*Science Serving South Carolina's Coast*

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## South Carolina Sea Grant Consortium

# 2006-2007 NSGO Annual Progress Report

Covering the Period
March 1, 2006 to February 28, 2007

Submitted August 31, 2007

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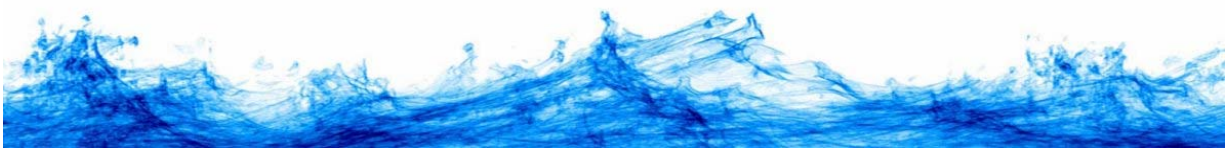

# 2006-2007 NSGO Annual Progress Report

South Carolina Sea Grant Consortium

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# 2006-2007 NSGO Annual Progress Report

South Carolina Sea Grant Consortium

## INTRODUCTION

This annual report, submitted by the South Carolina Sea Grant Consortium, summarizes activities and accomplishments by the Consortium and its partners for the period March 1, 2006 through February 28, 2007.

During the reporting period the Consortium reached an important milestone – it completely revised and updated its strategic plan for 2006-2010. The plan includes a major restructuring of its programmatic strategic goals as well as adds strategic goals for the agency's planning, program management, and administrative functions. Further, it now puts the Consortium's planning cycle in sync with its biennial Omnibus schedule. Details are reported below as an accomplishment in 2006-2007.

## S.C. SEA GRANT CONSORTIUM STRATEGIC PLAN

### Planning Process for the 2006-2010 Strategic Plan

The goal of the Consortium's strategic planning process was to "maximize the ability of S.C. Sea Grant's research, education, and outreach programs to address the coastal resource needs of South Carolina." To achieve the Consortium's strategic planning goal, three objectives were developed:

- Receive input from constituents and stakeholders
- Update the existing strategic plan based on the input received, and
- Use the updated strategic plan to guide future program and administrative efforts.

In the fall of 2005 the Consortium's management team (Core Group) undertook a detailed review of the Consortium's 2004-2007 Strategic Plan to identify how it could be improved to reflect the ever-changing needs of the program's constituencies, account for recent federal (e.g., U.S. Commission on Ocean Policy; federal Ocean research Priorities Plan) and regional (e.g., regional IOOS development; COSEE-SE) initiatives regarding the nation's coasts and oceans, to enhance its relationship to the goals of both the NOAA and National Sea Grant planning efforts, and to add elements of accountability and evaluation.

Strategic planning efforts of other Sea Grant programs were reviewed to gain insight as to how best restructure and receive input regarding the revised plan. To seek stakeholder input, the Consortium used an online survey. The survey was designed to receive feedback on the Consortium's existing strategic goals, objectives, and strategies and to identify the most pressing coastal and marine resource issues facing South Carolina. Results of the survey were used by Consortium staff to shape the revised plan; they can be found at http://www.scseagrant.org/oldsite/all_open_ended/SurveySummary.html.

The survey was conducted using the online service Survey Monkey®. Approximately 1,100 individuals were individually requested to complete the survey; the survey was also posted on

the Consortium's Web site to receive input from anyone who wished to complete it. Some 308 individuals responded to the survey (28% response rate).

The Consortium also engaged the staff of its administrative, program management, communications, extension, and education programs throughout the strategic planning process, culminating in a facilitated staff retreat to review and revise Consortium priorities, strategies, outcomes, and indicators.

Concurrent with the above, the Consortium engaged its Program Advisory Board (PAB) for input on the priorities of the agency. The PAB is composed of 30 members representing the leadership of key stakeholders, including state and federal agencies, business and industry, community leaders, and the external scientific community. One of the primary goals of the PAB is to provide the Consortium with guidance on the development of program priorities.

Two PAB meetings were held to discuss the Consortium's Strategic Plan revision. The goal of the first meeting in July 2006 was to discuss the mission, vision, goals, and objectives. PAB members reinforced concern about the rapid pace of change taking place along the coast of South Carolina and the region, especially in light of broader global issues like climate change and energy development, giving great urgency to the Consortium's mission to advance understanding of the changing coastal environment and provide science-based information for use by decision-makers and other to manage the change in ways that will support the state's economic, environmental, and social health. The PAB also underscored the important role that the Consortium plays as catalyst, educator and champion for science-based decision-making.

The second PAB meeting was held in May 2007 to review the survey findings, and review and revise the agency's core values, operational principles, and the specific strategies, outcomes, and indicators developed for each theme area. The PAB endorsed the plan for submission to the Consortium Board of Directors for their review, which will take place on September 12, 2007.

## The 2006-2010 Strategic Plan

The Consortium's 2006-2010 Strategic Plan is divided into two sections: Programmatic and Management. The Programmatic section includes the Consortium's plans for research, education and outreach-based activities. The Management section includes process-based activities which dictate how the Consortium will support its mission, assess customer satisfaction, ensure financial performance, and document human resource activities.

Within each section, the Consortium has identified major Strategic Areas of emphasis. Each Strategic Area includes a background statement, identification of key issues, and a single agency goal. For each goal, one to three objectives are identified; for each objective, a set of strategies, outcomes, and indicators are listed. The purposes for each are as follows:

- *Background Statement* - context and historical information for each Strategic Area.
- *Issues* - the underlying justification for the identification of activities to be undertaken for each Strategic Area.
- *Goal* - the overall anticipated outcome for each Strategic Area.
- *Objectives* - specific program/management areas of emphasis which will be addressed.
- *Strategies* - activities to be conducted to achieve the objective.
- *Outcomes* - the end results or consequences of the strategies employed.
- *Indicators* - the metrics to be used to measure success in achieving objectives.

The Consortium now has a Strategic Plan framework and process that will serve as the template for future strategic planning efforts. The Strategic Areas, goals, and objectives are expected to continue to be relevant for a number of years to come, and were reflected in the Consortium's Omnibus 2008-2010 Request for Proposals. The strategies the Consortium utilizes to achieve these goals and objectives are expected to be re-evaluated during every subsequent revision of the Plan. New strategies will be included as current strategies are addressed and new issues arise. The outcomes and indicators sections will be assessed on two-year cycles; however, there are short-term and long-term indicators included in the plan.

## SECTION I: AWARD REPORTING

The following summaries resulted from work conducted under the Consortium's 2006-2007 Omnibus Sea Grant Program Plan, and are organized by strategic area. All core projects were funded under award number **NA06OAR4170015**. Summaries are also provided for the Consortium's four Sea Grant NSI projects; separate award numbers were assigned.

### Coastal Ocean Processes

**Grantee (Principal Investigator) and Institution:** George Voulgaris, University of South Carolina
**Award Number:** NA06OAR4170015 (R/CP-12)
**Time Period:** March 1, 2006 through Feb. 28, 2007 (Year 1 of 2)
**Award Title:** Numerical Study of the Physical Conditions that Lead to Hypoxia Events in Long Bay, SC
**Project Progress Report:** Available at SCSGC office.

**Accomplishments and Outcomes:** Low oxygen events (< 3 mg/L) have been observed in the nearshore region of Long Bay, SC (Myrtle Beach area) affecting water quality and resulting in fish jubilees in the surf zone. These events and their frequency of occurrence are of great importance for the area since it is one of high economical and recreational value. These events appear to occur during favorable upwelling winds (i.e. from SW) during the summer season. Observational data from existing coastal monitoring stations maintained and operated by sub-regional observing systems, state agencies, and SECOORA (www.secoora.org) combined with 3-D numerical simulations were used to elucidate the physical conditions that may lead to hypoxia/low oxygen events in the region.

Stratification in the water column has been identified as one of the most important physical conditions necessary to induce a low oxygen level event on the bottom layer of the inner-shelf. Stratification inhibits vertical mixing and in turn oxygen exchange with the atmosphere. Numerical simulations were carried out to study the effects of wind (speed and direction), river discharge, and solar radiation on the vertical stratification and on the intrusion of Gulf Stream water (which at the same time enhances vertical stratification) in the coastal zone of Long Bay in 6-10m deep waters).

Results to-date show that strong solar radiation (thermal stratification), as experienced during the summer period, and oscillatory wind conditions are the required ingredients for maintaining the inner-shelf stratified during an upwelling event. These conditions allow the intrusion of the relatively low oxygen (~5 mg/L) Gulf Stream water (already located at the outer shelf) to the

inner-shelf, which typically has higher biological activity. The increment of biological activity at the bottom layer near the coast, the lack of oxygen exchange with the atmosphere, and the intrusion of already low oxygen water contributes significantly to the observed hypoxic events in Long Bay. High winds or steady winds do not allow the creation of conditions favorable for hypoxic events.

**Grantee (Principal Investigator) and Institution:** Eric Koepfler *et al*, Coastal Carolina University
**Award Number:** NA06OAR4170015 (R/CP-13)
**Time Period:** March 1, 2006 through Feb. 28, 2007 (Year 1 of 2)
**Award Title:** Identification of Coastal Hypoxia Mechanisms in Inner Shelf Waters of Long Bay, SC
**Project Progress Report:** Available at SCSGC office.

**Accomplishments and Outcomes:** The PIs examined a broad geographical region within Long Bay from Little River inlet to Winyah Bay along the South Carolina northern coast. Through a combination of high resolution spatial measurements and strategic temporally intensive measurements from fixed points of interest, they were able to examine low dissolved oxygen (DO) conditions which developed during the summer of 2006. Results from broad spatial sampling using DATAFLOW® revealed several periods of sub-oxic (<4 ≥2 mg $O_2$ / liter) conditions which were manifested in bottom waters and especially in regions off northern Myrtle Beach. During these dates, bottom water DO concentrations were positively correlated with chlorophyll, and vertical profiles indicated that the affected water mass was not advected from offshore areas or associated with upwelling phenomenon. Surface water quality (DO, chlorophyll) were not good predictors of more stressful bottom water conditions, but areas of low bottom water DO generally exhibited higher nutrient concentrations and pelagic respiration than observed in surface waters. There was a lack of statistical significance between water quality in putative discharge regions and control regions nearby; suggesting that discharge advection may be an important process. Student projects during the study were focused along fixed points of interest but were sampled more frequently, thereby encompassing our Dataflow focus over a broad temporal period. These studies revealed several key findings which included an observation that the sub-oxic period was restricted to summer, that the spatial pattern of bottom water DO conformed to our Dataflow study results, and that there was significant small-scale temporal variability (i.e., over a daily period) in chlorophyll and DO. Year two sampling is proceeding and focuses on smaller scale spatial and temporal processes. Year two appears to be manifesting differently from year one regarding the frequency of sub-oxic occurrence with less frequent events in the present year, suggesting that meteorologic controls are central to establishing conditions that may lead to coastal hypoxia.

Spatial patterns of both CHL and DO (Fig. 1) displayed the most longshore and least offshore variation on 7/10/06 when the wind field was from 90 degrees. Regarding CHL, the two wettest dates 8/24/06 and 9/04/06 (not shown) both displayed mostly longshore variability, while for DO these dates had more equal variability components. The gradient of longshore variability was often not precisely shore parallel but often manifested along a north-south axis. The nature of controls upon this broad scale spatial variability probably includes inner shelf hydrographic phenomenon which we plan to investigate in conjunction with G. Voulgaris (USC).

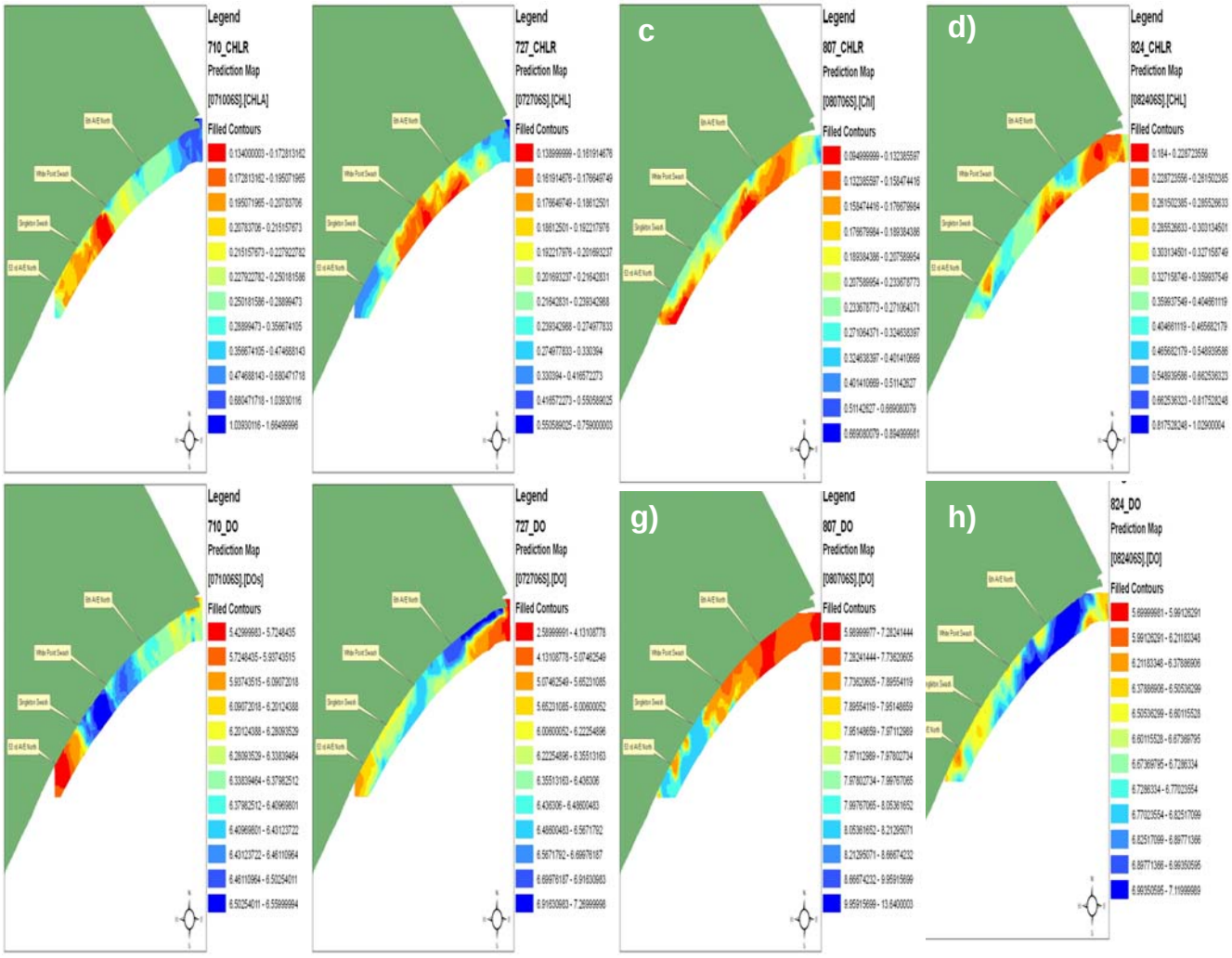



**Figure 1.** High resolution spatial maps of Chlorophyll *in vivo* fluorescence and Dissolved Oxygen within the northern study region. Chlorophyll values are shown in a-d, while Dissolved Oxygen are shown in e-h. Alphabetical order of each variable represents sequential sampling dates in June and July. Scale bars display low values in red grading to high values in dark blue.

**Grantee (Principal Investigator) and Institution:** Richard Viso, *et al*, Coastal Carolina University
**Award Number:** NA06OAR4170015 (R/CP-14)
**Time Period:** March 1, 2006 through Feb. 28, 2007 (Year 1 of 2)
**Award Title:** Electrical Characterization of Submarine Groundwater Seeps in Long Bay, SC
**Project Progress Report:** Available at SCSGC office.

