

Science Serving Coastal Mississippi and Alabama

Introduction

Founded in 1972, the Mississippi-Alabama Sea Grant Consortium (MASGC) is an organization of nine universities and laboratories supporting scientific research, education and outreach programs that foster the conservation and sustainable development of coastal and marine resources in Alabama and Mississippi. Coordinated by a central administrative unit in Ocean Springs, MS, the Consortium members include Auburn University, Dauphin Island Sea Lab, Jackson State University, Mississippi State University, The University of Alabama, The University of Alabama at Birmingham, The University of Mississippi, The University of Southern Mississippi, and the University of South Alabama. The Consortium has an extension program with offices in Biloxi, Mississippi and Mobile, Alabama and a legal program located at The University of Mississippi.

This report documents progress on the third year of the 2001–2003 Omnibus program under NOAA Grant #NA16RG2258 which began February 1, 2003, and ended on January 31, 2004.

Objectives of the MASGC program include working with organizations interested in the sustainability of coastal resources, promoting strategic assets of the program and its quality pool of investigators, and integrating programmatic efforts with those of research and education institutions to produce greater benefits for the coastal communities being served. The key to achieving results is in our approach of effective partnering, efficient management of program resources, and making prudent investments in program development.

Program development funds are used to initiate single and multi-institutional projects with the intention of seeding efforts resulting in larger proposals for submission to other federal, state, local, industry, or non-traditional Sea Grant sponsors. Funds are also used to address pressing issues of common interest in the coastal zones of Alabama, Mississippi, and the northern Gulf of Mexico by sponsoring workshops and symposia that bring experts together to formulate solutions.

The MASGC 2001–2003 Omnibus program began February 1, 2001. Included in this omnibus are sixteen projects: two in Advanced Technology, three in Seafood Production, three in Coastal Ecosystem Health, and seven Education and Human Resources projects, as well as the Program Administration and Program Development projects.

Programmatic Accomplishments and Impacts

MASGC is committed to interdisciplinary environmental scholarship, applied environmental research, and community-based natural resources management. MASGC supports applied, interdisciplinary marine science research and extension efforts using both targeted and cross-cutting approaches that foster the sustainable development and management of the Alabama and Mississippi coastal regions and Economic Exclusive Zone (EEZ). The National Sea Grant Program has three broad priority areas. The MASGC has four specific strategic areas that fall under these categories. These strategic areas include: Coastal Ecosystems and Habitats, Sustainable Fisheries, Marine Biotechnology and Industrial Ecology, and Marine Education, Outreach, and Human Resources.

Funding

During program year 2003–2004 MASGC received \$1,202,000 from the National Sea Grant Office core allocation with \$767,378 in matching funds with an additional \$100,000 added for year three funding of the National Sea Grant Law Center and \$125,935 added for the Regional Center for Ocean Sciences Education Excellence (COSEE) - Central Gulf of Mexico. MASGC also sponsored four projects through program development funds totaling \$48,861. (Appendix A).

Both the EPA’s Gulf of Mexico Program (GOMP) and NOAA’s Mississippi-Alabama Sea Grant Consortium (MASGC) have identified the threat of aquatic nuisance species (ANS) as a priority area for their activities for the northern Gulf of Mexico region. As a result, a funding partnership was developed between the MASGC and the EPA GOMP to develop a joint request for proposals for the 2001–2003 Omnibus. Each program contributed \$100,000 with an additional \$20,000 provided to MASGC by the GOMP for program administration. The number of projects was limited to five awards of approximately \$40,000 each. The required match of one non-federal dollar for every two dollars of federal funding was applied.

Publications

This reporting period covers year three of the 2001–2003 Omnibus. During the current reporting period, MASGC sponsored research that led to 34 manuscripts, 14 abstracts, and 15 presentations. Extension, Legal Program, and Communications production included 5 manuscripts, 2 abstracts, 30 presentations, 9 Legal Reporters, 16 newsletters, 2 outreach publications, and 1 workshop. Several other research, education, and outreach publications are in various stages of development.

Student Support

MASGC-sponsored research provides more than support for scientific discovery. Each research project also leads to the training of America’s next generation of scientists who appreciate the role Sea Grant has in “Science Serving America’s Coasts.” During the third year of this Omnibus, MASGC sponsored research has led to the training of 9 Ph.D., 9 M.S., and 6 J.D. candidates.

The MASGC Fellowship Program provided \$5,000 support to the following graduate students through “other source” funds:

Jeffrey J. Buler, The University of Southern Mississippi, Ph.D. candidate
Matthew W. Johnson, University of South Alabama, Ph.D. candidate
Jason P. Stutes, University of South Alabama, Ph.D. candidate.

MASGC sponsored two Dean John A. Knauss Legislative Fellows during the period of 02/01/03 through 01/31/04. Ms. Melissa Woods from the University of South Alabama served in Congressman Ron Kind’s Office and Mr. Julien Lartigue, also from the University of South Alabama, served in the office of Senator Ron Wyden (OR).

Exemplary Impacts

R/AT-1 - Identification and Isolation of Oyster Genes Resistant to Pollutants Using Genechip Technology. John Liu, Ph.D., David B. Rouse, Ph.D., Rex A. Dunham, Ph.D. and Richard K. Wallace, Ph.D., Auburn University.

The objectives of this project were to develop oyster cDNA microarray technology for study of genomic expression signatures (GES) in response to environmental agents; particularly the genes affected by mercury exposures, and to study the biological impact of mercury exposures to oysters.

Two cDNA libraries were made from the oyster tissues of gill and gonads. These gene libraries represent a whole collection of all expressed genes in the gill and in the gonad, respectively. A total of 4,572 cDNA clones were sequenced, generating 4,348 expressed sequence tags (ESTs) (95.1% success rate). All these ESTs have been submitted to dbEST. The ESTs had an average length of 641 bp. Combined with the existing oyster ESTs, a total of 5,206 ESTs are now available in the dbEST database from *C. virginica*. This work accounted for over 83% of ESTs available from the eastern oyster. These ESTs should be useful for studies of environmental pollution and stress biology as biomarkers.

R/SP-1 - Evaluation and Applications of Methodologies for Rapid Detection and Elimination/Reduction of *Vibrio vulnificus* and *V. parahaemolyticus* in Shellfish. Asim K. Bej, Ph.D., The University of Alabama at Birmingham.

Rapid Detection of *Vibrio vulnificus* in Shellfish and Gulf of Mexico Water Using Real-time PCR - Detection of a single cell of *V. vulnificus* in 1 g of enriched oyster tissue homogenate is in compliance with the recent Interstate Shellfish Sanitation Conference guidelines. The entire detection method, including sample processing, enrichment, and real-time PCR amplification, was completed within 8 h, making it a rapid single-day assay. Rapid and sensitive detection of *V. vulnificus* would ensure a steady supply of postharvest treated oysters to consumers, which should help decrease the number of illnesses or outbreaks caused by this pathogen.

Detection of Pathogenic Bacteria in Shellfish Using Multiplex PCR Followed by Covalink™ NH Microwell Plate Sandwich Hybridization - The results from this study showed that the combination of the multiplex PCR with a colorimetric microwell plate sandwich hybridization assay permits a specific, sensitive, and reproducible system for the detection of the microbial pathogens in shellfish, thereby improving the microbiological safety of shellfish to consumers.

Evaluation of Market Sauces on *Vibrio parahaemolyticus* and *V. vulnificus* - Treatment of *V. parahaemolyticus* with common food sauces yielded two possible choices for oyster treatment. Both Búfalo hot sauce and soy sauce contain the preservative sodium benzoate. It is suspected that this organic compound is responsible for completely eliminating viable cells in either exponential or stationary cultures. Similar results were obtained when applied on *V. vulnificus* cultures. Testing of soy sauce on half-shelled oysters exhibited reduction of total bacterial counts and these pathogens up to 3–4 fold. Additional experiments are being conducted to determine the effectiveness of soy sauce.

R/SP-2 - Nutritional Strategies for the Maturation and Rearing of Red Snapper. D. Allen Davis, Ph.D. and Ronald P. Phelps, Ph.D., Auburn University.

