum* has been implicated in fish and aquatic animal kills globally for over a century. In addition to widespread ecological impacts through the loss of entire fish populations within lakes, an economic burden is also felt by state and local agencies due to year class losses of fish for stocking lakes as well as loss of fishing and recreational use of the affected body of water. Multiple compounds have been implicated in *P. parvum* toxicity, but the identification and characterization of all *P. parvum* toxins remained to be accomplished. To address the unambiguous characterization of these toxins, we analyzed laboratory-cultured cells and uni-algal wild cells collected from an ichthyotoxic bloom event. A bioassay-guided fractionation process was employed to chemically define *P. parvum* toxins using both mammalian cells and larval fish. The results of these assays revealed that there was a distinct similarity in the toxic compounds present in cultured cells and field-collected cells. The toxins were also detected in the water from cultures and wild collections. These compounds were subsequently isolated and characterized using NMR and MS techniques as seven primary fatty acid amides and one hydroxamic acid. These compounds display cytotoxic, hemolytic and ichthyotoxic activity and have not yet been reported in *P. parvum* toxicity or in the toxicity of harmful algal species. Further research will probe the mechanism of action of the compounds.

Project Duration: On-going