**Accomplishments and Outcomes:** Submarine groundwater discharge (SGD) is gaining the attention of coastal scientists and resource managers as a potential pathway for exchange of nutrients, pathogens, and other chemical constituents between land and sea. Direct measurements of SGD are inexact and often logistically challenging to obtain; therefore, it is difficult to quantify SGD and associated transport of dissolved chemicals. Mass balance approaches based on geochemical tracers (e.g. radon, radium) provide more accurate discharge estimates averaged over large areas. This approach, however, does not consider the

potential for spatially inhomogeneous, geologically controlled focusing of SGD. A novel approach, utilizing electrical resistivity, has been successful in identifying SGD "hotspots" in estuarine and riverine settings. This approach was applied in the open ocean setting of Long Bay, SC and preliminary results indicate spatial variability in pore water resistivity. With resistivity serving as a proxy for pore water salinity, fresher water has been observed in the inner most few kilometers of the near shore area. In particular, flow focusing may be occurring in paleochannel systems extending offshore. With increasing distance from shore (out to nine kilometers), the resistivity signal becomes weaker and more uniform, implying mixing of fresh and salt water. In addition to resistivity mapping, preliminary Rn counts suggest SGD in the nearshore of Long Bay could be 50% or more of riverine discharge. These findings suggest that significant chemical transport to marine and estuarine environments may be occurring through the surficial aquifer. Measurements of basic water quality parameters (dissolved oxygen, salinity, temperature, and chlorophyll-a) were taken from bottom water during the resistivity surveys. The resistivity, Rn, and water quality data are being integrated into a geographic information system that will allow for examination of spatial correlations. The data collected to date provide only a snapshot in time of pore water and bottom water conditions. Temporal variation in resistivity, water quality, and Rn counts will be examined with a second set of surveys.

## Ecosystem Dynamics

**Grantee (Principal Investigator) and Institution:** David Owens, College of Charleston
**Award Number:** NA06OAR4170015 (R/ER-28)
**Time Period:** March 1, 2006 through Feb. 28, 2007 (Year 3 of 3)
**Award Title:** Using Diamondback Terrapins as a Sentinel Species for Monitoring Mercury Contamination in Estuarine Systems
**Project Completion Report:** Available at SCSGC office.

**Accomplishments and Outcomes:** Dosage experiments involving diamondback terrapins were completed in September 2006. Total mercury concentration in approximately 600 blood and scute samples has been determined and data are currently being analyzed. Through these experiments the PIs have demonstrated bioaccumulation of methylmercury in terrapin blood and scutes occurring via dietary exposure. Currently, they are investigating differences in mercury uptake rates between the two compartments and between sexes. The PIs have theorized that scutes represent a long-term depository for mercury, while the blood reflects short-term changes in mercury intake. Additionally, internal organ samples obtained from our dosed terrapins are being analyzed to gain better information about the path mercury takes within the terrapin. Mercury concentrations in such tissues as the liver, kidney, and brain will aid in understanding how blood and scute concentrations relate to internal body burdens. Results from these captive studies will ultimately be related back to continuing investigations of mercury concentrations in wild terrapins to gain a better understanding of the time frame represented by the mercury contained in blood and scutes.

In addition, a final round of field sampling occurred during the summer of 2006 along the southeastern coast of the United States, encompassing the Chesapeake Bay, Charleston Harbor, and southern Florida. Charleston was the location of a microscale sampling protocol that focused on two pristine and two polluted creeks, based on previously acquired sediment mercury data. Diamondback terrapin scute mercury levels do not show differences along the microscale sampling protocol ($F_{3,15}$=0.66, P=0.59). However, the regional scale sampling does show differences in scute mercury levels ($F_{4,25}$=22.58, P<0.0001), with significantly lower levels

in animals from the far western Florida Keys and significantly higher levels in animals from the York River. The York River site, on Chesapeake Bay, is directly adjacent to a coal-fired power plant, which is likely influencing mercury levels in this part of the river. However, these data are preliminary, and analyses are currently underway to characterize the methylation potential of sediments collected from each site. This is necessary to better understand the sediment chemistry, which dictates how much mercury is available for uptake, at each of the sampling sites. Analyses will be completed in the next few months, and will allow the research team to judge if the diamondback terrapin can serve as an appropriate indicator species for mercury contamination in estuaries.

**Grantee (Principal Investigator) and Institution:** Tammi Richardson, University of South Carolina
**Award Number:** NA06OAR4170015 (R/ER-29)
**Time Period:** March 1, 2006 through Feb. 28, 2007 (Year 1 of 2)
**Award Title:** Potential Impacts of Upstream Land Use Change on Phytoplankton Community Dynamics in Winyah Bay, SC
**Project Progress Report:** Available at SCSGC office.

**Accomplishments and Outcomes:** Effective water quality management in times of changing land use depends on a clear understanding of the potentially interactive effects of light quality, light quantity, and nutrient availability on phytoplankton community composition and the development of algal blooms. Characterization of phytoplankton community composition is critical because the taxonomic composition and relative abundance of different algal groups in a phytoplankton community are fundamental determinants of aquatic ecosystem structure and function. Harmful and nuisance algal blooms, decreases in water quality, alterations of trophic structure, and collapse of fisheries are all potential consequences of major shifts in community structure either at the algal group or species level. In year 1, the PI completed 5 cruises in Winyah Bay (May, July, Aug, Oct and Dec 2006) that involved sampling at 7 stations along a transect from the upstream (blackwater) region to the more oceanic water near the coast. Samples were collected from the surface and the fluorescence maximum, and included those for determination of phytoplankton community composition (by HPLC/ChemTax and microscopy), dissolved inorganic nutrients (nitrate + nitrite, ammonium, silicate by autoanalyzer), dissolved organic nutrients (DOP, DOC/DON), spectral irradiance (water color) and total PAR, CDOM (by absorption), and standard physical parameters (dissolved oxygen, fluorescence, temperature, conductivity and pH). All samples have been analyzed and statistical analyses performed. The team has performed detailed calibrations on the spectral fluorometer used for continuous monitoring in the upstream region of Winyah Bay. This requirement of extensive calibration has delayed permanent establishment of the instrument at the Georgetown Landing Marina (as originally planned), but the PIs did not feel it logical to deploy the instrument until quality control of the data could be assured. A detailed study of the degree of interference of CDOM with estimates of chlorophyll a by fluorescence readings from a YSI water quality probe is near completion. The PIs expanded the original objective to include the possible error in chlorophyll estimation that would result from species-specific physiological variability in fluorescence to chlorophyll ratios that result from phytoplankton photoacclimation (that will cause error along with CDOM absorption of blue light). Results are still being analyzed. Finally, in summer 2006 the science teacher-student team of Mr. Dale Soblo (Spring Valley High School, Columbia, SC) and Steven Schmidt (USC Marine Sciences undergraduate) participated in our summer field program of sampling at Winyah Bay and the Baruch Institute. The team has compiled a set of 4 lesson plans (with student and teacher guides) that are based on that summer's research experience.

**Grantee (Principal Investigator) and Institution:** Alicia Wilson and James Morris, University of South Carolina
**Award Number:** NA06OAR4170015 (R/ER-30)
**Time Period:** March 1, 2006 through Feb. 28, 2007 (Year 1 of 3)
**Award Title:** Integrated Hydrogeologic and Ecological Study of Salt Marsh Dynamics
**Project Progress Report:** Available at SCSGC office.

**Accomplishments and Outcomes:** Acute marsh dieback struck South Carolina salt marshes during the height of the 1998-2002 drought. This damage underscored the need to understand links between hydrology and ecology in these ecologically and economically important natural resources. The PIs have instrumented a marsh island where dieback occurred to test the hypothesis that the hydrology of the dieback site differs from the surrounding healthy marsh. Field observations have identified key differences in both surface and subsurface conditions. Surface observations suggest that a tidal node exists in the dieback area, so even though the island is routinely inundated during high tide, temperature and salinity can remain high. Surface temperatures at the site have been found to exceed 38˚C, which imposes a severe physiological stress on *Spartina alterniflora*. Evaporation of water from surface sediment is rapid at these temperatures, which can result in severe salt stress on the plants. Subsurface differences have also been identified. Most of the island is covered by a ~2 m layer of marsh mud overlying sand, but the thickness of the mud increases to more than 4 m below the dieback. This suggests that porewater flushing is limited in this part of the island. Piezometers were installed to monitor the subsurface hydrology of the island. Although previous studies have assumed that tidal fluctuations control subsurface flow in marshes, temperature data from the island piezometers suggest that seasonal temperature fluctuations and the formation of brines through evaporation could drive significant density-related overturn in the subsurface. Numerical models of porewater flow, including temperature and salinity, will be constructed to understand how this complex system operates and how it may have responded to the drought. Additional models will be used to determine whether withdrawal of fresh groundwater for water supply needs could induce dieback in nearby marshes. Whereas past studies of acute marsh dieback have focused on soil conditions in the root zone, current results suggest that future studies will need to consider larger-scale hydrologic and stratigraphic controls.

**Grantee (Principal Investigator) and Institution:** James Pinckney, University of South Carolina
**Award Number:** NA06OAR4170015 (R/ER-31)
**Time Period:** March 1, 2006 through Feb. 28, 2007 (Year 1 of 1)
**Award Title:** Effects of Sublethal Concentrations of Herbicides on Structure and Function of Phytoplankton Communities
**Project Completion Report:** Available at SCSGC office.

**Accomplishments and Outcomes:** Triazine herbicides, including atrazine (sold under the tradenames of Aatrex, Aatranex and Azinotox 500), are some of the most commonly used agricultural herbicides for corn and soybeans in the US. Triazines are lost in large amounts and high concentrations from agricultural fields to receiving waters through surface runoff and sediment transport. Widespread use of atrazine promotes this herbicide as a common contaminant in streams, rivers, and lakes. The Santee River Basin has a watershed drainage area of 61,000 $km^2$ (23,600 mi2) which includes urban, industrial, and agricultural land uses. Herbicides (particularly triazines) are routinely applied to agricultural lands within the drainage

basin during spring planting and exported to tributaries in runoff. The purpose of this research was to determine if sublethal levels of atrazine-induced stress result in reduced primary productivity, alterations in the fitness of some taxa, and/or facilitates changes in estuarine phytoplankton community composition. We conducted seven separate bioassay experiments during 2006. Short-term phytoplankton bioassays were used to measure initial phytoplankton responses to different levels of atrazine and nutrient exposure. The purpose of these experiments was to determine the effects of a range of atrazine/nutrient concentrations on phytoplankton primary productivity and biomass of specific algal groups (i.e., diatoms, cyanobacteria, dinoflagellates, cryptophytes, etc.) in natural estuarine phytoplankton assemblages. These data will be used to assess "who" responds to the different levels of atrazine treatments under ambient (light, nutrient, temperature, etc.) conditions. Water for the bioassays was collected from a depth of 0.5 m in Clambank Creek at Clambank Landing in the North Inlet estuary. This location was chosen because the phytoplankton in this area have not been pre-exposed (or pre-acclimated) to atrazine. Water was dispensed into 5.0 liter polycarbonate flasks and atrazine and/or nutrients added to the appropriate treatments. HPLC photopigment analyses have been conducted on all of the samples from the bioassays and data analysis is currently in progress. We anticipate project completion within the next two months. In addition to the original project objectives, funds were used to support the graduate research of Ms. Jean Marie Buschur. Her project examined the effects of benzalkonium chloride, a common surfactant in wastewater, on phytoplankton community composition. Her experiments were conducted in parallel with the atrazine bioassays detailed in the original proposal.

**Grantee (Principal Investigator) and Institution:** Courtney Murren and Allan Strand, College of Charleston
**Award Number:** NA06OAR4170015 (R/ER-32)
**Time Period:** March 1, 2006 through Feb. 28, 2007 (Year 1 of 2)
**Award Title:** Patterns and Processes of Establishment Success of Beach Vitex *(Vitex rotundifolia)* Populations and Potential for Eradication
**Project Progress Report:** Available at SCSGC office.

**Accomplishments and Outcomes:** Invasive species are costing the US billions of dollars annually, affecting agriculture, fisheries, and natural areas. One such ecologically fragile natural area is the dune system of the Carolinas, which is currently threatened by the rapid growth and high reproductive output of a woody vine, *Vitex rotundifolia*, or beach vitex (common anme). The lack of both basic and applied knowledge of the biology of *V. rotundifolia* prompted the Sea Grant Consortium to identify it as a research priority, and researchers Murren and Strand to pursue several avenues of research. The first objective was to assess pollination and mating system characteristics of the system. Data were collected throughout the flowering season in 2006 using techniques including visual inspection of pollinators, video recordings of pollinators and a large scale manipulative pollination experiment. These techniques are currently being replicated for a second year in order to assess temporal and spatial variation in pollinator activity and mating system attributes. The PIs have initiated three studies on seed germination, two in the field and one in the greenhouse. The field experiments will be assessed late summer 2007 and early spring 2008, while initial greenhouse experiment suggests that seeds are long-lived, yet germination rate is low. From a molecular genetics standpoint, the PIs are investigating AFLP diversity within and among populations to evaluate several alternative hypotheses of geographic spread. They have developed a spatially explicit model, sampled the populations, identified the markers to be used, and screened a subset of our sample. A sub-award to Gresham (Clemson), examined (1) sand accumulation and uncovered substantial variation in vitex covered and control dunes, (2) monitored demonstration plots of eradication

methods and decided that the 'hack and squirt' method was most successful, and (3) completed a competition experiment with sea oats. To date this work has included the involvement of 5 undergraduates and two graduate students.

**Grantee (Principal Investigator) and Institution:** Dwayne Porter, *et al*, University of South Carolina
**Award Number:** NA06OAR4170015 (R/ER-33)
**Time Period:** March 1, 2006 through Feb. 28, 2007 (Year 1 of 4)
**Award Title:** An Assessment of Stormwater Best Management Practices for Coastal South Carolina: The Oak Terrace Preserve Monitoring Project
**Project Progress Report:** Available at SCSGC office.

**Accomplishments and Outcomes:** No significant changes have been made to the existing objectives. However, as is common with many large-scale construction projects, there have been delays, but the principal investigators are adapting to them and proceeding with the proposed work. Delays in the installation of the main stormwater drainage pipes have resulted in unexpected delays of the project objectives. The proposed research is separated into three periods of construction (pre-, during-, and post-). As long as there are no further construction delays, the research will be restricted to the following timeline: pre-construction (e.g. low impervious cover) (March to June, 2007), during-construction (June, 2007 to January, 2008 and April, 2008 to June, 2009), and post-construction (June, 2009 to June, 2010). We recognize that the research period extends beyond the proposed funding period. At this time we are not requesting that S.C. Sea Grant Consortium extend the project beyond February 31, 2008.

Funding for the two-year project (February 2006 – February 2008) was provided to meet four objectives. The first objective was to develop and compare water budgets, flow rates, and pollutant masses and loadings for pre-, during- and post- construction phases of both a control (suburban-no BMP) and a treatment (BMP) watershed in the Oak Terrace Preserve. Construction delays have resulted in overall delays of the construction phases. Subsequently, sample collection has been postponed and a no-cost extension has been requested to support upcoming sampling efforts. On the other hand, site preparation and preliminary research has been conducted to support the first objective. Micro-watersheds have been identified for the reference (West Cameron Terrace) and treatment (Oak Terrace Preserve) watersheds. The micro-watersheds are separated into surface and groundwater, based upon surface topography and drainage infrastructure (see Figures 1 and 2 below). The installation of the flow gages has been delayed due to delays in the installation of stormwater drainage pipes; however, all of the equipment has been purchased for sample collection and analyses. We anticipate that the flow gages will be installed on site in 2007 as long as there are no further construction delays.

In May 2006, groundwater wells were installed within the reference and treatment microwatersheds. To install the groundwater wells it was necessary to receive homeowners' permission in the control watershed (West Cameron Terrace). Homeowner participation was minimal; subsequently 5 groundwater wells were installed in each watershed (rather than the proposed 10 wells in each watershed). Permits for the wells were acquired through both the City of North Charleston and SC Department of Health and Environmental Control. Soil cores were collected at each well and analyzed for depth to confining layer and porosity. Porosity ranged from 0.287 to 0.456 among the cores with an average porosity of 0.382 + 0.017. Water table loggers were purchased and deployed; however, the data were not retrievable. Efforts are currently focused on the data loggers to get them functioning properly.