The red snapper is a commercially important species in terms of wild capture and aquaculture potential. Consequently, there has been considerable interest in developing culture technologies for this species. In general, snapper are a very difficult species in which to control maturation and larval rearing. Hence, there are several projects that are being conducted at various research institutes designed to develop culture technologies. This project is geared to integrate with other research projects and provide information on maturation diets and the nutritional requirements of red snapper.

Two growth trials were successfully completed using subadult red snapper. The first trial evaluated diets containing 32-44% protein over a 10-week growth trial and the second trial evaluated dietary lipid levels of 8-14% in a 32% protein diet. With respect to protein, there were no significant differences observed in growth, survival, or feed utilizations. The addition of graded levels of lipids also resulted in minimal differences in growth or survival but resulted in increasing deposition of fat. Based on the observed results, both juvenile and subadult fish do not require high protein or lipid diets. Therefore, lower protein levels equal lower cost diets.

R/SP-3 - Development of Techniques for Inland Saltwater Shrimp Farming. D. Allen Davis, Ph.D., David B. Rouse, Ph.D., and Claude E. Boyd, Ph.D., Auburn University.

Inland production of shrimp provides an alternative to traditional coastal culture where land costs and user conflicts can inhibit commercial development. A high potential exists in western Alabama for producing marine shrimp in low salinity water. Many questions concerning nursery management and pond production in low salinity waters are not addressed in published reports, and need to be researched and demonstrated to producers in order to stimulate and strengthen the development of inland shrimp culture.

To continue the evaluation of the influence of nursery management on pond production, comparison was made of the effects of direct stocking and nursing of shrimp on survival, individual shrimp size and total production when the pond culture period was of equal length. At the conclusion of the 16 weeks of pond culture, there were no significant differences in survival, final weight, or production. Nursed shrimp were larger than the direct stocked but not significantly. The lack of differences is presumably due to low temperatures during the nursery phase, giving the nursed shrimp only a moderate size advantage combined with the high variability in pond results. Overall, the use of a nursery clearly extended the period for which post-larval shrimp can be obtained and it did provide some size advantage. Over 200 acres of inland shrimp ponds produced 3,000 pounds of shrimp per acre.

R/CEH-3 - Patterns of Habitat Use of Gulf Sturgeon (*Acipenser oxyrinchus desotoi*) in the Northern Gulf of Mexico. Stephen T. Ross, Ph.D., The University of Southern Mississippi and William T. Slack, Ph.D., Mississippi Museum of Natural Science.

Sonic tags will be attached to Gulf sturgeon during the freshwater phase of their life history in order to determine movement and habitat use in coastal waters of Mississippi and adjoining regions and to characterize benthic habitats used by Gulf sturgeon in coastal waters in terms of bottom type, water quality, and major prey taxa.

Telemetry data organized by sampling day from 1999–2004 show that Gulf sturgeon occupy the north-central Gulf of Mexico, including Mississippi Sound, primarily from November through March, with a few fish beginning to enter the marine environment in October. The majority of locations of Gulf

sturgeon in the marine environment were in the region of the barrier islands; particularly the barrier island passes. The data are based on all locations of Gulf Sturgeon in the marine environment, including relocations of the same fish in different months but not within the same month. Overall, 48 different fish are represented. Locations of Gulf Sturgeon within lower river channels are not included. The next most common location was in or near the Pascagoula estuary, but only during the time when fish are migrating from fresh to salt water. Although inshore locations in the Mississippi Sound were searched, with few exceptions, Gulf sturgeon have not been located in these areas, other than in the Pascagoula River estuary. Based on limited offshore searches, Gulf Sturgeon were not located in offshore areas south of the barrier islands.

Gulf sturgeon locations were generally shallow, averaging slightly over 4 m deep and none were found deeper than 6.6 m. Other variables showed wide variation typical of the dynamic nature of the barrier island passes that dominated the locations.

R/CEH-4 - *Relative Importance of Seagrass versus Epiphytes in Food Webs Based on Long-term ¹⁵N-Enrichment.* Michael J. Sullivan, Mississippi State University and Brian Fry, Louisiana State University.

The main goal was to evaluate responses of food webs within seagrass communities to eutrophication. There were three main objectives: to develop and test an isotope addition technique that would modify the $\delta^{15}\text{N}$ values of seagrass leaves and epiphytes so that they were distinct, to determine the relative effect of eutrophication on the growth and productivity of *Halodule wrightii* and its epiphytes, and to determine the relative contribution of the added nitrogen to the food web by seagrass and its epiphytes.

Despite the uncertain nature of the trophic relationships, the success of the isotope modification has revealed an unanticipated application. Label uptake by the consumers is impressive considering the tremendous jump in complexity from mesocosm to natural system experiments. The consumers containing label combined with the small size of the experimental beds suggest that individuals remain within or return to these beds over long periods of time. The isotope manipulation technique has potential application to address a variety of questions about the movement of organisms within and among beds. Isotope additions could essentially be used as a method for mark and recapture experiments, and thereby help to identify the necessary size and distance among experimental beds to ascertain that they are independent. This technique provides an opportunity to evaluate what would normally be impossible for small aquatic organisms in natural communities.

ED-1 - *The ABCs of Wetlands - An Environmental Learning Experience.* David L. Scott, Mobile County Public School System and Richard K. Wallace, Auburn University.

At the beginning of each project year, participants attended a one-day workshop at the Environmental Studies Center focusing on content skills and teaching strategies to prepare their students for field trips to follow later in the year. The workshop engaged teachers in first-hand study of various wetland habitats, including a carnivorous plant bog, bottomland forest, and the shoreline of a freshwater lake. The participants were guided through the Center's live animal exhibits where they encountered numerous examples of species native to coastal wetland areas. Examples were observed illustrating the effects of exotic species on wetland habitats, as well as other threats to these valuable natural resources. The workshop also served to introduce teachers to several examples of marine life common to the Caribbean and Gulf of Mexico.

Project implementation focused on four major areas of activity: teacher training, resource development and distribution, student field trips, and maintenance of teaching exhibits. Total participation over the three year period of the project involved 107 teachers and 1,814 students from 52 elementary schools.

EX-3 - Mississippi-Alabama Sea Grant Extension Program. C. David Veal, Mississippi State University, and Richard K. Wallace, Auburn University.

Ocean Springs Birding Trail - Begun as a joint project between the Land Trust for the Mississippi Coastal Plain, the Mississippi Coast Audubon Society, and the Mississippi Master Naturalist program, this project consists of the development of a series of public and private natural areas within the city of Ocean Springs into the Ocean Springs Birding Trail. Each site will have informational kiosks that describe the significance of the site and information on the rest of the trail. The Ocean Springs Birding Trail will be linked to the wider Mississippi Coastal Birding Trail that is currently under development. Local funding from the City of Ocean Springs and private donations will support the construction of kiosk, foot bridges, and other structural components, many of which will be planned and built as part of Boy Scout Eagle projects.

Extension projects having an impact on the reduction of nonpoint source pollution include - With support from Jackson County Master Gardeners and Mississippi Master Naturalists, extension personnel coordinate a team of extension professionals and volunteers focused on designing plans to landscape the Pelican Landing Conference Center and the Moss Point Center for Sustainable Development. Both sites are owned and operated by the City of Moss Point and are being promoted as examples of public facilities that incorporate sustainable and compatible landscape designs.

Dr. Mark LaSalle serves as the chair of the “Nature Area” development subcommittee of the Beauvoir Botanical Gardens project in Biloxi. With the assistance of a number of Coastal Master Naturalist volunteers, extension personnel have guided the development of a plan to restore the nature trail area with the “Primitive Forest” portion of Beauvoir as well as a plan to restore a portion of the Oyster Bayou lagoon system to a bayhead swamp drainage system. This system will serve to treat stormwater effluent from Beauvoir and a large portion of the surrounding Biloxi area.