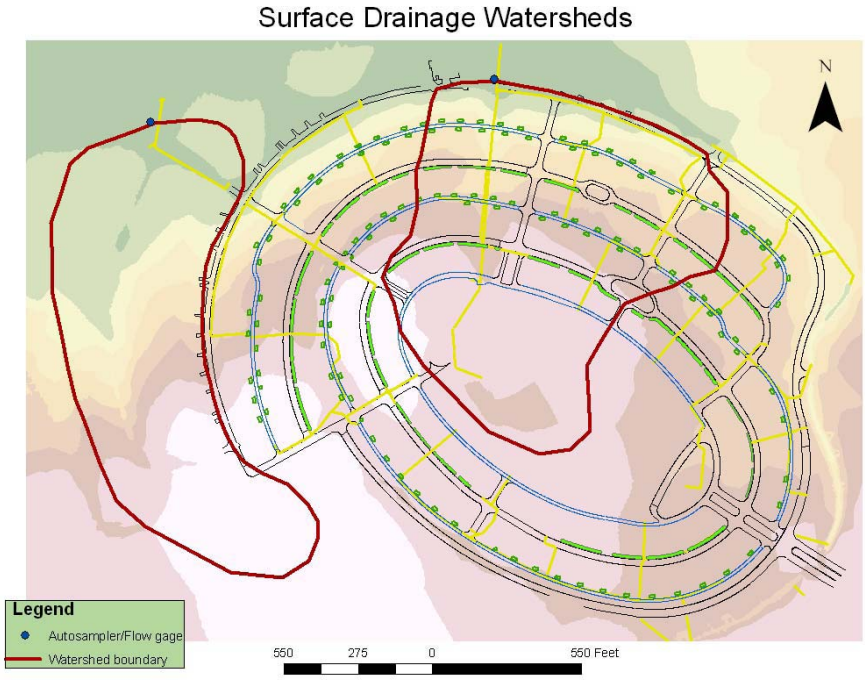



**Figure 1:** Surface drainage areas for the West Cameron Terrace and Oak Terrace Preserve drainage outflows.

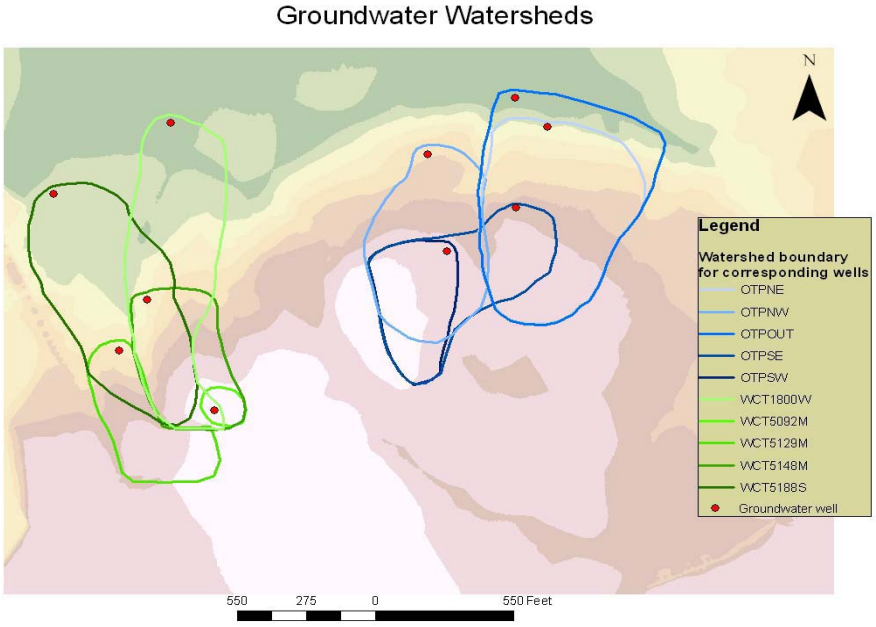



**Figure 2:** Groundwater watershed boundaries for individual wells within the West Cameron Terrace and Oak Terrace Preserve subdivisions.

The second objective was to compare the hydrodynamics and pollutant loadings of the BMP watershed in Oak Terrace Preserve to the suburban (no BMP) watershed. Due to construction

delays, there are currently no data available for the proposed analyses of pre-construction data for year one. A meeting of researchers from various fields (e.g. hydrology, ecology, geology, geography, biology, and chemistry) was held to assure the quality of the research and analyses.

The outreach components of the project (objectives 3 and 4) have been better defined by assigning specific tasks for Years 1 and 2. The third objective was to promote public awareness and understanding of watershed concepts and the link between development and water quality through outreach and education. The fourth objective was to use the Oak Terrace Preserve as a demonstration site for land use planners, developers, engineers, scientists, regulatory agencies, community officials, and the public. A meeting of outreach collaborators and S.C. Sea Grant Extension representatives was conducted to prioritize outreach tasks associated with the project. For the first year of the project we proposed to conduct (1) Focus groups to define homeowner's needs concerning environmental education, (2) Demonstration workshops that will educate engineers, planners, and developers on the potential uses, designs, and installations of Low Impact Development Practices (LIDs) utilized in Oak Terrace Preserve, and (3) Homeowner surveys to estimate annual pollutant loadings in each micro-watershed. In October 2006, eleven homeowners from the neighborhoods adjacent to Oak Terrace Preserve attended a focus group with the purpose of identifying homeowners' needs concerning environmental education. Currently the focus group talk is being transcribed and subsequent coding and analyses will follow. Due to construction delays none of the LIDs have been installed. Subsequently, no demonstration workshops have been conducted. Homeowner surveys have been developed and are currently under review by USC's Internal Review Board.

Year 2 tasks include (1) An economic evaluation of the costs associated with the LIDs of Oak Terrace Preserve compared to more traditional methods of stormwater management (e.g. curb-and-gutter, detention ponds, buffers) and (2) Development of homeowner fact sheets that will inform the residents of Oak Terrace Preserve about the purpose and maintenance of the LIDs in their neighborhood - the type of information include in the fact sheet will be derived from the focus group from Year 1, (3) Demonstration workshops that will educate engineers, planners, and developers on the potential uses, designs, and installations of Low Impact Development Practices (LIDs) utilized in Oak Terrace Preserve, and (4) Homeowner surveys to estimate annual pollutant loadings in each microwatershed.

### Coastal Natural Hazards

**Grantee (Principal Investigator) and Institution:** David Prevatt, Clemson University
**Award Number:** NA06OAR4170015 (R/CE-7)
**Time Period:** March 1, 2006 through Feb. 28, 2007 (Year 1 of 2)
**Award Title:** Predicting Wind Uplift Failures of Wood-framed Residential Roof Structures Using Influence Function and Database Assisted Design
**Project Progress Report:** Available at SCSGC office.

**Accomplishments and Outcomes:** In objective one, the Database-Assisted Design (DAD) Method was shown to be a valid experimental/analytical method to determine design wind loads on single-family wood-framed houses. Through discussion with NIST scientists who first proposed this methodology, it appears that preliminary results support earlier conclusions of the NIST study, i.e. that the DAD approach yields higher (less conservative) design wind loads on roof structures than currently accepted design methods. The research demonstrated the feasibility of combining wind load time histories from the wind tunnel with experimentally determined influence functions from a structural model.

The method of objective two yielded valuable data providing the time history of roof-to-wall uplift load on several trusses of a simple wood-framed, gable roof assembly. These time histories were developed using the DAD methodology to integrate wind tunnel derived pressures and the experimentally determined influence functions. Preliminary results indicate that the load time histories exceed the prescribed design loads in the current building code reference standard (ASCE 7-05). Although these results are valid only for 15/32 inch OSB sheathing, the conclusion is significant as current roof designs may yield non-conservative results.

Finally, experimentally-derived influence functions were developed for objective three using a 1/3 scale model of a wood-framed gable roof and a beam-analogy model of 15/32 inches OSB sheathing. The results show that up to 20% of the loads are transferred to the adjacent two or three trusses of the loaded truss.

While the database-assisted design methodology was shown to be a useful tool in developing the design loads for a residential structure, the results are in a preliminary stage, as there is still need for further validation. Scientists at NIST who viewed a presentation of the preliminary results are encouraged that this work is continuing. It is anticipated that with further work, this methodology will be employed by structural engineers in developing a more risk-consistent, reliable design methodology for residential wood-framed structure.

### Marine Aquaculture and Fisheries

**Grantee (Principal Investigator) and Institution:** Ted Smith, Wallace Jenkins, *et al*, South Carolina Department of Natural Resources
**Award Number:** NA06OAR4170015 (R/SE-3)
**Time Period:** March 1, 2006 through Feb. 28, 2007 (Year 3 of 4)
**Award Title:** Impacts of Stocked Red Drum on the Recreational Fishery of Murrells Inlet: Data Collection, Analysis and Development of Assessment Tools
**Project Progress Report:** Available at SCSGC office.

**Accomplishments and Outcomes:** Red drum are one of the primary inshore species targeted by both resident and visiting non-resident anglers. SCDNR is actively involved in programs to evaluate the use of hatchery-produced juveniles as a management tool to increase population abundance. Murrells Inlet has been the focus of such studies since 2002. During this time 2.4 million (~600,000/yr) small juveniles, 25 mm total length (TL), red drum were released. Using an adaptive management approach, the number released each year remained similar, while average size of fish stocked increased from 19.5 mm TL in 2002 and 2003 to 25 mm TL in 2004 and 36 mm TL in 2005. Trends in the data indicate that although increasing release size appeared to result in higher contributions in other estuaries (e.g., 40% North Edisto) contribution of fish released as small juveniles in Murrells Inlet have not made a similar contribution, range 3-16%, to the legal size population in the estuary. These data indicate that perhaps a recruitment bottleneck occurs in Murrells Inlet that affects not only the larval stage (as observed in studies in the Ashley River) but also the small juvenile (25 mm TL) life stage. To test this hypothesis, medium-size juveniles were stocked during 2005 and 2006. During spring 2005, 1,000 fish (155 mm TL) were released at a size comparable to the wild 2004 year class cohort. In 2006 (2005 year class), the number of medium-sized fish released was increased to 8,000 (125 mm TL). Data collected from both year classes indicate that these medium-size juveniles comprised a disproportionately high component of recaptures. For the 2004 year class, 1,000 fish stocked at a medium size made up a minimum of 45% of hatchery fish recaptures and 13% of the total captures, while the 2005 year class fish

stocked at a medium size made up 67% of all fish collected and 94% of hatchery fish recaptures. Total hatchery contribution was 71%. Sample collection and data analysis for these year classes is ongoing but the preliminary evaluation of the data indicates that in the ecologically impacted habitat of Murrells Inlet a recruitment bottleneck occurs at a fish size smaller than 125 mm TL and that if fish are stocked at that size or larger, they will bypass this bottleneck and make a large contribution to the fishery. These data confirm the utility of stocking and as SCDNR and federal regulatory agencies embrace an ecosystem management approach, data such as these will be critical to making informed decisions.

**Grantee (Principal Investigator) and Institution:** Erik Sotka, College of Charleston
**Award Number:** NA06OAR4170015 (R/CF-12)
**Time Period:** March 1, 2006 through Feb. 28, 2007 (Year 1 of 2)
**Award Title:** Genetic Estimates of Larval Sources of Gag Grouper from the Southeastern United States
**Project Progress Report:** Available at SCSGC office.

**Accomplishments and Outcomes:** The gag (*Mycteroperca microlepis*) is a large protogynous grouper known for its importance in both the recreational and commercial fisheries. The gag stock along the southeastern coast of the United States is currently experiencing overfishing, which is believed to be responsible for changes in several life history traits. It is therefore imperative that information be collected on all aspects of the life history and population structure of the species so that informative decisions can be made concerning the management of the gag fishery. This project will determine extent of spatial and temporal genetic variation of gag populations on the southeastern coast of the United States. Samples were collected by the South Carolina Department of Natural Resources and include several cohorts of adult gag (341) from North Carolina, South Carolina and Florida, 2005 young-of-the-year juveniles (30) from NC estuaries, and 1985 postlarvae from South Carolina. The PIs are currently genotyping a mitochondrial locus and multiple nuclear microsatellite loci for gag from North Carolina, South Carolina, and Florida to assess the spatial component of genetic variation.

On a temporal scale, the PIs are comparing the genotypes of multiple adult cohorts of known ages (3 vs. 4 vs. 5) with young-of-year juveniles from 2005 and archived postlarval samples from 1985. Since July of 2006, they have successfully extracted and genotyped all the 2005 adult and 2005 juvenile gag samples using 11 microsatellite loci. All of these 11 loci have been found to be polymorphic and have demonstrated consistent amplification. Preliminary results with three loci have revealed slight spatial genetic variation between North Carolina populations and those from South Carolina and Florida. A comparison between the 2005 adult gag ages 3, 4, and 5 showed that no temporal genetic differentiation exists between these three year classes; however, a definite conclusion on temporal structure may not be apparent until the 1985 postlarvae are included in the analysis.

The 1985 postlarval gag will be extracted this month and genotyped with the same 11 microsatellite loci by the beginning of October of this year. About 250-500 base pairs of the mitochondrial control region have been sequenced for all of the 2005 adult samples and a second locus has been created to further characterize the variation found within the control region. Both loci will be used to sequence the 2005 juvenile gag samples and the 1985 postlarvae by November 2007. Once data collection is complete, more extensive statistical tests will be preformed and definite conclusions developed. The project is expected to be completed this year and results presented by mid-December. Benefits and materials developed

from this project will include the characterization of genetic structure of gag on the southeastern United States for management purposes, a paper published in a peer reviewed journal, a fact sheet of fisheries genetics, and a PowerPoint presentation which can be given at local fishing clubs and environmental meetings.

## Coastal Communities and Economies

**Grantee (Principal Investigator) and Institution:** April Turner, South Carolina Sea Grant Consortium
**Award Number:** NA06OAR4170015 (A/CG-1)
**Time Period:** March 1, 2006 through Feb. 28, 2007 (continuing)
**Award Title:** Addressing the Challenges of Coastal Growth in South Carolina: A S.C. Sea Grant Consortium Initiative
**Project Progress Report:** Available at SCSGC office.

**Accomplishments and Outcomes:** Throughout the grant period, presentations, posters, and publications focusing on natural resource-based planning, alternative design principles and quality growth strategies were developed and delivered to council and planning commission members, engineers, planners, and citizens groups throughout the South Carolina coast. Additionally, the Coastal Communities section of the S.C. Sea Grant Web site and the SC NEMO Web site (www.scseagrant.org/scnemo.htm) continued to be monitored, updated, and revised to adequately communicate, inform, and educate people about the programs and initiatives provided through the Coastal Communities Extension Program. The recipients of the 2006-2007 SC Coastal Community Initiative Mini Grant awards are Horry County and the Town of Sullivan's Island. With the completion of the county-wide open space inventory for future acquisition and protection of significant properties, Horry County has begun the second phase of the project, which entails developing outreach materials for the local government officials and the public. Sullivan's Island is developing a management plan in conjunction with conducting a Conservation Management Study for a designated "conservation zone" to then disseminate to residents and visitors as a means to improve their understanding and foster good stewardship of the dune/maritime forest community ecosystems.

The SC NEMO Team has begun the process of revising the SCNEMO Program, with particular attention being paid to enhancing the program's principles and strategies with local scientific research information (science infusion). The SCNEMO Program was delivered to a number of coastal communities (Beaufort County, Bluffton, Charleston County, Meggett, Hollywood, and Ravenel) upon request of the communities.

The S.C. Sea Grant Consortium (SCSGC), along with federal and state project partners began a Jasper County-wide conservation planning effort, which enlisted the help of (and involvement of) more than 100 stakeholders representing local and regional government officials and staff, state and federal resource agencies, nonprofit conservation organizations, local businesses private land owners, and concerned citizens. The culmination of this two-year planning effort was the completion of the Jasper County Natural Resources Conservation Plan, which provides recommendations and guidelines to assist Jasper County with its comprehensive land use plan revisions. These recommendations are now being discussed by county officials for incorporation into the comprehensive plan.

**Grantee (Principal Investigator) and Institution:** Kim Connolly, University of South Carolina
**Award Number:** NA06OAR4170015 (A/CG-2)
**Time Period:** March 1, 2006 through Feb. 28, 2007 (Year 1 of 1)
**Award Title:** Regulatory Pathfinder for South Carolina Coastal Communities and Residents
**Project Completion Report:** Available at SCSGC office.

**Accomplishments and Outcomes:** This project is in the final phases, and by August 2007 there should be a publicly-available "Regulatory Pathfinder for South Carolina Coastal Communities and Residents." Specific objectives of this effort were to (1) Provide stakeholders with increased access to the relevant laws, regulations, and guidance documents, and to the agencies that implement or enforce them, (2) Summarize these laws and regulations in clear, concise language, (3) Explain clearly the interactions among these various laws, regulations, and guidance documents and (4) Provide examples of coastal areas, particularly in the southeastern US, that have attempted (successfully or unsuccessfully) to foster sustainable economic development that is compliant with the law.

The pathfinder is intended to make more accessible the complex web of federal, state, and local laws that govern many coastal activities. It has been designed to help those dealing with activities in coastal areas sorting through which laws exist, how they apply, and how they interact. The drafting is anticipated to provide one-stop shopping in terms of an introduction to these laws for coastal zone planners, resource managers, developers, and those involved in commerce, industry, recreation, and tourism. This concise, easily understandable reference compiles sources of information, including statutes, regulations, and policy documents related to implementing sustainable growth in the coastal region. The beta-version of the website is up and running at http://www.law.sc.edu/pathfinder/coastal_development/ and was reviewed by federal, state, and local regulators in a meeting on August 7th, 2207, before the website is announced to the public. It has separate sections dedicated to Local Government Officials; State Government Officials; Private Citizens; Business Owners & Commercial Developers; Relevant Definitions; Relevant Laws and Agency Contacts; and Projects which may need permits. It has a page designed for those with basic questions titled "Do I Need a Permit?" to help users determine if their property or project is within this area.

## Special Projects

**Grantee (Principal Investigator) and Institution:** Robert Bacon, South Carolina Sea Grant Extension Program
**Award Number:** NA06OAR4170015 (A/CH-1)
**Time Period:** March 1, 2006 through Feb. 28, 2007 (Year 2 of 4)
**Award Title:** Coastal and Inland – Flood Observation and Warning (CI-FLOW) in South Carolina
**Project Progress Report:** Available at SCSGC office.

Funding for the CI-FLOW Sea Grant Extension Agent Position, which is located at the NOAA National Severe Storms Laboratory (NSSL), was was secured through the NSGO during the reporting period; the position is expected to be filled in the latter thrid of 2007. The successful applicant will employ a familiarity with coastal issues to help pull technology from NSSL and the entire National Weather Center in Norman to the coastal states, and will initially help with CI-FLOW on the Tar in NC. Additionally, the Consortium has secured funding from NSGO for a Regional Sea Grant Extension Climate Extension Program has been secured; the regional

Coastal Climate Specialist was hired in August 2007. When all positions are filled, the CI-Flow project will have a very strong extension team to reach-out to relevant audiences.

J.J. Gurley, a scientist at NSSL, along with his Hollings' scholar student, are currently calibrating the TREX hydrologic model using observations at upper reaches of the Tar and Neuse river basins. Once parameter settings have been optimized and fixed, they will supply the model with a lateral boundary condition in estuarine regions. The boundary condition is a time series of modeled water surface heights emanating from Isabel's storm surge. Researchers at NC State have made the predicted storm surge hydrographs available.

Significant progress has been made in visualization of model output. They can now produce traditional simulated and observed hydrographs at individual grid points as well as animation of water surface elevations at every grid point in the basin. Lastly, they created animations of water depth shown in the cross-section of the Tar channel. They believe this latter product serves as a prototype for automating river flood alerts.

Suzanne Van Cooten has completed an archive of precipitation for a period of record from November 2004 to March 2005. The files are residing on the NSSL N: Drive. This period of record reflects a series of cold season precipitation events captured by the Wakefield, Raleigh, and Morehead City NEXRAD sites to work with OH MPE developers on improving multi-sensor QPE measurements. The next step is to provide FTP access to the precipitation files for OHD and NOAA in the Carolina collaborators. The precipitation files are a combination of all precipitation gauges reporting within a grid box defined by latitude 31 to 39 degrees and longitude 75 to 81 degrees. This grid box includes portions of NC, SC, West VA, MD, DE, and VA. The temporal resolution ranges from 5 minutes for CRN sites to 24 hour reporting from NWS COOP sites. Observing networks included are USGS, Corps of Engineers, RAWS, AWOS, ASOS, and state mesonets including NC ECONET. Van Cooten is working on an archive of precipitation for a period of record from January 2007 to June 6, 2007. This archive will cover the same gird area as the November 2004 to March 2005 database. However, some stations may be added or deleted due to observing program requirements in the various funding agencies. This database will be completed by mid-July and efforts will be made to make the data available via FTP to NOAA in the Carolina collaborators.

The NSSL hydro group has archived about 10 sea breeze cases and is looking at the complexity of the issue. The NSSL algorithm researchers have not yet looked at the difficulty of adapting algorithms within the WDSS-II workstation to the sea breeze problem. Now that the Hazardous Weather Testbed project is over for this year, they anticipate looking at the sea breeze data over the next several weeks. Jack Kain of NSSL has created a real time model output from the WRF 4km model runs for the area of interest for the sea breeze study. That grid can be viewed anytime at http://www.nssl.noaa.gov/wrf/ (note that the new grid encompassing the entire area from Northern Florida into central Virginia should be available soon).

The start of Extension activities associated with this project are on-hold awaiting the substantial completion of the scientific and engineering elements.

## NATIONAL STRATEGIC INVESTMENTS

### Fisheries Extension Enhancement Program

**Grantee (Principal Investigator) and Institution:** Amber Von Harten and Robert H. Bacon, S.C. Sea Grant Extension Program
**Award Number:** NA06OAR4170015
**Time Period:** September 1, 2006 through August 31, 2007 (Year 2 of 3)
**Award Title:** South Carolina at a Crossroads: The S.C. Sea Grant Fisheries Extension Enhancement Program
**Project Progress Report:** Available at SCSGC Office.

**Accomplishments and Outcomes:** The Marine Fisheries and Living Marine Resources program area has delivered science-based extension and outreach programming to commercial and recreational fishermen and fishery managers through targeted training workshops, educational forums, presentations, and printed publications. Specifically, major program accomplishments include:

1. Workshops and one-on-one consultations with the SC shrimp industry on organizing and filing federal paperwork for shrimp tariff fund distribution:

   Activities – Provided hands-on workshops for the SC Shrimpers Association and its' members outlining the shrimp tariff cases, funds distribution, required paperwork, and examples of completed paperwork. Additional one-on-one consultations were provided to approximately 50 individual shrimp fishermen.

   Outcomes – As a result of the training provided, SC shrimp fishermen correctly filed the shrimp tariff paperwork and close to $500,000 in funds were distributed to SC shrimp fishermen in 2006.

2. Regional state fishery managers meeting on blue crab fishery management:

   Activities – Organized and hosted by the South Atlantic regional Sea Grant Fisheries Extension & Enhancement Committee, state fishery managers from NC, SC, GA, and FL met for a two day forum outlining blue crab fishery management in the region. Each state provided an overview of blue crab fishery management and participants took part in a facilitated discussion identifying major blue crab fishery management issues, prioritizing these issues and developing solutions to address these issues collectively as a region.

   Outcomes – As a result of the forum, state blue crab fishery managers are networking about issues as they arise and solutions to some of the issues are being developed through collaboration with regional Sea Grant programs on targeted outreach publications on bycatch in crab traps, limited entry, harvest of female crabs and the peeler crab fishery. Also, a survey of participants indicates high interest in future forums dealing with other state fishery management issues, such as red drum and the shrimp fishery.

3. Coordination and implementation of a Cooperative Fisheries Research Grant Program in partnership with the SC Department of Natural Resources:

Activities – In coordination with SCDNR, a Request for Proposals (RFP) was developed outlining research priorities and proposal submission requirements for the CFR grant program. Grant writing training sessions were held in three regions of the coast to provide applicants with an overview of the RFP and provide an opportunity to discuss research ideas with program staff. Priorities were developed in the areas of new harvesting technology, fisheries management, fisheries development, shellfish technology, and historical summaries/narratives of SC fisheries. Approximately 50 fishermen attended the training sessions and 43 pre-proposals were submitted in 2006. A total of 16 proposals were funded in 2006 in the priority areas outlined above for approximately $240,000 in grants.

Outcomes – Results indicate increased communication between fishermen and fishery managers and scientists. Additionally, fishermen gained a better understanding of how science works and how it plays into fisheries management decisions.

## National Marine Aquaculture Initiative

**Grantee (Principal Investigator) and Institution:** T.I.J. Smith, Michael Denson, and Wallace Jenkins, SCDNR
**Award Number:** NA16RG2250
**Time Period:** September 1, 2006 through August 31, 2008
**Award Title:** National Initiative for Aquaculture Development and Fishery Enhancement of Cobia, (*Rachycentron canadum*)
**Project Progress Report:** Not yet due from the project PIs.

**Accomplishments and Outcomes:** Research in South Carolina is focused on improving the predictability of spawning for cobia, pond nursery trials for juveniles, efficacy of stocking, and characterization of wild population genetics. Spawning experiments compared the efficacy of using hCG or GNRH to induce final maturation of wild caught brood fish. Seven females were captured in spawning condition (oocytes >600 um) from the Broad River in Beaufort county. The fish were held in 6.1m diameter, outdoor tanks which received flow through water from the adjacent estuary. Each female was paired with 3 or 4 recently captured ripe males. A total of 9 spawning events were induced by hormone injection of hCG or GNRH. Four females were injected with hCG and produced 4.3 million eggs. Fertility of the spawned eggs was 36%. Five additional females were implanted with Sydel Ovaplant™ slow release pellets and subsequently spawned 3.3 million eggs. Fertility of the GNRH induced spawns was higher and averaged 73%. Finally, 3 additional spawns occurred without further use of hormones. Natural spawns produced 1.8 million eggs of which 76% were fertilized.

Larvae produced were stocked into replicate nursery ponds at different densities to examine effect of stocking densities on fingerling production. Two pond nursery trials compared survival at stocking densities of 400,000 and 700,000 larvae/ha and at 400,000 and 200,000 larvae/ha. Ponds in trial 1 produced an average of 2,826 ± 1,007 fingerlings (51.3 mm TL, 0.39 g). Mean survival for all ponds in trial 1 was 5.49% and there was no significant difference between density treatments. Ponds in trial 2 produced an average of 1087 ± 671 fingerlings (71.59 mm TL, 1.22 g). Survival in the 400,000 larvae/ha treatment averaged 1.64% and was significantly lower than the 7.59% survival in the 200,000 larvae/ha treatment.

During summer, 53,264 juveniles produced in the nursery experiments, were stocked into the estuary where parents had been collected. Approximately 4,000 juveniles were also retained for growout and planned diet experiments. In addition, 1,000,000 fertilized eggs, 36,000 larvae and 5,000 juveniles were shipped to cooperators. Genetic analysis of the wild and hatchery populations is ongoing with efforts currently being focused on developing micro satellite based marks that can be used to characterize the wild population and identify specific families produced by the hatchery.

As noted above, progress to date on all objectives has been substantial and has greatly increased knowledge of cobia life history and production. These data combined with those of other investigators will assist in making cobia culture in the US a reality.

**Grantee (Principal Investigator) and Institution:** Craig Browdy, SCDNR
**Award Number:** NA16RG2250
**Time Period:** September 1, 2006 through August 31, 2008 (Year 1 of 2)
**Award Title:** Commercialization of Bait Shrimp Farming Based on Selected Specific Pathogen Free Stocks
**Project Progress Report:** Not yet due from the project PIs.

**Accomplishments and Outcomes:**

2006 *L. setiferus* Broodstock Development – The proposed research began in fall of 2006. As detailed in the original proposal, in order to begin research in the fall time frame, a collaborative effort was initiated between Mote Marine Laboratory (MML) and Waddell Mariculture Center (WMC) leveraging funding from the US Marine Shrimp Farming Program and Mote Marine Foundation to begin initial *Litopenaeus setiferus* broodstock collection in May, 2006. Wild *Litopenaeus setiferus* were sourced from the southern extent of the Charleston Harbor in Charleston, S.C. Fertilization for seven spawns ranged from 0.4% to 23.7%. Tissue samples from all spawning females and males, from which sperm was attained, were sent for PCR assay for WSSV, TSV, IHHNV and YHV. All of this parent population was found to test NEGATIVE for these viruses. Additional tissue samples were archived for further study to develop genetic tools for parentage analysis. Larvae were cultured producing four family lines of F1 juveniles. These juveniles were tested at the PL 30 stage by PCR assay for WSSV, TSV, IHHNV and YHV. All shrimp family lines tested were found to be NEGATIVE for these viral infections. Shrimp were reared to broodstock size at MML and WMC. Although shrimp grew faster in WMC ponds, broodstock did not survive harvest and transfer to MML. Broodstock were successfully produced at MML, however, in January 2007, principal investigator and shrimp project leader Ryan Gandy resigned from MML. Plans to develop bait shrimp hatchery and production technologies at MML were placed on hold. An agreement was negotiated with Ocean Boy Farms (OBF) to transfer broodstock from MML to maturation systems at OBF for F1 PL production. Kevan Main took over as the MML principal investigator and agreed to hold shrimp in raceway or tank systems until August 2007 as necessary to complete year one grant objectives. On February 14, 2007 a total of 750 broodstock were transferred from from MML raceways to OBF for maturation and production of F2 PL. remaining broodstock were maintained at MML as a backup stock. Shrimp at OBF were acclimated to full strength seawater and stocked into maturation tanks. Following successful maturation and larval production from the F1 broodstock F2 PL were transferred to WMC and Auburn University. F2 broodstock are currently being cultured at WMC.

Wild *Litopenaeus setiferus* were again sourced from the nearshore Atlantic Ocean just south of Charleston SC harbor in May 2007 to increase the number of family lines under culture. A total of 27 spawns were collected. Tissue samples were preserved from all spawning females and males, from which nauplii were attained. Pleopods preserved in 95% ethyl alcohol were sent for PCR assay for WSSV, TSV, IHHNV and YHV to the Texas Veterinary Medical Diagnostic Laboratory. All of this parent population was found to test NEGATIVE for these viruses. Additional tissue samples were archived for further study to develop genetic tools for parentage analysis. Nauplii from 10 spawns were transferred to the WMC for larval culture. Postlarvae were successfully reared from 9 spawns and held in quarantine at WMC to PL30. These juveniles were tested at the PL 30 stage by PCR assay for WSSV, TSV, IHHNV and YHV. All shrimp family lines tested were found to be NEGATIVE for these viral infections. Of these nine families eight were cultured to taggable size, tagged with elastomer implants and released into ponds at WMC for culture to broodstock size.

2007 *F. duorarum* Broodstock Development – The closed recirculating induced maturation system at the facility was renovated after three years that it was not in use. The biofilter and the diatomaceous filter were replaced in order to improve performance. Larval rearing space was increased by adding larval rearing tanks. As high temperatures negatively affected our ability to produce algae during the summer, a special area was enclosed and equipped with air conditioning units to maintain suitable temperatures.

About 150 wild brood stock of the Atlantic Pink shrimp, *Farfantepenaeus duorarum*, were acquired from the Dry Tortugas, Florida and were shipped to TAES on 6/7/07. Shrimp were kept under quarantine conditions. Preliminary PCR results from testing by Texas Veterinary Medical Diagnostic Lab suspected infection by Taura Syndrome Virus. Further testing is currently under way while the facility is kept under quarantine.

Fishermen were already contacted to collect a new batch of brood stock. Arrangements were made with Crystal River Mariculture Center to receive 10,000 PL of this species to provide the foundation for the F1 generation.

Bait Shrimp Production Performance Evaluation – Alabama – During the first quarter of the grant, appropriate personnel were hired at Auburn University, our nursery system modified to allow better conditions for nursing the shrimp and our pond systems were pre-conditioned by drying them, repairing maintenance issues, tilling the soil to oxidize organics and the ponds have been filled. Post-larval Litopenaeus setiferus wereshipped from OBF the first week of June for the initiation of growth trials.

Economics and Marketing – The two objectives of the economic and marketing portions of this project are to evaluate the economic viability of live bait-shrimp production systems, and secondly, to evaluate the demand for live bait-shrimp by bait dealers in the Gulf of Mexico and coastal region of South Carolina. The first objective has not yet been addressed but detailed discussions with co-PI's concerning their production systems and shrimp production will begin in July 2007. The second objective has been on-going at Mississippi State with a marine bait dealer database being established using internet searches in larger towns along the GOM and South Carolina. This database will be augmented with additional bait dealer lists from participating institutions in this project. The live bait shrimp survey is in development at this point and will be field tested in July.

### National Coastal Climate Extension Program

**Grantee (Principal Investigator) and Institution:** M. Richard DeVoe, SC Sea Grant Consortium; Robert H. Bacon, S.C. Sea Grant Extension Program; and Greg Carbone, University of South Carolina
**Award Number:** NA16RG2250
**Time Period:** September 1, 2006 through August 31, 2009 (Year 1 of 3)
**Award Title:** The Carolinas Coastal Climate Outreach Initiative
**Project Progress Report:** Not yet due from the project PIs.

**Accomplishments and Outcomes:** The team formation and building process has been completed. In this period, the team has continued an excellent working relationship throughout the applicant recruiting, review, and interview process. The team has met face-to-face on several occasions and has communicated regularly via conference call and email. Discussion has been initiated re: recruitment of program advisory committee members.

All of our team members participated in the "Workshop on Climate Science and Services: Coastal Applications for Decision Making through Sea Grant Extension and Outreach", April 10-12, 2007, in Charleston, South Carolina. Several team members presented at the workshop.

Dr. Greg Zielinski was recently hired as Coastal Climate Change Specialist.

## SECTION II: IMPACTS

The following impacts have, and are having, a positive effect on the coastline of South Carolina. These examples illustrate how we live by our motto Science Serving South Carolina's Coast. Each impact is directly tied to one or more strategic goals of the South Carolina Sea Grant Consortium. The following impacts have, and are having, a positive effect on the coastline of South Carolina and the region.