Sea Grant extension personnel serve as the facilitator for the Coastal Alabama Clean Water Partnership, a stakeholder group whose mission is “Working to protect, improve, and maintain water quality in Alabama’s Coastal River Basins by meeting the goals of the Clean Water Act through basin-wide public/private partnerships.” The Juniper Creek Restoration Project, completed in 2003–2004, implemented innovative waste management techniques on a dairy farm. The first use of these techniques in Alabama, it is anticipated that it will reduce pathogen loadings in Juniper Creek which is listed on the Alabama List of Impaired Water Bodies for pathogen.

The Sea Grant Extension Program was instrumental in the creation of an Alabama Stream Restoration Committee, in partnership with the Alabama Department of Environmental Management, Alabama Cooperative Extension System, and Mobile Bay National Estuary Program. This group is working to identify stream channel restoration needs and coordinate restoration activities throughout Alabama. Over the past year, two workshops were held in coastal Alabama. Forty people attended “Introduction to Stream Restoration Using Natural Channel Design,” and twenty attended “Performing a Feasibility Study: Coastal Stream Assessment and Field Techniques.” These workshops build technical capacity in agencies and professionals from Alabama, Mississippi, Florida, and other states.

Coastal Community Growth and Development - The Sea Grant Extension Program is participating in a broad-based effort to designate a Coastal Alabama Scenic Byway, showcasing cultural and natural resources, and is co-sponsoring the Healthy Coastal Community Initiative (HCCI) with the Mobile Bay National Estuary Program. The goal of this project is to promote the principles of smart growth and low impact building design in coastal Alabama. HCCI sponsored a low impact design charrette, which drew 40 landscape architects and building professionals. A survey of municipal officials was completed to gauge interest and knowledge of smart growth and low impact design issues. Extension personnel are currently assisting in the coordination of a Smart Growth Conference to be held in Spring 2004 and a Transportation Summit to be held in Summer 2004.

Gear Technology Transfer - Technology transfer programming was provided to the shrimp fleet in the northern Gulf regarding the use of turtle excluder devices (TEDs) and bycatch reduction devices (BRDs). New TED regulations requiring the use of larger escape openings became effective in the Gulf on August 21, 2003. Many shrimpers experienced production losses as a result of modifications made to existing TEDs in order to meet the new requirements. A partnership was established with the National Marine Fisheries Service Harvesting Systems Branch in Pascagoula to distribute new TEDs to offshore boats for demonstration purposes. One TED was provided to each of 80 boats to use in comparison with their existing TEDs (normally 4 TEDs are used at a time) so that fishermen could compare catch rates between the new TEDs and their existing gear. Reductions in unwanted bycatch of up to 50 percent with no loss in shrimp production have been documented. Over 100 dockside demonstrations were conducted showing fishermen how to comply with federal and state fishery management regulations while minimizing production losses and downtime.

Aquaculture - Extension personnel assisted the teachers and administrators of the Mobile County Public School System in expanding the existing high school aquaculture programs at Alma Bryant High School. Middle school aquaculture programs were initiated within Mobile County at Clarke School of Math and Science and Alba Middle School. In Baldwin County, the development of Fairhope High School's aquaculture and aquaponics program continued. New programs in this county include that of Baldwin County High School, Summerdale Middle School, and Daphne High School. The end of 2003 brought the number of schools in Mobile and Baldwin counties (AL) in which Sea Grant has a presence to seven.

L-2 - Marine Habitat Conservation: Law and Policy Outreach. Kristen M. Fletcher, J.D., LL.M. and Richard J. McLaughlin, J.D., LL.M., J.S.D., The University of Mississippi. Project closed 04/30/04.

The staff of the Legal Program responded to marine habitat-related advisory requests regarding conservation easements, marine protected areas, and activities related to Mississippi Coastal Preserves. Research was conducted on marine protected areas in the Gulf of Mexico, conservation easements in Alabama and Mississippi, and essential fish habitat. Results of the fisheries research were published as a law journal article. Two reports were published in-house: *Marine Protected Areas in the Gulf of Mexico: A Survey* and *A Citizen's Guide to Conservation Easements in Alabama and Mississippi*.

C-1 - Program Communications. Timothy H. Reid, Mississippi-Alabama Sea Grant Consortium.

The Alabama-Mississippi Clean Marina Program - The Clean Marine Program is a non-regulatory program whose goal is to promote and reward responsible marinas for utilizing best management practices to protect the land and water surrounding the marina. In addition, the program reaches out to boaters and other water enthusiasts to encourage stewardship of area waters. Based on strong participation and interest received at an MASGC-sponsored marina workshop in April 2003, a bistate Alabama-Mississippi Clean Marina Program (CMP) was developed over the following 12 months. MASGC's

Communications Coordinator spearheaded this development with input from a 30-person CMP Advisory Committee and a CMP Management Team. In addition, assistance was sought from the established CMPs located in Florida and Texas. Funding partners included MASGC, Mississippi Department of Marine Resources (DMR), Alabama Department of Natural Resources, Alabama Department of Environmental Management and the Mobile Bay National Estuary Program. During the fall and winter of 2003–2004, the CMP was promoted through informal group and individual presentations. As of January 2004, four marinas had signed a written pledge to work towards the Clean Marina designation within the next year and more are expected to follow.

Impact Statements - During February–April 2003, the MASGC Communications Program developed and produced a series of 12 informational sheets for the purpose of disseminating the highlights of MASGC accomplishments of the past four years. This series targeted the strength of MASGC strategic areas such as water quality, mercury in seafood, aquaculture, seafood safety, and marine natural products. The results of the distribution of these Impact Statements is an increase in interest in our program from the general public and the media; increase in interest from local agencies in potential partnership opportunities; and an increase in the education of our policy makers and legislators in the significant results that MASGC-funded projects have produced in the last four years.

R/CEH-8 - *Deriving the Origin and Nature of the Invasive Jellyfish, *Phyllorhiza punctata*, Through Molecular Studies of Native and Non-Native Populations.* NOAA Scientist - Barry A. Costa-Pierce, Ph.D. (replaced by D. LaDon Swann, Ph.D.), Mississippi-Alabama Sea Grant Consortium and Lead Scientist, William M. Graham, Ph.D., Dauphin Island Sea Lab. (Pass-through funding from OAR)

The primary objective is to determine whether the Gulf of Mexico population of *Phyllorhiza punctata* is separate and reproductively distinct from Caribbean populations on a molecular level. Such separation implies reproductive isolation. If it is determined that the Gulf population is distinct from Caribbean populations, then we must entertain the likelihood that the major occurrence in 2000 developed from a smaller, cryptic population in the Gulf of Mexico.

Complete morphometric measurements have been made for populations of *Phyllorhiza punctata* from Australia (three populations), the Caribbean Sea (Puerto Rico), San Diego, and northern Gulf of Mexico. Measurements have also been made on the small number of complete preserved specimens from North Queensland. Using the 39 morphological characters, it was shown without question that the Gulf of Mexico population is distinctly different from all other *P. punctata* populations. Moreover, the differences between Caribbean and Gulf of Mexico populations are as different from each other as they are from the Australian populations. This finding has been interpreted even without the completion of the molecular analyses, to mean that the Puerto Rico population (the only other described population in the Caribbean basin) is not the source population for the northern Gulf of Mexico. Rather, it is theorized that the northern Gulf population is a newly introduced species, probably brought into these waters via direct shipping and not the Loop Current as hypothesized elsewhere.

Currently, there is no concerted effort in place in this country to understand jellyfish invasions. As such, this project is the first important step in understanding this issue, and quite possibly, in developing future programs for controlling jelly fish invasions.