### Coastal/Inland Flood Observation and Warning (CI-FLOW) System

*Improving flood detection and warning capabilities*

Riverine and coastal flooding associated with hurricanes, tropical storms, and other forces of nature, cause significant loss of property and economic hardship each year. To help communities in South Carolina, North Carolina and beyond, the S.C. Sea Grant Consortium and its partners, the National Sea Grant Office, North Carolina Sea Grant, and the NOAA National Severe Storms Laboratory (NSSL), are leading a regional project, CI-FLOW (Coastal/Inland Flood Observation and Warning), to pilot a new flood detection and monitoring system. Test results are being used in conjunction with National Weather Service flood tools to improve flash flood detection and warning capabilities. CI-FLOW is also being integrated by N.C. State University researchers into a hurricane storm surge model to provide more accurate inputs from riverine flooding, and as well as being transferred to Sea Grant programs in the Gulf of Mexico for flood applications there. During the reporting period, funding was made available for a CI-FLOW Sea Grant Extension agent position, which will be located at NSSL. Data collection has made great strides, as well as the modeling effort on the Neuse and Tar River basins. More specifics are reported earlier in this report.

## Red Drum Stocking Program

*The future appears brighter for the highly prized fish*

Red drum are one of the primary inshore species targeted by both resident and visiting non-resident anglers. SCDNR is actively involved in programs to evaluate the use of hatchery-produced juveniles as a management tool to increase population abundance. Murrells Inlet has been the focus of such studies since 2002. Since the beginning, a total of 2.4 million juveniles have been stocked.

The study is at the point where three year classes are now being followed – and these cohorts represent three different class sizes (TL). Sample collection and data analysis for these year classes is ongoing but the preliminary evaluation of the data indicates that in the ecologically impacted habitat of Murrells Inlet a recruitment bottleneck occurs at a fish size smaller than 125 mm TL and that if fish are stocked at that size or larger, they will bypass this bottleneck and make a large contribution to the fishery. These data confirm the utility of stocking and as SCDNR and federal regulatory agencies embrace an ecosystem management approach, data such as these will be critical to making informed decisions. Most importantly, the results are very specific as to what fish size(s) work in this important effort to enhance the red drum fishery.

## Statewide Cleanup Nets 33.5 Tons of Trash

*Beach Sweep/River Sweep*

The 18th annual Beach Sweep/River Sweep was held September 16, 2006, and nearly 5,000 volunteers across South Carolina joined forces to rid beaches, marshes, and waterways of unsightly, and sometimes dangerous, debris. The litter cleanup, supported primarily with donations from the private sector, is organized by the S.C. Sea Grant Consortium and the S.C. Department of Natural Resources, and is held in conjunction with The Ocean Conservancy¹s International Coastal Cleanup.

Covering over 1,050 miles in 38 of South Carolina¹s 46 counties, cleanup crews removed 33.5 tons of trash, recycling much of what was collected. On the coast, volunteers tackled over 100 sites from North Myrtle Beach to Daufuskie Island that were made safer, healthier, and more beautiful for all to enjoy. Aside from the typical cans, bottles, and cigarette butts, some unusual items include car parts; tires; appliances; carbon dioxide container; large pieces of Styrofoam; construction material; many plastic beach chairs, tents, and umbrellas; charcoal grills; propane tanks; plastic toys; inflatable kiddie pools; bowling ball; firework debris; derelict crab traps; compressor pump; 55-gallon drums; port-a-potty; and plastic detonator cords from explosive demolition of the Cooper River Bridges.

Major sponsors of the 2006 Beach Sweep/River Sweep were Applied Technology and Management, BP Cooper River Plant, Ben and Jerry¹s of Charleston, Charleston City Marina, Coastal Expeditions, Duke Power, HDR Engineering, Hilex Poly Co., Magnolia Plantation and Gardens, Marine Terminals of S.C., Mount Pleasant Waterworks, Osprey Marina, Piggly Wiggly Carolina Co., South Carolina Ports Universal Data Solutions.

## Advances in Home Hurricane Protection

*"Dr. Nail vs. The Monster"*

A former Clemson student funded by South Carolina Sea Grant, Ed Sutt, worked at Clemson University's Wind Load Test Facility while studying for his civil engineering degree. He

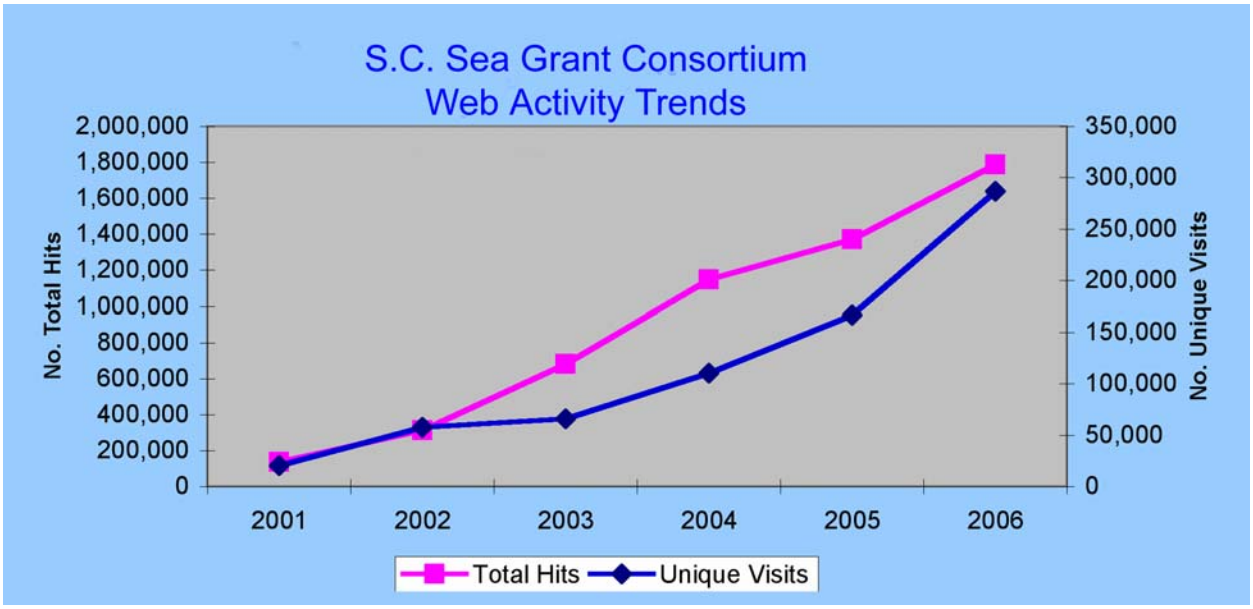
examined better ways to secure residential home structures under threat from hurricanes and earthquakes. He discovered that house failures often start with a broken window. High winds then inflate the house and cause the roof to lift from its frame. The solution? – modify the simple nail that has been around for centuries. Sutt invented a nail made with carbon-steel alloy, a wider head than other nails (by 25%), barbs that hold the shaft firmly in the frame to prevent pullout, and a twist below the nail head to fill the space that the barbs open to hold the nail in place. After receiving his PhD from Clemson, Sutt returned to the wind tunnel facility to test his nail against "The Monster" – a huge, steel I-Beam contraption designed to rip walls away from their frames by replicating the simultaneous hurricane forces of uplift and shear. The Monster can generate 20,000 pounds of force. At 9,000 pounds, nails begin to pull out of the framework. At 13,500 pounds people run for cover – the structure splits apart with a startling crack sound. Then Sutt's nail is tested. The sounds of stress grow louder, nut the nail holds at 20,000 pounds. Sutt's invention is now known as the Hurri-Quake® nail. For his efforts, Dr. Ed Sutt was voted the 2006 Grand Award Winner "Innovation of the Year" by the national magazine, *"Popular Science."*

### Public Use of Consortium Web site Continues to Increase

*Now more than 1.7 million hits annually*

The Consortium's staff continues to improve the Consortium Web site (www.scseagrant.org) by enhancing its interactive features, making the site more accessible to people with disabilities, and keeping the information up-to-date and relevant. The Consortium has posted a retrofitted Web site, which is 508 Compliant, and is in the process of transferring all information to the new site. Total hits for 2006 were 1,788,277; unique visits totaled 286,906. Traditional means of communication are still extremely important for information delivery – the Consortium's extension and communications staff produced over 67 publications in FY05-06, which informed our constituents about coastal issues and, where appropriate, facilitated the transfer and exchange of information.

**Figure 1.** Annual trends for total hits and unique visits to the SCSGC Web site.



### *Coastal Heritage* magazine recognized by SC State Library

*One of only ten publications selected*

The S.C. Sea Grant Consortium received the South Carolina State Library's Notable State Document Award for *Coastal Heritage*. The publication was chosen out of 2,500 documents received and catalogued by the State Documents Depository System in the year 2006. According to the South Carolina State Library, the purpose of the annual awards is to "recognize state governmental publications of outstanding merit and usefulness to the citizens of South Carolina." Only 10 of these awards are given each year. According to Mary Morgan, director of information services at the library, "While much of the Consortium's work is scientific in nature, *Coastal Heritage* focuses on the heritage of the coastal region, providing well-written and illustrated articles covering sometimes little known aspects of the history of the region. For example, the Summer 2006 issue covered the rice industry in South Carolina, both its African roots and its current day revival." Morgan also noted that *Coastal Heritage* is a repeat winner, having received a Notable State Document award in 2000, which demonstrates its continuing value to the state and its citizens.

## SECTION III: PERFORMANCE MEASURES

### Key Numeric Performance Measures

The Consortium's key numeric performance measures, organized into four goal areas, are evaluated on an annual basis as a component of its State of South Carolina Annual Accountability Report. The table that follows captures in a single "chart" the relevant summary of numerical results for FY06-07, with comparisons to FY05-06, FY04-05 and FY03-04. Selected programmatic outcomes are provided in the ERP Performance Measures section of this report that follows.

**Mission Accomplishment**

- Rating by the external National Sea Grant Program Assessment process
- Number of professional awards for its *Coastal Heritage* magazine and other products
- Number of proposals prepared and submitted; number of proposals funded
- Number of faculty supported at the Consortium's universities
- Number of graduate and undergraduate students supported through Consortium funding
- Number of K-12 teachers with formal ocean science-based training and graduate credit
- Implementation planning milestones met
- Grant award and interagency billing and accounting processes within a two-week timeframe

**Customer Satisfaction**

- Number of extension workshops and presentations, and attendance
- Number of extension publications and products produced
- Number of communications publications and products produced
- Number of news releases distributed; number of media placements as a result
- Number of unsolicited media placements
- Number of hits and unique visits to the Consortium Web sites
- Number of coastal site captains and individual volunteers on the coast in Beach Sweep

**Financial Performance**

- State recurring funds secured
- Extramural (competitive and otherwise) funding secured from non-state sources
- Return on investment (federal funding to state funding)
- Annual single agency audit with no significant findings

**Human Resource Results**

- Staff retention/vacancy levels
- Number of staff training and development opportunities
- Staffing level of six Sea Grant Extension Specialists

**Table:** Trends in Performance Measures

| MEASURE | FY03-04 | FY04-05 | FY05-06 | FY06-07 |
|---|---|---|---|---|
| **Mission Accomplishment** | | | | |
| National Sea Grant Performance Rating | Excellent | High Performance | High Performance | High Performance |
| Communications Awards (#) | 3 | 5 | 5 | 6 |
| Research/Education Proposals Submitted | 49 | 47 | 53 | 52 |
| Research/Education Proposals Funded (#) | 32 | 28 | 31 | 34 |
| Faculty Supported - SC Universities | ND | 80 | 85 | 108 |
| Graduate/Undergrad Students Supported | ND | 35 | 54 | 62 |
| K-12 Teachers Trained in Ocean Sciences | 35 | 50 | 120 | 690 |
| | | | | |
| **Customer Satisfaction** | | | | |
| Extension Workshops | ND | 102 | 81 | 76 |
| Participants – Extension Workshops | ND | 1,500 | 2,000 | >1,900 |
| Publications/Products – Extension | ~25 | 30 | 22 | 18 |
| Publications/Products - Communications | 35 | 32 | 45 | 41 |
| Responses to Requests for Publications | 1,478 | 4,125 | 4,859 | 4,468 |
| News Releases (#) | 14 | 18 | 11 | 12 |
| Media Placements due to News Releases | 131 | 130 | 142 | 128 |
| Unsolicited Media Placements | 91 | 95 | 39 | 37 |
| Agency Web Site - Hits | 843,900 | 1,328,515 | 1,607,461 | 1,883,119 |
| Agency Web Site – Unique Visits | 76,600 | 142,450 | 235,188 | 292,331 |
| Volunteer Site Captains (#) Beach Sweep | ~75 | ~100 | >100 | 116 |
| Volunteers (#) Beach Sweep | ~3,000 | >2,500 | >3,500 | 3,200 |
| | | | | |
| **Financial Performance** | | | | |
| State Recurring Funding | $ 440,505 | $ 354,164 | $ 452,308 | $ 545,748 |
| Extramural Funding | ~$5,500,000 | ~$6,009,000 | ~$5,500,000 | ~$5,280,000 |
| Return on (State) Investment | 1,249% | 1,696% | 1,216% | 967% |
| Single Agency Audit | No Findings | No Findings | No Findings | No Findings |
| | | | | |
| **Human Resource Results** | | | | |
| Staff Training Opportunities | ND | 4 | 10 | 15 |
| Staff Retention/Rehiring | 7 Vacancies | 4 Vacancies | Fully Staffed | 2 Vacancies |

## Results Matched to ERP Performance Measures

Listed below are accomplishments during the reporting period, which address the three ERP performance measures. Currently, they are qualitative in nature, but we are in the process of *quantifying* the contributions the South Carolina Sea Grant Consortium makes to the state's coastal communities and resources. The previous table of performance results and trends is a step toward that goal.

**MEASURE 1: Return on investment from the discovery and application of new sustainable coastal, ocean, and Great Lakes products.**

***Project Number:*** *R/SE-2*
***Project Title:*** *Impacts of Stocked Red Drum on the Recreational Fishery and Local Community of Murrells Inlet: Biological and Economic Considerations*
***Principal Investigator and Institution:*** *Theodore I.J. Smith, SC Department of Natural Resources*
***Funding Source:*** *NOAA National Sea Grant College Program*

This project utilizes a multi-disciplinary approach (e.g., culturists, stock enhancement scientists, geneticists, extension specialists, resource economists) to address a critically important fisheries resource issue in South Carolina related to the health of the local red drum (also called red fish and spottail bass) fishery. S.C. Sea Grant researchers at the SCDNR Marine Resources Research Institute are evaluating the outcomes of a directed stocking program that should serve as a model for red drum restoration efforts throughout coastal South Carolina and elsewhere in the region. One of the issues being examined is the effect of stocking size on return level. During fall 2005, a total of 625,269 larger (as compared to 2003-2004) "marked" red drum juveniles were stocked into Murrells Inlet. Research to-date indicates that the stocking program is having a significant positive effect on the red drum population in the Murrells Inlet area. Estimates of variability and changes in population size are planned for 2006 and 2007 to obtain further information on the best protocols for sustaining the red fish population. Efforts include collection of fin clips (genetic samples) from the adult population to demonstrate the contribution of stocked fish in the adult spawning population.

Based in part on the results of this program, the states of Mississippi and Georgia are both in the process of developing similar stocking experiments to test the utility of stocking in their own areas. The South Carolina stocking project received regional honors as the recipient of 2003 Palmetto Vision Award.

***Project Number:*** *A/CG-2*
***Project Title:*** *Smart Growth Initiative*
***Principal Investigator and Institution:*** *April Turner and M. Richard DeVoe, South Carolina Sea Grant Consortium*
***Funding Source:*** *USEPA, through the NOAA National Sea Grant College Program*

As part of the Smart Growth pilot project implemented through the SCSG Coastal Community Initiative, a series of stakeholder workshops were held in Jasper County to promote the use of natural resource-based planning by educating local decision-makers and landowners about innovative quality growth policies, tools, and strategies for natural resource conservation. The workshops also provided a forum for gathering input about the conservation concerns and issues participants felt needed to be addressed. The information gathered served as a platform

for making decisions about local priorities and policies for natural resource conservation, which culminated in the development of the *Jasper County Resource Conservation Plan*. The Plan evolved as a result of the efforts of more than 100 stakeholders, representing local and regional government officials and staff, state and federal resource agencies, nonprofit conservation organizations, local businesses private land owners, and concerned citizens. Included in the Plan are: an explanation of its purpose; a description of the county and its wealth of natural and cultural resources; a list of identified issues and goals, objectives, and strategies to address those issues; conservation priorities; a community vision; and a plan of action and implementation. The Plan has been submitted to Jasper County staff and council to integrate its components into the Natural Resource Element of the county's Comprehensive Land Use Plan, which is currently under revision.

**MEASURE 2. Cumulative number of coastal, marine, and Great Lakes issue-based forecast capabilities developed and used for management.**

***Project Number:*** *R/COP-7*
***Project Title:*** *The South Atlantic Bight Land Use - Coastal Ecosystem Study (LU-CES)*
***Principal Investigator and Institution:*** *M. Richard DeVoe, Program Manager, S.C. Sea Grant Consortium; 24 additional PIs from 8 institutions in SC and GA*
***Funding Source: NOAA Coastal Ocean Program***

The LU-CES study, a multidisciplinary research program initiated and managed by the Consortium, has generated information on direct cause-and-effect linkages between population and development trends and their impacts on the region's salt marsh-tidal creek ecosystems. That research, and information and data gathered over the life of the study, has formed the basis for a recently published (2006) book by Springer-Verlag titled *Changing Land-Use Patterns in the Coastal Zone: Managing Environmental Quality in Rapidly Growing Regions*. Up to two dozen investigators from various marine-related natural and social science disciplines contributed to the book by writing chapters covering their areas of research. Due to the multidisciplinary and collaborative nature of the study, the book should become a landmark in the area of understanding coastal estuarine ecosystem dynamics and the nature of anthropogenic inputs. In the future, we will also increase our interactions with potential users of LU-CES information (planners, engineers), developing specific applications for our models and data products.

**MEASURE 3. Percentage/number of tools, technologies, and information services that are used by NOAA partners/customers to improve ecosystem-based management.**

***Project Number:*** *R/CF-10*
***Project Title:*** *SC Blue Crabs: South Carolina Blue Crab Regional Abundance Biotic Simulation*
***Principal Investigators and Institutions:*** *Michael Childress, Clemson University; Elizabeth Wenner, SC Department of Natural Resources*
***Funding Source:*** *NOAA National Sea Grant College Program*

Carolina's blue crab, which supports a $5-million-dollar commercial fishery, can be one of the most difficult species to manage. In response, Sea Grant researchers have created a spatially explicit individual-based population model of blue crabs in South Carolina. The model has been parameterized and validated through analyse of fisheries independent data on the abundance and distribution of blue crab postlarvae, juveniles and adults across a network of sampling sites. The researchers tested the model through "what if" scenarios to determine the impact of changes in water quality due to flood, drought, hypoxia, tropical storms, and /or fishing pressure

on blue crab populations. Comparisons were made among the population density, average size and annual catch of blue crabs during a five year simulation of drought vs. average water conditions. The model found crab abundances to be only 70% of normal densities during the drought conditions with the greatest impact occuring during the spring and summer quarters. This is more sensitive than the observed trawl data estimates of crab abundance which found crab abundances to be 90% of normal densities during the drought of 1999-2003 primarily during the summer quarter only. However, the model estimates of impact were much closer to the observed decrease in annual landings during the same period (down to 76% of normal landings) during the drought of 1999-2003. Comparisons of "what-if" scenarios will be completed and posted to the SCBCRABS Web site. A web interface has been developed for this simulation model so fishermen, scientists, students and the general public can learn about blue crab population dynamics, life history and fisheries management policy. An active web site exists that is currently being fine tuned to accomplish this task at www.clemson.edu/SCBCRABS.

***Project Number:*** *R/SR-1*
***Project Title:*** *Developing Approaches and Associated Metrics for Restoration Success: Determining Intertidal Oyster Matching Goals with Using Small and Large Scale Reefs*
***Principal Investigator and Institution:*** *Loren Coen, SC Department of Natural Resources*
***Funding Source:*** *NOAA National Sea Grant College Program*

Scientists interested in oyster reef restoration met at a regional workshop in 2004 in Myrtle Beach, SC, to determine what metrics were suitable for assessing oyster reef restoration goals and would allow comparison between the various restoration projects. Six restoration goals were agreed upon, and eleven metrics (reef size, reef condition in density and size frequency, associated fauna, reef arch, landscape fragmentation, salinity, DO, Chl, TSS and turbidity, and temperature) were identified.

The South Carolina investigators examined a suite of metrics over the past two years on natural and restored reefs along the coast. One metric was the interrelationship between oyster density, oyster size, and resident reef fauna on constructed and natural reefs. The major finding was that over time the restored reef's resident faunal assemblages exhibited increasing convergence in community composition. The project has collected new data for proposed metrics on South Carolina restored and natural reefs, and the metrics are being applied at multiple, replicated South Carolina restoration sites of differing ages and spatial scales. A novel technique for assessing the success of restored oyster reefs is the effect on water quality. The investigators have developed a novel metric that uses rapid assessment of seston uptake by populations of bivalve mollusks and mathematical modeling of the process. The process to-date has been successful in yielding much information that is now undergoing analysis. Another technique that has been deployed is the use of overhead digital photograph which yields information about marsh growth into the reefs and changes in sedimentation.

Finally, the workshop members are engaged in a variety of studies in Southwest Florida (Florida Gulf Coast University), South Carolina (SC DNR), North Carolina (University of North Carolina-Wilmington) and Virginia (College of William and Mary) using the metrics agreed upon in 2004 and data and results will be shared.

***Project Number:*** *R/ER-24*
***Project Title:*** *Succession of Tidal Wetlands on the Cooper River, SC: Ecological Functions and Management Alternatives*
***Principal Investigator and Institution:*** *James Morris, et al, University of South Carolina*

***Funding Source:*** *NOAA National Sea Grant College Program*

This project builds on previous Sea Grant work to enhance understanding of the ecological functioning of former rice field (wetland) impoundments along the Cooper River. This knowledge is being incorporated into simulation models of the marshes to serve as an aid for basin resource management and planning. The focus is to further develop the mechanistic spatial simulation model of wetland succession by incorporating the results of past and proposed field work on impoundment bathymetry, spatially varying sedimentation rates, plant community biomass and successional characteristics, and water quality and is on target for a successful completion.

The model includes a conceptual model of plant community growth and succession that is driven by water depth and sediment accumulation. It is being integrated with a mechanistic model of marsh sedimentation using community biomass and sea level rise as forcing functions. The model is grid-cell based with a 1-year time step. The simulation machine is written using Matlab and is coupled with ArcView GIS. The model will produce a characterization of the ecological consequences of management alternatives that are of direct interest to the state's coastal zone and natural resource managers and stakeholder groups along the Cooper River.

***Project Number:*** *R/ER-26*
***Project Title:*** *Control of Saltmarsh Cordgrass by Blue Crab Predation on Periwinkle Snails: An Immunological Gut Check*
***Grantee (Principal Investigator) and Institution:*** *Robert Feller, University of South Carolina*
***Funding Source:*** *NOAA National Sea Grant College Program*

The overall goal of this study is to quantify the degree to which blue crabs prey upon periwinkle snails and the degree to which periwinkle snails ingest smooth cordgrass. The concern is that periwinkle predation on above ground biomass of *Spartina alterniflora*. A recent hypothesis of top-down (predation) control of saltmarsh plant growth mediated by a trophic cascade involving blue crab consumption of periwinkle snails, the putative grazer of saltmarsh cordgrass, was tested in North Inlet, SC. Snail densities averaged 50 per square meter throughout the summer and fall. Based upon the visual and immunological analysis of wild-caught blue crab gut contents, the proportion of crabs containing identifiable solid parts (opercula, shells) or solubilized proteins from periwinkle snails was low during all summer times of collection. Based upon estimates of blue crab abundance, measurements of the gut retention time of periwinkle meals and the number of periwinkle snails that could be ingested on a daily basis by blue crabs, the impact of blue crab predation on the periwinkle snail population was minuscule. Little evidence was found to support the trophic cascade hypothesis involving predator-prey interactions between blue crabs and periwinkle snails.

***Project Title:*** *A/C-1*
***Project Title:*** *Beach Sweep/River Sweep*
***Principal Investigator and Institution:*** *Susan Ferris Hill, S.C. Sea Grant Consortium*
***Funding Sources:*** *Donations and Private Contributions*

The 18th annual Beach Sweep/River Sweep was held September 16, 2006, and nearly 5,500 volunteers across South Carolina joined forces to rid beaches, marshes, and waterways of unsightly, and sometimes dangerous, debris. Volunteer-driven cleanup crews were located in 41 of South Carolina's 46 counties, and they removed an estimated 50 tons of trash, recycling much of what was collected. Savings of the 2006 South Carolina cleanup to the taxpayers in terms of volunteer hours has been calculated (number of volunteers x 2 hours average worked x

$5.15 Federal minimum wage) as a conservative $56,650.

Beach Sweep/River Sweep—the largest one-day litter cleanup in South Carolina—is part of The Ocean Conservancy's International Coastal Cleanup, and is organized each year by the S.C. Sea Grant Consortium and the S.C. Department of Natural Resources. Over the past 17 years, more than 88,000 volunteers have collected 820 tons of trash in South Carolina's waterways.

**PROJECTS ADDRESSING MORE THAN ONE OF THE PERFORMANCE MEASURES**

***Project Title:*** *A/C-1*
***Award Title:*** *S.C. Sea Grant Consortium Web site*.
***Principal Investigators and Institution:*** *Susan Ferris Hill and Patty Snow, S.C. Sea Grant Consortium*
***Funding Sources:*** *NOAA National Sea Grant College Program and State of South Carolina General Appropriations*

The Consortium's staff continues to enhance the SCSGC Web site (www.scseagrant.org) by expanding its interactive features, making the site more assessable to people with disabilities, and keeping the information current. The site serves as a tool and information service to foster better understanding of coastal ecosystem issues and how they can be best managed. The state of South Carolina mandated that all state government sites would be 508 Compliant and meet the accessibility standards by July 21, 2006. Due to the number and sizes of the S.C. Sea Grant Consortium's sites, this was a major undertaking, given over 1,500 html pages and seven sites to reconfigure. What transpired was the conversion of the 1,500 previous static html pages into a newly created data-driven custom web application built using the .NET framework. All the site information is now in a separate database that is retrievable for a myriad of other uses by the agency. This custom Web application uses cascading style sheets (CSS) and along with a modified site architecture, and a new content manager interface, can create forms "on the fly" and make updates instantaneously which streamlines the maintenance aspect, increases our functionality, while making it fully accessible at the same time. These major changes significantly improve some of the agency's key management processes, and contribute to user satisfaction.

## SECTION IV: APPENDICES

### Management Metrics

### A. Staff Composition

The S.C. Sea Grant Consortium currently employs or supports a total of 21 staff, including the Executive Director. Fourteen (14) staff are situated in state-approved FTE positions; the remainder (seven) are employed as Temporary Grant Employees (TGEs).

**FTEs/TGEs (Full Time Employees = 12 man months) Devoted to Sea Grant**

| Sea Grant Staffing | # of Individuals | # of FTEs/TGEs Funded by Sea Grant dollars | # of FTEs/TGEs Funded by Non-Sea Grant dollars |
|---|---|---|---|
| Administration/Mgmt. | 8 | 4.30 | 3.70 |
| Communications | 4 | 1.00 | 3.00 |
| Extension | 7 | 3.50 | 1.50 |
| Education | 2 | 0.25 | 1.75 |
| Research | TBD | TBD | TBD |
| **TOTAL** | **21** | **9.05** | **9.95** |

Management team composition and percentage of time the Sea Grant Director and management staff devoted to core Sea Grant activities:

| Management Team Member | Position | FTEs devoted To Sea Grant |
|---|---|---|
| Rick DeVoe | Executive Director | 0.5 |
| Elaine Knight | Assistant Director | 0.5 |
| Denise Sanger | Assistant Director for Planning & Research | 0.65 |
| John Dwyer | Assistant to Director - Program Management | 0.6 |
| Robert Bacon | Extension Program Leader | 1.0 |
| Susan Ferris Hill | Communications Director | 0.5 |

### B. Program Development Projects (2006-2007)

Please note that the S.C. Sea Grant Consortium does not require a non-federal match for Sea Grant development projects.

**P/M-2A** – South Carolina Space Grant and SC Sea Grant Kathryn Sullivan Science and Engineering Fellowship – Caroline Yount, Clemson University -- $7,000

**P/M-2B** – Hydrology Dynamics and Potential Water Quality Impacts, Turkey Creek Watershed, Francis Marion National Forest and Quinby Creek Watershed, Huger, South Carolina – Dr. Tim Callahan, College of Charleston -- $10,604

**P/M-2C** – Preliminary Assessment of the Occurrence of the Invasive Asian Green Mussel in South Carolina – Dr. Elizabeth Wenner, SCDNR -- $10,000

**P/M-2D** – Contamination of Coastal Stormwater Pond Sediments: Potential Risk to Wildlife and Human Health, Dr. John Weinstein, The Citadel -- $9,896

**P/M-2E** – Meeting Support for the Restore America's Estuaries 4th Annual Conference – Harvey Potts, Restore America's Estuaries -- $1,500

**P/M-2F** – Support for publication of "The Complete Guide to Coastal Boating" – Lorianne Riggin, SC Department of Natural Resources -- $5,000

**C. Partnerships (Consortium-wide)**

**National:**

- National Oceanic and Atmospheric Administration (NOAA)
  - NOAA National Ocean Service
    - Coastal Services Center
    - NCCOS-Coastal Ocean Program
    - Center for Coastal Environmental Health and Biomolecular Research
    - Hollings Marine Laboratory
    - National Estuarine Research Reserve Program
      - ACE Basin NERR
      - North Inlet/Winyah Bay NERR
  - NOAA Oceanic and Atmospheric Research
    - National Sea Grant College Program
    - Atlantic Oceanographic and Meteorological Laboratories
    - National Severe Storms Laboratory
  - NOAA National Weather Service
    - WFO-Charleston
    - WFO-Raleigh
    - WFO-Wilmington
  - NOAA Office of Ocean Exploration
  - NOAA Office of Education
  - NOAA in the Carolinas
  - NOAA SART
- U.S. Department of the Interior
  - United States Geological Survey
    - Coastal and Marine Geology Program
    - Water Resources - SC
- National Science Foundation
- U.S. Department of Agriculture
  - USDA-Natural Resource Conservation Service
  - Natural Resources and Conservation Service
  - Southern Regional Aquaculture Center
  - Farm Service Agency
  - Risk Management Agency
  - Cooperative State Research, Education and Extension Service [CSREES]
  - Foreign Agriculture Service

- U.S. Department of Homeland Security
    - U.S. Coast Guard – Charleston
    - U.S. Federal Emergency Management Agency (Region IV)
- U.S. Centers for Disease Control and Prevention
- U.S. National Park Service
    - Fort Sumter
    - Fort Moultrie
- U.S. Environmental Protection Agency
    - Region IV - Southeast
    - Office of Policy, Economics and Innovation
- U.S. Army Corps of Engineers
    - Charleston District
- National Federation of Regional Associations for Coastal Ocean Observing (NFRA)
- Ocean.US
- National Marine Educators Association
- National Non-Point Education for Municipal Officials (NEMO) Network
- National Ocean Sciences Bowl (CORE)

**Regional:**

- South Atlantic Fishery Management Council
- Atlantic States Marine Fisheries Commission
- Wild American Shrimp Inc.
- Southern Shrimp Alliance
- Georgia Department of Natural Resources
- Southeast Universities Research Association
- SouthEast Coastal Ocean Observing Regional Association (SECOORA)
- SouthEast Atlantic Coastal Ocean Observing System (SEACOOS)
- SouthEast Center for Ocean Sciences Education Excellence (COSEE-SE)
- Southeast Phytoplankton Monitoring Network
- Ocean Sciences Bowl, South Carolina/Georgia Region (Annual)

**State and Local:**

- South Carolina Forestry Commission
- South Carolina Department of Natural Resources
    - Office of Fisheries Management
    - Waddell Mariculture Center
    - Land and Water Resources Division
    - Flood Program
    - SC Water Resources
    - Law Enforcement Division
- S.C. Department of Education
    - Office of the Science Coordinator
- S.C. Department of Health and Environmental Control
    - Ocean and Coastal Resource Management
    - Bureau of Water
    - Trident and Waccamaw Health Districts
- S.C. Department of Parks, Recreation and Tourism
    - Myrtle Beach State Park
    - Huntington State Park

    - Edisto Beach State Park
    - Hunting Island State Park
    - Givhans Ferry State Park
- S.C. Emergency Management Division
- S.C. State Ports Authority
- S.C. Soil and Water Conservation Service
- S.C. Task Group on Harmful Algae
- S.C. Center for Technological Innovation
- S.C. Government Webmasters Association
- S.C. Information Resources Council
- Cities/Towns in South Carolina (selected)
    - City of Charleston
    - City of Folly Beach
    - City of Georgetown
    - City of Hardeeville
    - City of Isle of Palms
    - City of Myrtle Beach
    - City of North Myrtle Beach
    - City of Surfside Beach
    - Town of Bluffton
    - Town of Edisto Beach
    - Town of Hilton Head Island
    - Town of Kiawah Island
    - Town of Pawleys Island
    - Town of Ridgeland
    - Town of Sullivan's Island
    - Town of Yemassee
- S.C. Association of Counties
- Berkeley-Charleston-Dorchester Council of Governments
- Lowcountry Council of Governments
- Waccamaw Regional Council of Governments
- County Governments in South Carolina (selected)
    - Beaufort
    - Berkeley
    - Charleston
    - Colleton
    - Dorchester
    - Georgetown
    - Horry
    - Jasper
- School Districts
    - Berkeley County School District (Project Inquiry; COASTeam)
    - Charleston County School District (Office of the Science Curriculum Coordinator; Project Inquiry; COASTeam)
    - Colleton County School District (COASTeam)
    - Dorchester County School District (COASTeam)
- Public schools in coastal South Carolina communities (>180)
- Lowcountry Estuarium
- South Carolina Aquarium
- Jasper Soil and Water Conservation District
- South Carolina Science Council