Appendix A

Projects Funded

2001–2003 Omnibus Projects

Project #	Federal Funds	Project Information
R/AT-1	\$ 74,697	<i>Identification and Isolation of Oyster Genes Resistant to Pollutants Using Genechip Technology.</i> John Liu, Ph.D., David B. Rouse, Ph.D., Rex A. Dunham, Ph.D. and Richard K. Wallace, Ph.D., Auburn University. Project Closed 01/31/04.
R/AT-2	\$ 54,925	<i>Design and Synthesis of New Anticancer and Antitubercular Agents Based on Marine Natural Product, Puupehenone.</i> Jordan K. Zjawiony, Ph.D. and Mark T. Hamann, Ph.D., The University of Mississippi. Project extended to 01/31/05.
R/SP-1	\$ 48,909	<i>Evaluation and Applications of Methodologies for Rapid Detection and Elimination/Reduction of Vibrio vulnificus and V. parahaemolyticus in Shellfish.</i> Asim K. Bej, Ph.D., The University of Alabama at Birmingham. Project closed 07/31/04.
R/SP-2	\$ 68,708	<i>Nutritional Strategies for the Maturation and Rearing of Red Snapper.</i> D. Allen Davis, Ph.D. and Ronald P. Phelps, Ph.D., Auburn University. Project extended to 01/31/05.
R/SP-3	\$ 60,173	<i>Development of Techniques for Inland Saltwater Shrimp Farming.</i> D. Allen Davis, Ph.D., David B. Rouse, Ph.D., and Claude E. Boyd, Ph.D., Auburn University. Project extended to 01/31/05.
R/CEH-2	\$ 58,572	<i>Detection and Action of Endocrine Disrupting Chemicals in Estuarine Ecosystems.</i> Marius Brouwer, Ph.D., The University of Southern Mississippi. Project extended to 12/31/04.
R/CEH-3	\$ 51,979	<i>Patterns of Habitat Use of Gulf Sturgeon (Acipenser oxyrinchus desotoi) in the Northern Gulf of Mexico.</i> Stephen T. Ross, Ph.D., The University of Southern Mississippi and William T. Slack, Ph.D., Mississippi Museum of Natural Science. Project Closed 07/31/04.
R/CEH-4	\$ 75,044	<i>Relative Importance of Seagrass versus Epiphytes in Food Webs Based on Long-term ¹⁵N-Enrichment.</i> Michael J. Sullivan, Mississippi State University and Brian Fry, Louisiana State University. Project Closed 07/31/04.

Project #	Federal Funds	Project Information
ED-1	\$ 19,863	<i>The ABCs of Wetlands - An Environmental Learning Experience.</i> David L. Scott, Mobile County Public School System and Richard K. Wallace, Auburn University. Project closed 07/31/04.
ED-5	\$ 24,147	<i>Mississippi-Alabama Sea Grant Consortium Education Efforts.</i> Sharon H. Walker, Mississippi-Alabama Sea Grant Consortium. Project closed 01/31/04.
EX-3	\$225,526	<i>Mississippi-Alabama Sea Grant Extension Program.</i> C. David Veal, Mississippi State University, and Richard K. Wallace, Auburn University.
L-1	\$ 73,849	<i>Mississippi-Alabama Sea Grant Legal Program.</i> Kristen M. Fletcher, J.D., LL.M., Josh Clemons, J.D., Richard J. McLaughlin, J.D., LL.M., J.S.D., and William Hooper, Jr., J.D., The University of Mississippi. Project extended to 01/31/05.
L-2	\$24,518	<i>Marine Habitat Conservation: Law and Policy Outreach.</i> Kristen M. Fletcher, J.D., LL.M. and Richard J. McLaughlin, J.D., LL.M., J.S.D., The University of Mississippi. Project closed 04/30/04.
L-3	\$100,000	<i>National Sea Grant Law Center.</i> Kristen M. Fletcher, J.D., LL.M., Stephanie Showalter, J.D., MS.E.L., Richard J. McLaughlin, J.D., LL.M., J.S.D., and William Hooper, Jr., J.D., The University of Mississippi.
C-1	\$ 89,064	<i>Program Communications.</i> Timothy H. Reid, Mississippi-Alabama Sea Grant Consortium.
ED-10	\$125,935	<i>Center for Ocean Sciences Education Excellence (COSEE) - Central Gulf of Mexico.</i> Sharon H. Walker, Ph.D., The University of Southern Mississippi.
M/PA-1	\$211,330	<i>Program Administration.</i> D. LaDon Swann, Mississippi-Alabama Sea Grant Consortium.
M/PD-1	\$ 40,696	<i>Program Development Funds,</i> D. LaDon Swann, Mississippi-Alabama Sea Grant Consortium.

Activities Supported From Program Development Funds

Project #	Federal Funds	Project Information
R/CCD-2-PD	\$ 9,758	<i>Coastal Corridor - Phase I.</i> Colette E. Boehm, Alabama Gulf Coast Convention and Visitors Bureau
R/CCD-3-PD	\$ 10,000	<i>Planning and Implementing Educational Conferences and Workshops on Smart Coastal Growth and Its Potential Impact.</i> Wendy Allen and Charlene Lee, Interlink, LLC
ED-13-PD	\$ 19,103	<i>Enhanced Educational Efforts at the Scott Aquarium and the Dauphin Island Sea Lab Through MS-AL Sea Grant Consortium Program Development Support.</i> Sharon H. Walker, Ph.D., The University of Southern Mississippi and John J. Dindo, Ph.D., Dauphin Island Sea Lab
ED-11-PD	\$ 10,000	<i>A Field Guide to Aquatic Habitats and Common Fauna of the Northern Gulf of Mexico: Chandeleur Islands, Louisiana to St. Joseph's Bay, Florida.</i> Mark S. Peterson, Ph.D., The University of Southern Mississippi and Kenneth L. Heck, Jr., Dauphin Island Sea Lab

Gulf of Mexico/MASGC Special Competition in Education and Outreach Projects in Aquatic Nuisance Species

Note - MASGC's share of the funding for this Special Competition came from FY's 97-99 Regional Funds

R/CEH-6	\$ 9,499 (EPA Funds)	<i>Aquatic Nuisance Species Outreach.</i> Richard K. Wallace, Ph.D., Auburn University. (02/01/01 - 07/31/04).
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National Strategic Initiatives

Minority Serving Institutions

SG-MSI-1	\$ 68,000	<i>Sea Grant-Minority Serving Institution Partnership Program to Strengthen Marine Science Program at Jackson State University.</i> Paulinus Chigbu, Jackson State University. Project closed 04/30/04.
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Gulf Oyster Industry Initiative

GMO-99-21	No-cost Extension	<i>Transferring and Adapting Existing Technology Used in Harvesting Other Shellfish Species to Oyster Farming on Privately Held Leases Along the Gulf of Mexico.</i> C. David Veal, Mississippi State University. Project Closed 04/30/04.
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Project #	Federal Funds	Project Information
GMO-99-25	\$ 22,981	<i>Selecting for Tolerance to Low Oxygen in the Eastern Oyster (Crassostrea virginica).</i> Richard K. Wallace, Ph.D. and David B. Rouse, Ph.D., Auburn University. (10/01/03 - 09/30/04)
R/AT-4-GOIP	\$ 84,042	<i>Gulf of Mexico Oyster Industry Program: High Intensity X-Ray Irradiation Processing as a Means of Treating Shell Stock Oysters to Eliminate Vibrio Pathogens.</i> Linda S. Andrews, Ph.D., Benedict C. Posadas, Ph.D., and C. David Veal, Ph.D., Mississippi State University. (06/01/03 - 05/31/04). Project extended to 05/31/05.

Aquatic Nuisance Species

ED-4	\$124,264	<i>Southeast Regional Aquatic Nuisance Species (ANS) Education and Outreach Network.</i> John J. Dindo, Ph.D., Dauphin Island Sea Lab, Howard D. Walters, M.Ed., The University of Southern Mississippi, and Michael J. Spranger, Ph.D., University of Florida. (10/01/01 - 09/30/03 extended to 03/30/04).
R/CEH-9	\$140,438	<i>Assessing the Potential of Nuisance Jellyfish Predation on the Eggs and Larvae of Red Drum and Red Snapper in the Northern Gulf of Mexico.</i> William M. Graham, Ph.D., Dauphin Island Sea Lab and James H. Cowan, Jr., Ph.D., Louisiana State University. (10/01/01 - 09/30/03) Project extended to 09/30/04.
ED-9-NSI	\$150,809	<i>Sea Grant Aquatic Nuisance Species Research Program: Southeast Regional Strategic Outreach Network.</i> Sharon H. Walker, Ph.D., The University of Southern Mississippi; John J. Dindo, Ph.D., Dauphin Island Sea Lab; Michael Spranger, Ph.D., University of Florida; and William Hall, Ph.D., University of Delaware. (06/01/03 - 05/31/05). Year one extended to 11/30/04.