- 113 Calhoun Street Foundation
- Charleston County Parks and Recreation Commission
- Caw Caw Interpretative Center
- Folly Beach County Park
- Lowcountry Science Fair
- S.C. Marine Educators Association
- Leadership South Carolina
- Roper Mountain Science Center

**NGOs:**

- Ashley Scenic River Advisory Council
- Beaufort County Open Land Trust
- Beaufort County Water Quality Task Force
- Boy Scouts of America, Coastal Carolina Council
- DeeDee Paschal Barrier Island Trust
- Friends of Hunting Island
- Friends of the Edisto
- Friends of the Rivers
- Keep South Carolina Beautiful
- Low Country Institute (Spring Island, S.C.)
- Maritime Association of the Port of Charleston
- Noisette Foundation
- Palmetto Bluff Conservancy
- S.C. Aquaculture Association
- S.C. Aquatic Plant Management Society
- S.C. Association for Hazard Mitigation
- S.C. Coastal Conservation League
- S.C. Chapter of the American Planning Association
- S.C. Community Development Association
- S.C. Downtown Development Association/Community Builders
- S.C. Economic Developers Association
- S.C. Marine Association
- S.C. Municipal Association
- S.C. Nature-Based Tourism Association
- S.C. Seafood Alliance
- S.C. Shellfish Association
- S.C. Shrimp Growers Association
- S.C. Shrimpers Association
- S.C. Wildlife Federation
- Spring Island Trust
- The Nature Conservancy
- Trust for Public Land
- Upstate Forever
- Ducks Unlimited
- Historic Ricefields Association
- Winyah Bay Foundation

**International:**

- Aquatic Plant Management Society (International)

- International Conference on Shellfish Restoration
- International Gullee-Geechee Coalition
- The Ocean Conservancy

**Industry/Business:**

- S.C. Chamber of Commerce
- Charleston Metro Chamber of Commerce
- Applied Phytogenetics, Inc.
- Applied Technology and Management, Inc.
- BASF
- Berkeley Electric Cooperative
- BMW Manufacturing Corp.
- BP Cooper River Plant
- Bull's Bay Seafood
- Coastal Discovery Museum
- Coastal Landscape Construction
- Dewees Island Development
- Duke Power Company
- Gold Kist, Inc.
- Great Bay Farms (NH)
- Griffin BioSafe Systems
- Hilex-Poly, Inc.
- Institute of Business and Home Safety (IBHS)
- Island Fresh Seafood
- Lockheed Corporation
- Lowcountry Seafood, Inc.
- Magnolia Plantation and Gardens
- Marine Terminals of S.C.
- Mistyvale Crawfish Farm
- Noisette Company
- Palmetto Aquaculture Corporation
- Paradise Seafarm
- Piggly Wiggly Carolina Company
- Professional Lake Management, Inc.
- Ripley's Aquarium
- Santee Cooper
- SCANA Corporation
- SePro
- Sonoco Products, Inc.
- Southland Fisheries Corporation
- Swimming Rock Fish & Shrimp Farm
- Thickwater Clam Farm
- Universal Data Solutions

**Academic Institutions:**

- University of South Carolina
- Clemson University
- South Carolina State University
- Coastal Carolina University

- The Citadel
- College of Charleston
- Medical University of South Carolina
- S.C. Sustainable Universities Initiative
- University of Florida
- Florida International University
- Florida Gulf Coast University
- VIMS
- Dartmouth University
- SUNY-Albany
- University of NC - Chapel Hill
- University of NC - Wilmington
- Georgia Institute of Technology
- North Carolina State University
- Skidaway Institute of Oceanography
- Texas A&M University
- University of Connecticut Extension Service
- University of Georgia (Research Foundation)
- University of Massachusetts – Dartmouth
- University of New Hampshire
- University of North Carolina – Wilmington
- University of Texas – El Paso

**Sea Grant Programs (Direct Interactions):**

- Georgia Sea Grant College Program
- North Carolina Sea Grant Program
- Florida Sea Grant College Program
- Virginia Sea Grant College Program
- South Atlantic Sea Grant Fisheries Extension and Enhancement committee (NC, SC, GA, and FL Sea Grant College Programs)
- National Sea Grant Fisheries Extension and Enhancement committee (reps from each of the SG regions and the NSGO)
- National Sea Grant Strategic Initiative, Fisheries Theme Team

**Additional Organizations:**

- Murrells Inlet Fishing Clubs
- Hilton Head Sportfishing Club
- Georgia Aquarium
- North Carolina Aquarium
- Discovery Place
- Fernbank Science Center
- Osprey Point Golf Resort
- Edisto Beach Community
- Dunes Properties®
- Good Hope Plantation and Corporation
- Turkey Hill Plantation
- Okatee Club
- Fife Plantation
- Kinghorn Insurance Services

- Spring Hill Plantation
- Nada Williams Realty
- Copper Station

**D. Leveraged Funds**

In FY2006-07, the Consortium secured about $4.1million in extramural, non-core Sea Grant (competitive and otherwise) grant funding from non-state sources – approximately 70% of the Consortium's total budget. The grants are listed below – those in italics are new grants secured during the reporting period:

**Strategic Goal 2 - Coastal-Ocean Processes**

- "Southeast Atlantic Coastal Ocean Observing System – Outreach and Education" – Office of Naval Research (through the University of North Carolina – Chapel Hill) - $60,260 – September 1, 2006 to August 31, 2007 (Year 5 of 5) – M. Richard DeVoe and L. Lundie Spence (S.C. Sea Grant Consortium) and Robert H. Bacon (S.C. Sea Grant Extension Program).

- "SouthEast Coastal Ocean Observations Regional Association (SECOORA): Building a Regional Association Framework for the Coastal Ocean Observing System of the Southeastern United States" – NOAA Coastal Services Center - $379,549 – October 1, 2006 to September 30, 2007 – NOAA Coastal Services Center - (Year 2 of 3) – M. Richard DeVoe and Parker Lumpkin (S.C. Sea Grant Consortium).

- "Enhancing Communications and Coordinating Outreach Activities throughout the IOOS Community: The NFRA Contribution" - NOAA Coastal Services Center - $24,995 – August 1, 2006 to July 31, 2007 (Year 2 of 3) – M. Richard DeVoe (S.C. Sea Grant Consortium) and Josie Quintrell (National Federation of Regional Associations).

- *"Development of a Research Plan for the South Atlantic Region" – Georgia Sea Grant College Program – $10,000 – June 1, 2006 to May 31, 2007 (Year 1 of 1) – M. Richard DeVoe and Denise Sanger (S.C. Sea Grant Consortium).*

**Strategic Goal 3 - Ecosystem Dynamics**

- "Expanding Existing Surveillance Systems to Include *Pfeisteria*, Other Harmful Algal Blooms, and Marine Toxins in South Carolina" – Centers for Disease Control - $365,803 – September 1, 2006 to August 31, 2007 (Year 4 of 5) – M. Richard DeVoe (S.C. Sea Grant Consortium). Involves faculty and students from Marine Resources Division-SCDNR, University of South Carolina, S.C. Department of Health and Environmental Control, NOAA-NOS Charleston Laboratory, and Medical University of South Carolina.

- "A Harmful Algal Bloom Initiative for South Carolina: Assessing the Potential Impacts of Red Tides, *Pfiesteria*, and Toxic Algae" – S.C. Department of Natural Resources - $25,390 - October 1, 2006 to September 30, 2007 (Year 2 of 2) – M. Richard DeVoe (S.C. Sea Grant Consortium).

- "Sea Grant Studies of Hypoxia in Long Bay, South Carolina" – S.C. DHEC-Ocean and Coastal Resources Management - $159,275 – January 1, 2005 to February 28, 2007 –

George Voulgaris (University of South Carolina) and Eric Koepfler et al. (Coastal Carolina University)

- *"Development of a Conceptual Model for an Integrated Coastal Demographic-Economic-Environmental Prediction and Forecasting Initiative" – NOAA Centers for Coastal Ocean Research-CCEHBR - $600,000 – July 1, 2006 to December 31, 2007 - M. Richard DeVoe (S.C. Sea Grant Consortium). Involves faculty and students from University of South Carolina, Clemson University, and NOAA-NOS Charleston Laboratory, and NOAA Hollings Marine Laboratory.*

- *"Providing Ocean and Human Health Research, Education, and Training to Appropriate Audiences – a HML-SCSGC MOA Initiative" – NOAA Hollings Marine Laboratory - $192,742 – August 1, 2006 to present – M. Richard DeVoe (S.C. Sea Grant Consortium).*

**Strategic Goal 4 - Coastal Natural Hazards**

- "South Carolina Coastal Erosion Study - Phase II" - U.S. Geological Survey - $237,000 - September 1, 2006 to August 31, 2007 (Year 6 of 6) - M. Richard DeVoe (S.C. Sea Grant Consortium). Involves faculty from Coastal Carolina University, University of South Carolina, College of Charleston and Georgia Institute of Technology.

- I-FLOW - NOAA National Sea Grant College Program – National Strategic Investment Program - $16,666 – March 1, 2006 to February 28, 2007 (Year 2 of 3) – Robert H. Bacon (S.C. Sea Grant Extension Program).

- *"South Carolina Coastal Erosion Study - BERM" - S.C. DHEC-Ocean and Coastal Resources Management - $34,956 - September 1, 2006 to August 31, 2007 (Year 1 of 1) – M. Richard DeVoe (S.C. Sea Grant Consortium and Paul T. Gayes (Coastal Carolina University).*

- *"The Carolinas Coastal Climate Outreach Initiative" - NOAA National Sea Grant College Program – National Strategic Investment Program - $100,000 – September 1, 2006 to August 31, 2007 (Year 1 of 3) – M. Richard DeVoe (S.C. Sea Grant Consortium) and Robert H. Bacon (S.C. Sea Grant Extension Program).*

**Strategic Goal 5 - Emerging Technologies**

- "Cooperative Program in Fisheries Molecular Biology (FISHTEC)" - NOAA National Ocean Service - $90,000 - September 1, 2006 to August 31, 2007 (Year 14 of 14) - M. Richard DeVoe (S.C. Sea Grant Consortium). Involves faculty from the University of South Carolina and scientists from SCDNR-Marine Resources Research Institute.

**Strategic Goal 6 - Marine Aquaculture and Fisheries**

- "S.C. Sea Grant Fisheries Extension Enhancement Program" – NOAA National Sea Grant College Program - $78,254 – June 1, 2006 to April 30, 2007 (Year 3 of 5) – M. Richard DeVoe (S.C. Sea Grant Consortium) and Robert H. Bacon (S.C. Sea Grant Extension Program).

- "South Carolina Cooperative Fisheries Research Grant Program" – NOAA Fisheries through the S.C. Department of Natural Resources – $292,500 - (Year 2 of 2) – M. Richard DeVoe (S.C. Sea Grant Consortium).

- *"Commercialization of Bait Shrimp Farming based on Specific Pathogen-free Stocks" - NOAA National Sea Grant College Program – National Marine Aquaculture Initiative - $500,000 – September 1, 2006 to August 31, 2008 – David E. Brune (Clemson University).*

- *"National Initiative for Aquaculture Development and Fishery Enhancement of Cobia" - NOAA National Sea Grant College Program – National Marine Aquaculture Initiative - $356,337 – September 1, 2006 to August 31, 2008 – T.I.J. Smith (S.C. Marine Resources Research Institute).*

**Strategic Goal 7 - Coastal Communities and Economies**

- *"Cooperative Coastal Processes Specialist Extension Position" – Coastal Carolina University – $36,015 – January 1, 2006 to December 31, 2007 (continuing) – M. Richard DeVoe (S.C. Sea Grant Consortium).*

**Strategic Goal 8 - Public Awareness and Outreach**

- "Support for Beach Sweep/River Sweep '06 Activities" - Private Cash Donations - ~$20,000 - September 2006 – Susan Ferris Hill (S.C. Sea Grant Consortium).

- *"Marine Debris: Newspapers in Education" - S.C. DHEC-Ocean and Coastal Resources Management - $35,000 – June 1, 2006 to October 31, 2007 - M. Richard DeVoe (S.C. Sea Grant Consortium) and Lundie Spence (Southeast Center for Ocean Sciences Education Excellence).*

**Strategic Goal 9 - Marine Education and Training**

- "Southeastern Center for Ocean Sciences Education Excellence (COSEE-SE): A Systematic Approach to Forming Ocean Science Education Partnerships" – National Science Foundation (with partial funding provided by the National Oceanic and Atmospheric Administration) – $440,000 – September 1, 2006 to August 31, 2007 (Year 2 of 5) – L. Lundie Spence (S.C. Sea Grant Consortium).

## Communications Metrics

### E. Publications

### Technical Reports

Atlantic States Marine Fisheries Commission. 2006. The Importance of Habitat Created by Shellfish and Shell Beds along the Atlantic Coast of the U.S. Prepared by Coen, L.D., and R. Grizzle, J. Lowery and K.T. Paynter, Jr, contributors, MRD Educational Report number of 21.

Burrows, F., J. M. Harding, R. Mann, R. Dame, and L. Coen. 2005. Restoration monitoring of oyster reefs. Pp. 175-249 in Thayer, G.W., D. H. Merkey, T. A. McTigue, F. M. Burrows, R. J.

Coen, L., K. Walters, D. Wilber, and N. Hadley, 2007. A SC Sea Grant Report of a 2004 Workshop to Examine and Evaluate Oyster Restoration Metrics to Assess Ecological Function, Sustainability and Success Results and Related Information, Sea Grant Publication, 27pp.

Coen, L.D., V. Shervette, and N. Hadley, 2007. Managing Oysters in South Carolina: A Five Year Program to Enhance/Restore Shellfish Stocks and Reef Habitats on Through Shell Planting and Technology Improvements. SC Saltwater Recreational Fisheries License Program Final Report, 124pp.

**Proceedings, Workshops and Symposia**

Brenkert, K. IV, T. I. J. Smith, A. D. Stokes, M. R. Denson, W. E. Jenkins, and C. R. Weirich. 2006. Spawning and larval production of cobia in South Carolina 2001-2005. Proceedings 2nd International Sustainable Marine Fish Culture Conference & Workshop, Harbor Branch Oceanographic Institute, Ft. Pierce, FL.

Hayes, L. "Effects of Impervious Cover on Regional Vegetative Buffer Efficiency: A Demonstration of the Need for Innovative Stormwater Management Technologies", South Carolina Aquatic Plant Management Society, August 16, 2006, Myrtle Beach SC

Hayes, L. "Oak Terrace Preserve - Redevelopment of North Charleston's Century Oaks", South Carolina Association of Stormwater Managers, September 8, 2006, Columbia, SC

Hayes, L. "Tidal Creek Ecosystems: A Case Study & Lessons Learned from a Small Scale", Beaufort County Stormwater Management Utility Board, September, 2006, Beaufort, SC

Hayes, L. "Tidal Creek Ecosystems: A Case Study & Lessons Learned from a Small Scale", Tybee Buffer Ordinance Workshop, November 14, 2006, Tybee Island, GA

Hayes, L. "Tidal Creek Ecosystems: A Case Study & Lessons Learned from a Small Scale", McIntosh County Planning and Zoning Commission Workshop, March 25, 2007, Darien, GA

Hayes, L. "Implementing the Use of Low Impact Development Practices (LIDs) in Coastal, South Carolina", Estuarine Research Foundation, November 4-8, 2007, Providence, RI

Owens, D., R. Day, G. Blanvillain, J. Schwenter (presenter), S. Christopher and W. Roumillat. 2006. Turtles as Physiological Models for Environmental Stress: Can they be "used" as Models and is it Ethical? Book of Abstracts, Twenty sixth annual Symposium on Sea Turtle Biology and Conservation,. M. Frick, A. Panagopoulou, A. Rees, K. Williams Compilers. Crete, Greece. p. 72.http://www.seaturtle.org/ists/

Schwenter, J. (presenter), G. Blanvillain, R. Day, S. Christopher and D. Owens. 2006. Turtles as Environmental Indicators: Using the Diamondback Terrapin (*Malaclemys terrapin*) to Monitor Estuarine Mercury Contamination. Book of Abstracts, Twenty sixth annual Symposium on Sea Turtle Biology and Conservation,. M. Frick, A. Panagopoulou, A. Rees, K. Williams Compilers. Crete, Greece. p. 279. http://www.seaturtle.org/ists/

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Von Harten, A. 2006. Making the Fisheries Extension Connection: S.C. Sea Grant Extension and the S.C. Commercial Shrimp Industry Crisis. Proceedings from the Annual joint meeting of the S.C. Fishery Worker's Association and the S.C. Chapter of The American Fisheries Society. February 16-17, 2006. Charleston, SC.