Marine Environmental Biotechnology

ED-8-NSI	\$ 49,827	<i>Sea Grant Marine Environmental Biotechnology Program: Southeast Education Network.</i> Sharon H. Walker, Ph.D., The University of Southern Mississippi, and John J. Dindo, Ph.D., Dauphin Island Sea Lab. (06/01/03 - 05/31/05). Year one extended to 11/30/04.
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Project #	Federal Funds	Project Information
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Aquatic Nuisance Species (ANS) Task Force

(Pass-through funding from OAR)

R/CEH-8	\$ 92,335	<i>Deriving the Origin and Nature of the Invasive Jellyfish, Phyllorhiza punctata, Through Molecular Studies of Native and Non-Native Populations.</i> NOAA Scientist - Barry A. Costa-Pierce, Ph.D. (replaced by D. LaDon Swann, Ph.D.), Mississippi-Alabama Sea Grant Consortium and Lead Scientist, William M. Graham, Ph.D., Dauphin Island Sea Lab. (06/01/01 - 08/31/03) Project extended to 05/31/04.
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Fisheries Extension Enhancement

EX-5	\$ 23,464	<i>Gulf of Mexico and Caribbean Regional Fisheries Extension Initiative - Mississippi Component.</i> David D. Burrage, Mississippi State University Coastal Research and Extension Center. (06/01/02 - 05/31/03). Project extended to 06/30/04. and
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EX-6	\$ 17,010	<i>Gulf of Mexico and Caribbean Regional Fisheries Extension Initiative - Alabama Component</i> Richard K. Wallace, Auburn University Marine Extension and Research Center (09/01/02 - 08/31/03). Project extended to 08/31/04.
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EX-7	\$ 28,712	<i>Fisheries Extension Enhancement: An Educational Program Regarding Methylmercury in Gulf of Mexico Marine Fish.</i> David D. Burrage, Mississippi State University Coastal Research and Extension Center, Richard K. Wallace, Auburn University Marine Extension and Research Center, and Ronald R. Lukens, Gulf States Marine Fisheries Commission. (09/01/02 - 08/31/03). Project extended to 08/31/04.
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Appendix B

Collaborators, Partners, and Affiliates

Universities

Auburn University, Auburn, Alabama
Dauphin Island Sea Lab, Dauphin Island, Alabama
Gulf Coast Geospatial Center, Gulf Coast Research Laboratory
Harbor Branch Oceanographic Institution, Ft. Pierce, Florida
Hood College Coastal Studies Semester Program, Frederick, Maryland
Jackson State University, Jackson, Mississippi
Louisiana State University, Baton Rouge, Louisiana
Michigan State University
Mississippi State University, Starkville, Mississippi
Mobile County Public School System, Mobile, Alabama
Purdue University
The Croft Center for International Studies at The University of Mississippi
The Dean Rusk Center at the University of Georgia
The University of Alabama, Tuscaloosa, Alabama
The University of Alabama at Birmingham, Birmingham, Alabama
The University of Florida, Gainesville, Florida
The University of Mississippi, Oxford, Mississippi
The University of Southern Mississippi, Hattiesburg, Mississippi
University of South Alabama, Mobile, Alabama

State and Federal Agencies

Alabama Cooperative Extension System
Alabama Department of Conservation and Natural Resources, Marine Resource Division
Alabama Department of Environmental Management
Alabama Department of Natural Resources
Alabama Department of Transportation
Alabama Forestry Commission
Gulf Island National Seashore, National Park Service
Gulf States Marine Fisheries Commission
Louisiana Department of Wildlife and Fisheries
Mississippi Cooperative Extension Program
Mississippi Department of Marine Resources
Mississippi Department of Wildlife, Fisheries, & Parks
Mobile Bay National Estuary Program
U.S. Coast Guard Marine Safety Office (Mobile, AL)
U.S. Department of Agriculture, Cooperative State Research, Education, and Extension Service
U.S. Environmental Protection Agency
U.S. FDA Seafood Laboratory, Dauphin Island, AL
U.S. Fish & Wildlife Service Daphne Field Office
U.S. Fish and Wildlife Service
U.S. Naval Oceanographic Office
U.S. Navy

Weeks Bay National Estuarine Research Reserve

Sea Grant Institutions

Florida Sea Grant College Program
Georgia Sea Grant College Program
Illinois-Indiana Sea Grant College Program
Louisiana Sea Grant College Program
Puerto Rico Sea Grant College Program
Texas Sea Grant College Program

Partnerships

Alabama Gulf Coast Area Chamber of Commerce
Alabama Gulf Coast Convention & Visitor's Bureau
Alabama Stream Restoration Committee
Alabama-Mississippi Clean Marina Program
Alba Middle School (AL)
Alma Bryant High School (AL)
Baldwin County (AL) High School
Baldwin County Planning & Zoning Department
Bayou LaBatre Chamber of Commerce
Biomar Inc. (Spain)
Bon Secour National Wildlife Refuge
City of Foley
City of Gulf Shores
City of Moss Point
City of Ocean Springs (MS)
City of Orange Beach
Clarke School of Math & Science (Mobile County, AL)
Club Caribbean Dive and Travel
Coastal Alabama Clean Water Partnership
Coco-Cola Bottling Company of Mobile
Daphne (AL) High School
Dauphin Island Chamber of Commerce
Dauphin Island Parks and Beach Board/Fort Gaines
Degussa Corporation
Fairhope (AL) High School
Fort Morgan
Gulf Coast Resources Conservation & Development Council
Institute for Tuberculosis Research, College of Pharmacy, University of Illinois
Interlink, LLC
Jackson County (MS) Master Naturalist Program
Java Jean's Bagels
Knight-Abbey Printing
Land Trust for the Mississippi Coastal Plain
Litton Industries/Ingalls Shipbuilding
Maritime & Seafood Industry Museum
Mississippi Coast Audubon Society
Mississippi Gulf Coast Community College
Mississippi Master Naturalists

Mississippi Museum of Natural Science
Mobile Area Water and Sewer System
Mobile County (AL) Soil & Water Conservation Service
National Center for Natural Products Research (NCNPR)
Natural Resources Conservation Service
Papa John's Pizza
Port of Pascagoula
Shaughnessy Printing Co.
Ship Island Excursions
South Alabama Regional Planning Commission
South Baldwin Chamber of Commerce
South Mississippi Environmental & Agricultural Coordination Organization (SMEACO)
Southern Association of Marine Educators
Summerdale (AL) Middle School
T.J.'s Custom Apparel
Town of Dauphin Island
Wildlife Care and Rescue Center, Inc.

Appendix C
Sources of Significant Non-federal Funding
Program Year 2003

Funding Source	Amount
Mississippi State Appropriation	\$175,000
Mississippi-Alabama Sea Grant Consortium Subscriber Fees	\$112,500
Exxon Corporation Sponsorship of MASGC Fellowship	\$ 5,000
Alabama Power Company Sponsorship of MASGC Fellowship	<u>\$ 5,000</u>
TOTAL	\$297,500

Appendix D

Program Awards and Honors

Dr. Sharon H. Walker received NOAA's Team Member of the Month award in January 2004. The Team Member of the Month recognizes excellence for demonstrated and sustained effort in advancing NOAA's mission, and pays tribute to a non-NOAA employee in order to give credit to the outstanding partners who make NOAA programs a success.

The Mobile County Public Schools' Environmental Studies Center, directed by David L. Scott, was the recipient of the 2004 BEEP (Best Environmental Education Program) Award for the Best Environmental Course or Curriculum in Alabama. The award, given by the Environmental Education Association of Alabama (EEAA) was for the ESC's educational program, "The ABC's of Wetlands." This program involved teachers and students in a study of wetland habitats and the importance of these habitats to wildlife and society.

Appendix E

Publication List

This reporting period covers year three of the 2001-2003 Omnibus. Several publications are at various stages of the publishing process. However, during the current reporting period MASGC sponsored research that led to 30 manuscripts, 15 abstracts, and 15 presentations. Education, Extension, Legal Program, and Communications production included 2 manuscripts, 2 abstracts, 29 presentations, 9 Legal Reporters, 20 newsletters, and 5 outreach publications and 1 workshop.

R/AT-1 - Identification and Isolation of Oyster Genes Resistant to Pollutants Using Genechip Technology. John Liu, David B. Rouse, Rex A. Dunham, and Richard K. Wallace, Auburn University.

Manuscripts:

1. Peatman, E.J., X. Wei, J. Feng, L. Liu, H. Kucuktas, P. Li, C. He, D. Rouse, R. Wallace, R. Dunham, and Z. Liu. *Development of Expressed Sequence Tags (ESTs) from Eastern Oyster (Crassostrea virginica): Lessons Learned from Previous Efforts.* (2004). Marine Biotechnology. (in press).
2. Peatman, Eric J. *Development of Expressed Sequence Tags (ESTs) from Eastern Oyster (Crassostrea virginica): Lessons Learned from Previous Efforts.* M.S. thesis, Auburn University. 2004. (in preparation).
3. Goong, Stuart. *Biological Impact of Mercury Exposure on Growth and Reproduction of Oysters.* Ph.D. dissertation. 2004. (in preparation).

Abstracts:

1. Peatman, E.J., X. Wei, L. Liu, H. Kucuktas, P. Li, C. He, D. Rouse, R. Wallace, R. Dunham, and Z. Liu. *Development of EST Resources from Eastern Oyster (Crassostrea virginica) for Identification of Marine Biomarkers.* 12th International Plant and Animal Genome Conference, San Diego, CA, January 10-14, 2004. PAG XII, p. 734. www.intl-pag.org/pag/12/abstracts/P5o_PAG12_734.html.
2. Lundqvist, M.L., M.J. Jenny, G.W. Warr, P.S. Gross, G.R. Vasta, J.A.F. Robledo, Z.J. Liu, J. Tomkins, G.C. Fang, C. Saski, M. Gomez-Chiarri, J-M. Escoubas, E. Bachere, P. Roche, D. Hedgecock, R.W. Chapman. *Current State of Oyster (Crassostrea) Functional Genomics Resources.* 12th International Plant and Animal Genome Conference, San Diego, CA, January 10-14, 2004. PAG XII, p. 735. www.intl-pag.org/pag/12/abstracts/P5o_PAG12_735.html.

R/AT-2 - Design and Synthesis of New Anticancer and Antitubercular Agents Based on Marine Natural Product, Puupehenone. Jordan K. Zjawiony and Mark T. Hamann, The University of Mississippi.

Manuscripts:

1. Tan, Bo, Isamu Katsuyama, Mark T. Hamann, and Jordan K. Zjawiony. *Puupehenone Alkylates the Heterocyclic Bases of DNA and RNA: The Plausible Mechanism for the Inhibition of Nucleotide Biosynthesis.* Journal of American Chemical Society. (in review).

Two additional publications are in preparation from the research in the third year.

R/CEH-2 - Detection and Action of Endocrine Disrupting Chemicals in Estuarine Ecosystems.

Marius Brouwer, The University of Southern Mississippi.

Manuscripts:

1. Karels, A.A., S. Manning, T. Hoexum Brouwer, and M. Brouwer. *Reproductive Effects of Estrogenic and Antiestrogenic Chemicals on Sheepshead Minnow (Cyprinodon variegates).* Env. Tox. Chem. 22: 855-865. (2003). MASGP-04-020.
2. Karels, Arthur A. and Marius Brouwer. *Cloning, Sequencing and Phylogenetic Classification of an Estrogen Receptor " Subtype of Sheepshead Minnow (Cyprinodon variegates).* Comp. Biochem. Physiol. 135: 263-272. (2003). MASGP-04-018.
3. Cheek, A.O., J.A. Fentress, S.L. Steele, H.L. Bart, Jr., and M. Brouwer. *Models and Murkiness: Evaluating Fish Endocrine Disruption in the Laboratory and the Field.* Proceedings of the 3rd International Conference on Pharmaceuticals and Endocrine Disrupting Chemicals in Water, March 19-21, 2003, Minneapolis, MN. 8p. MASGP-04-019.

Abstracts:

1. Kuhl, A.J. and M. Brouwer. *Brain Aromatase and Its Response to the Xenoestrogen o,p-DDT in Japanese Medaka.* Soc. Env. Tox. Chem. Abstract Book. P. 105. (2003).
2. Karels, A.A., S. Manning, T. Hoexum-Brouwer, and M. Brouwer. *Reproductive Effects of Estrogenic and Anti-estrogenic Chemicals on Sheepshead Minnows (Cyprinodon variegatus).* 12th International Symposium on Pollutant Responses in Marine Organisms, Tampa, FL. (May 2003).
3. Kuhl, A.J. and M. Brouwer. *Medaka Brain Aromatase and Its Response to the Xenoestrogen, o,p-DDT.* 12th International Symposium on Pollutant Responses in Marine Organisms, Tampa, FL. (May 2003).

R/CEH-3 - Patterns of Habitat use of Gulf Sturgeon (*Acipenser oxyrinchus desotoi*) in the Northern Gulf of Mexico. Stephen T. Ross, The University of Southern Mississippi, and William T. Slack, Mississippi Museum of Natural Science.

Manuscripts:

1. Heise, R.J., W.T. Slack, S.T. Ross, and M.A. Dugo. *Spawning and Associated Movement Patterns of Gulf Sturgeon in the Pascagoula River Drainage, Mississippi*. Transactions of the American Fisheries Society 133: 221-230. MASGP-04-017.
2. Heise, R.J., W.T. Slack, S.T. Ross, and M.A. Dugo. *Gulf Sturgeon Summer Habitat Use and Fall Migration in the Pascagoula River, Mississippi*. Environmental Biology of Fishes. (submitted).
3. Dugo, M.A., B.R. Kreiser, S.T. Ross, W.T. Slack, R.J. Heise, and B.R. Bowen. *Conservation and Management Implications of Fine-scale Genetic Structure of Gulf Sturgeon in the Pascagoula River, Mississippi*. Journal of Applied Ichthyology 20: 243-251 (2004). MASGP-04-038.

R/CEH-4 - Relative Importance of Seagrass versus Epiphytes in Food Webs Based on Long-Term ¹⁵N-Enrichment. Michael J. Sullivan, Mississippi State University, and Brian Fry, Louisiana State University.

Manuscripts:

1. Mutchler, T., M.J. Sullivan, and B. Fry. *Potential of ¹⁴N Isotope Enrichment to Resolve Ambiguities in Coastal Trophic Relationships*. Marine Ecology Progress Series 266: 27-33. (2004). MASGP-04-034.
2. Mateo, M.A., J. Cebrian, K. Dunton, and T.R. Mutchler. *Carbon Flux in Seagrass Ecosystems*. In: *Seagrass Biology* (A.W.D. Larkum, R.J. Orth and C.M. Duarte, eds), CRC Press. (2004).
3. Moore, A.D., M.J. Sullivan, S.W. Phipps, and D.F. Millie. *The Effects of Patch Size on Primary Production and Biomass of the Seagrass *Halodule wrightii* and Its Epiphytes*. Botanica Marina. (In revision).

Invited Papers:

1. Sullivan, M.J. *Trophic Importance of Benthic Microalgae in Seagrass Beds*. Presented to the Biological Sciences Department, Florida State University, Tallahassee, May 12, 2004.

Presentations:

1. Mutchler, T.R., M.J. Sullivan, B. Fry, P.V. Zimba, and P.A. Sanderson. *Response of Seagrass Community Food Webs to Nutrient Enrichment with a ¹⁴N-labeled Fertilizer*. 17th Biennial Estuarine Research Federation Conference, Seattle, WA, September 14-18, 2003.
2. Mutchler, T.R., M.J. Sullivan, and B. Fry. *Response of Seagrass Community Food Webs to Nutrient Enrichment with a ¹⁴N-labeled Fertilizer*. 88th Annual Meeting of the Ecological Society of America, Savannah, GA, August 3-8, 2003.