Von Harten, A., S. Baker, L. Liguori, C. Adams, February 21-22, 2007. South Atlantic Sea Grant Regional Fisheries Extension & Enhancement Project: REGIONAL FISHERY MANAGER'S MEETING - BLUE CRAB Meeting Summary.

Wind Loads on Single-Family Dwellings in Suburban Terrain - Comparing Field and Wind Tunnel Simulation, Proceedings of the 2006 SEI Structures Congress Structural Engineering and Public Safety, May 18-20, 2006, St. Louis, MO.

Wind Load Determination Using Field Data and Wind Tunnel Studies on Residential Buildings, Proceedings of the Fourth LACCEI International Latin American and Caribbean Conference for Engineering and Technology (LACCET'2006) "Breaking Frontiers and Barriers in Engineering: Education, Research and Practice" 21-23 June 2006, Mayagüez, Puerto Rico.

**Brochures, Fact Sheets, Posters**

Arthur, Courtney. 2007. Poster presentation. Diamondback terrapins and mercury: the who, what, how, where and why of using Malaclemys terrapin as an estuarine sentinel species. International Sea Turtle Symposium, 25 February 2007, Myrtle Beach, SC. In press.

Anderson, WD, WA Cox and JM Whetstone. 2006. Returning to Saltwater Pond Culture of *Crassostrea virginica*. *Meeting proceedings.* National Shellfisheries Association.

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Denson, Michael R., Wallace E. Jenkins, Kent Ware, Alvin Stokes, Jack Whetstone, TheodoreI.J. Smith. An overview of South Carolina's red drum stocking program. World Aquaculture 2007 – National Shellfisheries Association.

Denson, Michael R., Wallace E. Jenkins, Theodore I.J. Smith, Jack Whetstone. Occurrence of Stocked Red Drum *Sciaenops ocellatus* in the Adult Population. World Aquaculture 2007, National Shellfisheries Association.

Hadley, N. H. and J.M. Whetstone. Northern Quahog Clam Hatchery Techniques. *Monograph.* Southern Regional Aquaculture Center Factsheet Series.

Hadley, Nancy H. and Jack M. Whetstone. Hatchery and Nursery Production of the Hard Clam (*Mercenaria mercenaria*). Summer 2007. Southern Regional Aquaculture Center Factsheet Series.

Smith, Jenkins, Denson, Heyward, Stokes and Whetstone. 2005. South Carolina's Approach to Restoring Red Drum Abundance. Aquaculture America 2005.

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and Nursery Studies with Black Sea Bass and Cobia in South Carolina. 2006. Aquaculture America 2006.

Whetstone, J.M., Anderson, Battey, DeVoe, Krauter and Segars. 2005. Development of Eastern United States Interstate Shellfish Seed Transport Regulations. Aquaculture America 2005.

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Whetstone, J.M., Leslie Sturmer and Michael Oesterling 2005. Biology and culture of the hard clam (*Mercenaria mercenaria*). Southern Regional Aquaculture Center Factsheet Number 433.

**Books/Monographs**

Kleppel, G.S., M.R. DeVoe and M.V.Rawson, 2006. *Changing Land-use Patterns in the Coastal Zone: Managing Environmental Quality in Rapidly Developing Regions*. Springer Series on Environmental Management. Springer-Verlag, New York, NY. 305 p.

Whetstone, J. 2006. Aquatic Weed Control in Irrigation Water Supplies. pp. 99-102. In: B. McCarty, ed., 2006 Pest Control Guidelines for Professional Turfgrass Managers. EC699, *Monograph*. Clemson Univ. 114pp.

**Peer-reviewed Journal Articles/Book Chapters**

Blanvillain G, J.A. Schwenter , R. D. Day, D. Point , S. J. Christopher, W. A. Roumillat and D.W. Owens.(2007) Diamondback terrapins, *Malaclemys terrapin*, as a sentinel species for monitoring mercury pollution of estuarine systems in South Carolina and Georgia, USA. Environmental Tox. and Chem., Vol. 26, No. 1441-1450.

Bolton-Warberg, M., L.D. Coen and J. Weinstein. 2006. Acute toxicity and acetylcholinesterase inhibition in grass shrimp (*Palaemonetes pugio*) and oysters (*Crassostrea virginica*) exposed to the organophosphate dichlorvos: laboratory and field studies. Archives of Environmental Contamination and Toxicology.

Brumbaugh, R.D. and L.D. Coen, in review. Approaches for small-scale oyster reef restoration to address recruitment vs. substrate limitation. J. Shellfish Res. Special Issue.

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Keppler, C.J., A.J. Lewitus, A.H. Ringwood, J. Hoguet and T. Staton. 2006. Sublethal cellular effects of short-term raphidophyte and brevetoxin exposures on the eastern oyster Crassostrea virginica. Marine Ecology Progress Series 312:141-147.

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**Videos/CDs/DVDs**

*See Communications report below.*

**Maps/Charts**

*None.*

**Handbooks/Manuals/Guides**

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Childress, M.J., E. Wenner and L. DeLancey. 2007. SCBCRABS: South Carolina Blue Crab Regional Abundance Biotic Simulation - User Manual Version 1.0. South Carolina Sea Grant Consortium. pp 49.

Halfacre-Hitchcock, A., and D. R. Hitchcock. 2005. Critical Line Buffer Ordinances: Guidance for Coastal Communities. Water Quality Improvement and Community Enhancement Series, SCDHEC-OCRM, 72 pp.

Salz, and P. F. Gayaldo, eds. Science-based Restoration Monitoring of Coastal Habitats. Volume Two: Tools for Monitoring Coastal Habitats. NOAA Coastal Ocean Program, Decision Analysis Series No 23. NOAA National Centers for Coastal Ocean Science, Silver Spring, MD. 628 pp. plus appendices.

Whetstone, J.M. 2005. Aquatic Weed Control in Irrigation Water Supplies. pp. 99-104. In: B. McCarty, ed., 2005 Pest Control Guidelines for Professional Turfgrass Managers. EC699, Clemson Univ. 114pp.

Whetstone, J. 2006. Aquatic Weed Control in Irrigation Water Supplies. pp. 99-102. In: B. McCarty, ed., 2006 Pest Control Guidelines for Professional Turfgrass Managers. EC699, Clemson Univ. 114pp.

Whetstone, J.M. 2007. Aquatic Weed Control in Irrigation Water Supplies. pp.99-102. In: B. McCarty, ed., 2007 Pest Control Guidelines for Professional Turfgrass Managers. EC699, Clemson Univ. 114pp.

**Electronic Publications**

*See Communications report below.*

**Theses/Dissertations**

Buschur, J.M. 2007. Benzalkonium chloride photodegradation resistance, adsorption qualities, and toxicological effects on estuarine phytoplankton. M.Sci. Thesis, Marine Science Program, University of South Carolina, Columbia, SC.

Denson, M.R., W. E. Jenkins, D. L. Berlinsky and T. I. J. Smith. 2007. A comparison of human chorionic gonadotropin and luteinizing releasing hormone analogue hormone for ovulation induction in black sea bass *Centropristis striata* (Linnaeus (1758). Aquaculture Research 38:918-925.

**Newsletters/Periodicals**

*See Communications report below.*

**Media Placements**

*See Communications report below.*

**Other**

Blanvillain, Gaëlle, J. A. Schwenter, R. D. Day, M. M. Peden-Adams, S.J. Christopher and D. Owens. (NIST Review). Health impairment of a diamondback terrapin (*Malaclemys terrapin*) population at a superfund site in Brunswick, GA, USA. In review with NIST prior to submission.

Carnegie, R.B., N.A. Stokes, C. Audemard, E.M. Burreson, M.J. Bishop, C.H. Peterson, A.E. Wilbur, T.D. Alphin, M.H. Posey, and L.D. Coen, in prep. An introduced pathogen acquires a native oyster host: *Bonamia* sp. parasitism of *Ostreola equestris* on the Southern Atlantic coast of the USA

Turner, A.L. 2005. Coastal Development Mini Grants. CCD Bulletin: Issues in Community Development, v.5 (May, 13 2005);1-2.

Walters, L.J., P.E. Sacks, M.Y. Bobo, D.L. Richardson and L.D. Coen, 2007. Impact of hurricanes on intertidal oyster reefs in Florida: reef profiles and disease prevalence. Florida Scientist.

## E.2. Total Number of Publications

| Category | Number of Publications |
|---|---|
| Technical reports | 4 |
| Proceedings and symposia (research) | 14 |
| Brochures, fact sheets, posters | 12 |
| Books, monographs | 2 |
| Peer-reviewed journal articles & book chapters | 35 |
| Videos/CDs/DVDs | - |
| Maps and charts | - |
| Handbooks/manuals/guides | 7 |
| Electronic publications | - |
| Thesis and Dissertations (research) | 2 |
| Newsletters and periodicals (# of issues) | 9 |
| Media placements/Press releases | - |
| | |
| Presentations (research and extension) | 89 |
| Publications planned (research) | 11 |
| Web sites (internal and external) | 9 |

**Communications and Information Services – Publications and Products 2006-2007**

The Consortium's Communications and Information Services (CIS) program generated the following:

| CIS Statistics | Number |
|---|---|
| On-line Publication Requests | 1,371 |
| General Publication Requests | 3,097 |
| Media Requests | 20 |
| Media Placements | 235 |
| Number of Web site hits (see Figure below)<br>Number of Web site unique visits | 1,836,178<br>287,392 |
| Number of PDF Downloads of Consortium publications from National Sea Grant Library Web site | 3,120 |
| Publications and Information Products (Note: Information products are listed below according to the strategic plan objectives they support.) | 47 |

Ecosystem Dynamics –

- 2006 International Conference on Shellfish Restoration conference materials: Web site information, pre-announcement, second announcement, 90-page conference program with three inserts, hats, and t-shirts.
- S.C. Task Group on Harmful Algae Web site (www.scseagrant.org/oldsite/schab/index.htm). This site will be converted to a database-driven site.
- *South Carolina Coastal Wetland Impoundments*, a State of Knowledge technical report by Daniel L. Tufford is currently in production.

Coastal Ocean Studies –

- *Meeting the Needs of Southeastern Coastal Resource Managers through Coastal Ocean Observing Systems*, a CSO/SECOORA technical report by B.C. Davis and E.A. McDonald.
- Name badges for the Southeast Coastal Ocean Observing Regional Association workshop September 12-13, 2006.
- Binder cover sheet for the Southeast Coastal Ocean Observing Regional Association workshop September 12-13, 2006.

Climate and Hazards –

- *Coastal Heritage: After the Storm*, Volume 20, Number 4, Spring 2006
- *Coastal Heritage: Rising Tide—Will Climate Change Drown Coastal Wetlands?,* Volume 21, Number 3, Winter 2007.
- *Q&A on Purchasing Coastal Real Estate in South Carolina,* jointly published by SCSGC, S.C. Department of Environmental Control Office of Ocean and Coastal Resource Management, and S.C. Department of Natural Resources.

Fisheries and Aquaculture –

- Name badges for the National Sea Grant Fisheries Extension workshop September 2006.

Marine Education –

- 2006 Beach Sweep/River Sweep materials: t-shirts, mesh bags, patches for Scouts, and other assorted communications pieces.
- Center for Ocean Sciences Education Excellence—Southeast promotional product: Earth—The Water Planet.
- Center for Ocean Sciences Education Excellence—Southeast t-shirt
    - *Coastal Heritage Curriculum Connection,* a companion teacher activity guide for *Coastal Heritage*, Vol. 20, No. 4, Spring 2006, “After the Storm.”
    - *Coastal Heritage Curriculum Connection,* a companion teacher activity guide for *Coastal Heritage*, Vol. 21, No. 1, Summer 2006, “African Roots, Carolina Gold.”
    - *Coastal Heritage Curriculum Connection,* a companion teacher activity guide for *Coastal Heritage*, Vol. 21, No. 2, Fall 2006, “Discovery Learning Comes of Age.”
    - *Coastal Heritage Curriculum Connection,* a companion teacher activity guide for *Coastal Heritage*, Vol. 21, No. 3, Winter 2007, “Rising Tide: Will Climate Change Drown Coastal Wetlands?”
    - Newspapers in Education marine debris insert in *The Post and Courier* for middle- and high-school teachers and students. Assisted with content and photographs, edited content for AP style, organized the files for *The Post and Courier*, and proofread the 16 page supplement. Published August 29, 2007, distributed to newspaper subscribers and educational insert subscribers; is also available for purchase from *The Post and Courier*.

History and Culture –

- *Coastal Heritage: African Roots, Carolina Gold*, Volume 21, Number 1, Summer 2006.
- Reprinted *Coastal Heritage: The Living Soul of Gullah* (Volume 14, Number 4, Spring 2000) and *Coastal Heritage: Gullah’s Radiant Light* (Volume 19, Number 3, Winter 2005-05).

Public Engagement –

- Aggressive, targeted distribution of *Coastal Heritage* and other products at pertinent events.
- S.C. Sea Grant exhibit, Winyah Bay Heritage Festival, Georgetown, January 2007, 2,000 attendees.
- S.C. Sea Grant exhibit at Kiawah Island Disaster Awareness Day, June 2006.

- 2006 Beach Sweep/River Sweep volunteer-driven litter cleanup held Saturday, September 16, 2007. This 18th annual, statewide event recruited nearly 5,000 volunteers who covered over 1,050 miles in 38 of 46 South Carolina counties. 33.5 tons of debris was removed and recycled. Beach Sweep/River Sweep is supported by private sector donations.

Building visibility and support for S.C. Sea Grant's program and activities –
- Eight electronic forms for SCSGC FY08-10 Request for Proposals for SCSGC Web site
- PDF of FY08-10 Request for Proposals for SCSGC Web site
- FY08-10 Request for Proposals printed postcard
- FY06-08 Omnibus proposal binders
- Updated SCSGC collateral material: letterhead, pocket folders, staff business cards
- Hired a graphic artist in March 2006
- *Inside Sea Grant*, Volume 9, Number 2, Summer 2007. This publication has been re-formatted to include more newsworthy items and is currently in production
- South Carolina Sea Grant Consortium Biennial Report 2004-2006 is currently in production.
- Conversion of the SCSGC Web site from static .html-based site to database-driven site (www.scseagrant.org).
- Updates to S.C. Non-point Education for Municipal Officials Web site, which will be converted to a database-driven site (www.scseagrant.org/oldsite/scnemo.htm).

Building visibility and support for the National Sea Grant network –
- Hurricane portal on the HazNet site (www.haznet.org).

**F. Students Supported**

| Category | Number of New Students | Number of Continuing Students | Number of Degrees Awarded |
|---|---|---|---|
| Knauss Fellowship | 2 | 2 | NA |
| Industry Fellowship | 0 | 0 | NA |
| NMFS/SG Fellowship | 0 | 0 | NA |
| State Fellowship | 0 | 0 | NA |
| Coastal Mgt. Fellows | 0 | NA | NA |
| SG Supported MS/MA Students | 15 | 4 | 11 |
| SG Supported PhD Students | 4 | 3 | 1 |
| SG Supported<br>Juris Doctor Students<br>Engineering Students | <br>3<br>2 | <br>0<br>1 | <br>3<br>1 |
| SG Supported Under-graduate Students | 6 | 2 | 5 |
| Other (e.g., Interns) | 7 | NA | 3 |
| **TOTAL** | **39** | **12** | **24** |

## F. Program Awards

*Coastal Heritage* is recognized by its peers as an excellent publication, and has garnered the following awards:

- 2006 Notable State Document Award from the South Carolina State Library. Only 10 of these awards are given each year, and they "recognize state governmental publications of outstanding merit and usefulness to the citizens of South Carolina."
- Two prestigious awards from the Society for Technical Communication (STC) Carolina Chapter for 2006-2007: Best of Show and Distinguished awards. According to the STC judges, "*Coastal Heritage* is well-written, well-designed, and of considerable interest. The quality is very high overall and it was obvious that care was taken with the conception and follow-through for all the articles."
- Two awards in the 2006-2007 Council for the Advancement and Support of Education (CASE) District III competition: an Award of Merit in the Low Budget Publication category; and Award of Merit in the Other Magazines category.
- A 2007 APEX Award for Publication Excellence from Communication Concepts, a professional development organization for communicators.