R/SP-1 - Field Applications of Multiplex PCR to Monitor Microbial Contamination in the Gulf of Mexico. Asim K. Bej, The University of Alabama at Birmingham.

Manuscripts:

1. Myers, M.L., G. Panicker, A.K. Bej. *PCR Detection of a Newly Emerged Pandemic Vibrio parahaemolyticus O3:K6 in Pure Cultures and Seeded Waters from the Gulf of Mexico.* Applied and Environmental Microbiology. 69(4):2194-2200. (2003). MASGP-01-036.
2. Kaufman, G.E., A.K. Bej, J. Bowers, and A. DePaola. *Oyster-to-Oyster Variability in Levels of Vibrio parahaemolyticus.* Journal of Food Protection 66(1): 125-129 (2003). MASGP-04-023.
3. Lee, C-Y., G. Panicker, and A.K. Bej. *Detection of Pathogenic Bacteria in Shellfish Using Multiplex PCR Followed by CovaLink™ NH Microwell Plate Sandwich Hybridization.* Journal of Microbiological Methods 53: 199-209 (2003). MASGP-04-022.
4. Panicker, G., M.L. Myers and A.K. Bej. *Rapid Detection of Vibrio vulnificus in Shellfish and Gulf of Mexico Water by Real-time PCR.* Applied and Environmental Microbiology. 70(1):498-507. (2004). MASGP-04-008.
5. Rizvi, A.V., G. Panicker, M.L. Myers, A.K. Bej. *Detection of Vibrio parahaemolyticus Serovar O3:K6 in Gulf of Mexico Water and Shellfish Using Real Time PCR with TaqMan® Fluorescent Probes.* Applied and Environmental Microbiology. (In review).
6. Panicker, G., M.C.L. Vickery, and A.K. Bej. *Multiplex PCR Detection of Clinical and Environmental Strains of Vibrio vulnificus in Shellfish.* Canadian Journal of Microbiology. (Accepted for publication).
7. Kaufman, G.E., A.K. Bej, J. Bowers, G.M. Blackstone M.C.L. Vickery, and A. DePaola. *An Alternative Matrix for Real-time PCR Quantification of Vibrio parahaemolyticus in Oysters.* Journal of Food Protection. (Accepted for publication).
8. Panicker, G., and A.K. Bej. *Real-time PCR Detection of Vibrio vulnificus in Shellfish: Comparison of Oligonucleotide Primers and Probes Targeting vvhA.* Applied and Environmental Microbiology. (In review).
9. Rizvi, A., G. Panicker, M. Myers, and A.K. Bej. *Rapid Detection of Vibrio parahaemolyticus in Shellfish Using Multiplexed Real-time PCR with SYBR Green I.* (In preparation).
10. Myers, M. and A.K. Bej. *Serum-induced Rapid Growth in Vibrio vulnificus.* (In preparation).
11. Blankinship, L. and A.K. Bej. *Evaluation of Market Sauces on the Viability of V. parahaemolyticus and V. vulnificus in Pure Cultures and in Shellfish.* (In preparation).

Abstracts:

1. Rizvi, Amy V. and Asim K. Bej. *Detection of Vibrio parahaemolyticus O3:K6 Using Real-Time PCR with TaqMan® Fluorescent Probes in Gulf of Mexico Water and Shellfish.* Annual Meeting of Alabama Academy of Science, University of Montevallo, AL. (2004).

2. Panicker, Gitika and Asim K. Bej. *Detection of Total and Pathogenic Vibrios using Multiplexed PCR and DNA Array Hybridization*. Annual Meeting of Alabama Academy of Science, University of Montevallo, AL. (2004).
3. Panicker, Gitika, Amy Rizvi and Asim K. Bej. *Quantitative Real-time PCR with TaqMan® Probes for Detection of Clinical and Environmental Vibrio vulnificus in Shellfish*. Annual Meeting of American Society for Microbiology, New Orleans, LA. (2004).
4. Rizvi, Amy V., Gitika Paniker, and A.K. Bej. *Rapid Detection of Vibrio parahaemolyticus in Gulf of Mexico Water Using SYBR Green I and TaqMan® Probe Real-Time PCR Methods*. Annual Meeting of American Society for Microbiology, New Orleans, LA. (2004).
5. Rizvi, Amy V., Gitika Panicker, and Asim K. Bej. *Rapid Detection of Vibrio vulnificus in Shellfish Using SYBR Green I and TaqMan® Real-time PCR*. American Society for Microbiology, New Orleans, LA. (2004)
6. Panicker, Gitika and Asim K. Bej. *Detection of Vibrio vulnificus in Gulf of Mexico Water and Shellfish Using Molecular Methods*. Alabama Academy of Science, Jacksonville, AL. (2003).
7. Panicker, G., and A.K. Bej. *Rapid Detection of Vibrio vulnificus in Gulf Water and Shellfish Using Real-time PCR*. 103rd American Society for Microbiology, Washington, D.C. (2003).
8. Panicker, G., and A.K. Bej. *Detection of Total and Pathogenic Vibrio vulnificus Using PCR and Oligonucleotide Microarrays*. International Association for Food Protection, New Orleans, LA. (2003).
9. Rizvi, Amy and Asim K. Bej. *Rapid Detection of Vibrio parahaemolyticus in Gulf of Mexico Water Using Real-time PCR*. 80th Annual Meeting of the Alabama Academy of Science, Jacksonville State University, AL. (2003).

Presentations:

1. Center for Ocean Sciences Education Excellence (COSEE). Presentation of a seminar and a workshop to teachers and educators on the Detection of *Vibrio vulnificus* in Shellfish and Gulf of Mexico Water Using Real-time PCR Method at Dauphin Island Sea Lab, AL. (2003).
2. Annual Meeting of the Southern Association of Marine Educators (SAME). Gulf of Mexico Marine Biotechnology Program. Keynote address: Marine Microbes (Bacteria) and Biotechnology. Dauphin Island Sea Lab, AL. (2003).

R/SP-2 - Nutritional Strategies for the Maturation and Rearing of Red Snapper. D. Allen Davis and R.P. Phelps, Auburn University.

Abstracts:

1. Papanikos, N., R.P. Phelps, D.A. Davis, A. Ferry, and D. Maus. *Red Snapper, Lutjanus campechanus, Broodstock Nutrition and Egg and Larval Quality*. Aquaculture 2003: Book of Abstracts, Aquaculture America, Baton Rouge, LA. p. 219. (2003).

Presentations:

1. Miller, C.L., D.A. Davis, and R.P. Phelps. *Effects of Dietary Protein and Lipids on Growth and Body Composition of Juvenile Red Snapper*, *Lutjanus campechanus*. Alabama Fisheries Association, Gulf Shores, AL, February 16-18, 2004.
2. Phelps, R.P. *Advances and Constraints in the Production of Red Snapper*, *Lutjanus campechanus*. International Sustainable Marine Fish Culture Conference and Workshop, Harbor Branch Oceanographic Institution, Fort Pierce, FL, October 9-10, 2003.
3. Papanikos, N., R.P. Phelps, K. Williams, A.D. Davis, A. Ferry, and D. Maus. *Assessment of Egg and Larval Quality in Red Snapper*, *Lutjanus campechanus*, *Under Natural Spawning Conditions*. 7th International Symposium of Reproductive Physiology of Fish, Mie, Japan, May 18-23, 2003.
4. Miller, C.L., D.A. Davis, and R.P. Phelps. *Effects of Lipids on the Growth Rate and Body Composition of Juvenile Red Snapper*, *Lutjanus campechanus*. Aquaculture America, Louisville, KY, February 18-21, 2003.
5. Ross, M.T., R.P. Phelps, and D.A. Davis. *Lipid and Fatty Acid Composition of Red Snapper Lutjanus campechanus Ovaries and Eggs*. Aquaculture America, Louisville, KY, February 18-21, 2003.

R/SP-3 - Development of Techniques for Inland Saltwater Shrimp Farming. D. Allen Davis, and David B. Rouse, Auburn University.

Publications:

1. Davis, D.A., I.P. Saoud, C.E. Boyd, and D.B. Rouse. *Effects of Potassium, Magnesium, and Age on Growth and Survival of Litopenaeus vannamei Post-Larvae Reared in Inland Low Salinity Well Waters in West Alabama*. Journal of the World Aquaculture Society (submitted).
2. Saoud, I.P. and D.A. Davis. *Salinity Tolerance of Brown Shrimp Farfantepenaeus aztecus as it Relates to Postlarval and Juvenile Survival, Distribution, and Growth in Estuaries*. Estuaries. (In press).
3. Saoud, I.P., D.A. Davis, and D.B. Rouse. *Suitability Studies of Inland Well Waters for Litopenaeus vannamei Culture*. Aquaculture. 217: 373-383. (2003). MASGP-04-013.
4. McGraw, W.J., D.A. Davis, D. Teichert-Coddington, and D.B. Rouse. *Acclimation of Litopenaeus vannamei Post Larvae to Low Salinity: Influence of Age, Salinity Endpoint and Rate of Salinity Reduction*. Journal of the World Aquaculture Society. 33: 78-84. (2002). MASGP-04-015.
5. Davis, D.A., I.P. Saoud, W.J. McGraw, and D.B. Rouse. *Considerations for Litopenaeus vannamei Reared in Inland Low Salinity Waters*. VI International Symposium on Aquaculture Nutrition. Cancun, Quintana-Roo, Mexico, September 3-6, 2002. MASGP-04-014.
6. Saoud, I.P., D.A. Davis, and D.B. Rouse. *Shrimp Culture in Low-salinity Waters Inland*. World Aquaculture Magazine. 33: 51-52. (2002). MASGP-04-016.

Presentations:

1. Davis, D.A., I.P. Saoud, D.B. Rouse, C.E. Boyd, T. Samocha, J.S. Wilkenfeld, G. Treece, and G. Whitis. *Recent Advances in Low Salinity Shrimp Culture Technologies*. Del 40 Aniversario del Departamento de Investigaciones Cientificas y Technologicas, Hermasillo, Sonora, Mexico. March 28, 2003.
2. Davis, D.A., I.P. Saoud, and D.B. Rouse. *Effects of Potassium, Magnesium, and Age on Acclimation of Litopenaeus vannamei Postlarvae to Inland Saline Well-Waters in West Alabama*. Aquaculture America 2003, Louisville, KY, February 18-21, 2003.
3. Davis, D.A., O.D. Zelaya, and D.B. Rouse. *Influence of Artemia and Algae Supplements During Nursery Phase of Litopenaeus vannamei*. Aquaculture America 2003, Louisville, KY, February 18-21, 2003.
4. Davis, D.A., O.D. Zelaya, and D.B. Rouse. *Influence of Indoor Nursery Period and Direct Stocking on Final Pond Production and Size Distribution of Litopenaeus vannamei*. Aquaculture America 2003, Louisville, KY, February 18-21, 2003.
5. Davis, D.A., D. Rouse, and C.E. Boyd. *Research Update of Low Salinity Work*. Alabama Shrimp Association Meeting, Alabama Fish Farming Center, Greensboro, AL, February 12, 2003.

R/SP-4 - Fisheries Recruitment in the Northcentral Gulf of Mexico: Can Important Geographic Sources of Juvenile Nursery Habitat be Determined Using Otolith Microchemistry? Bruce H. Comyns, Chet F. Rakocinski, Mark S. Peterson, Alan M. Shiller, and Zhongxing Chen, The University of Southern Mississippi.

Two significant publications will come from this work. The first is close to completion.

C-1 - Program Communications. Timothy H. Reid, Mississippi-Alabama Sea Grant Consortium.

Publications:

Sea Briefs (four issues) Tim Reid, Editor

1. *Securing Seafood Safety*. MASGP-03-011-01.
2. *MASGC Earns High Marks in National Review*. MASGP-03-011-02.
3. *Fish Food*. MASGP-03-011-03.
4. *New Research Projects for 2004*. MASGP-03-011-04.

EX-3 - Mississippi-Alabama Sea Grant Extension Program. C. David Veal, Mississippi State University and Richard K. Wallace, Auburn University.

Publications:

1. Burrage, D. *Evaluation of the Gulf Fisheye Bycatch Reduction Device in the Northern Gulf Inshore Shrimp Fishery*. Gulf of Mexico Science 2004 (1): 85-95. MASGP-04-044.
2. Burrage, D. *2004 Mississippi Tide Tables*. MASGP-03-014.

Gulf Coast Fisherman (12 issues) Dave Burrage, Editor

3. *Mississippi to Close Crab Season for Abandoned Trap Removal*. MASGP-03-002-01.
4. *First Mississippi Crab Trap Removal a Success*. MASGP-03-002-02.
5. *New Gulf TED Regulations Effective August 21, 2003*. MASGP-03-002-03.
6. *DMR Seeks Shrimp Industry Input Regarding Disaster Relief*. MASGP-03-002-04.
7. *2003 Louisiana Shrimp Season Openings Set*. MASGP-03-002-05.
8. *License Reminder*. MASGP-03-002-06.
9. *Mississippi Shrimp Season Under Way*. MASGP-03-002-07.
10. *New TED Regulations Effective August 21, 2003*. MASGP-03-002-08.
11. *Gulf of Mexico Shrimp Vessel Permit Reminder*. MASGP-03-002-09.
12. *Threatened Status Retained for Loggerhead Sea Turtles*. MASGP-03-002-10.
13. *Individual Fishing Quotas Proposed for Gulf Red Snapper*. MASGP-03-002-11.
14. *Mississippi Oyster Season Looking Good*. MASGP-03-002-12.

Sea Harvest News (4 issues) Richard K. Wallace, Editor

15. *Crab Trap Clean-up* MASGP-03-003-01.
16. *New TED Regulations Effective August 21, 2003*. MASGP-03-003-02.
17. *Nominations Sought for Alabama Shrimp Disaster Relief Steering Committee*. MASGP-03-003-03.
18. *TED Information Sessions Set for August 5th and August 7th*. MASGP-03-003-04.
19. *Mercury in Fish - Frequently Asked Questions (FAQs)*. MASGP-03-004.

Invited Papers

1. Posadas, B.C. *Preliminary Economic Benchmarks of Raw Oyster Postharvest Processing Systems*. Presented at the Gulf and South Atlantic Fisheries Development Foundation Oyster Education Public Conference, June 4-6, 2003, New Orleans, LA.
2. Posadas, B.C. and R.A. Posadas. *Consumer Preferences for Postharvest Processed Raw Oysters in Coastal Mississippi*. Presented at the Gulf and South Atlantic Fisheries Development Foundation Oyster Education Public Conference, June 4-6, 2003, New Orleans, LA.
3. Waters, P.L. *Collaboration Between Alma Bryant High School Aquaculture Program and Auburn University Researchers Yield Mutually Beneficial Results*. Book of Abstracts for Aquaculture America 2003. Aquaculture America 2003, Louisville, KY, February 18-21, 2003.
4. *Economic and Marketing Considerations of Freshwater Prawn Production in the U.S.* Invited paper presented at Aquaculture America 2003, Louisville, KY, February 18-21, 2003.
5. *Economic Feasibility of Offshore Aquaculture in the Gulf of Mexico*. Invited paper presented at Aquaculture America 2003, Louisville, KY. February 18-21, 2003.

Presentations:

1. *How Shrimpers Can Take Advantage of Tourism*. Invited presentation at the International Work Boat Show, December 4, 2003, New Orleans, LA.
2. *Economic Benchmarks of Postharvest Processing Systems for Raw Oyster Products in the Gulf of Mexico*. Paper presented at the Seafood Science and Technology Conference, November 3-5, 2003, Biloxi, MS.
3. *Consumer Awareness, Preferences, and Consumption of Postharvest Processed Raw Oyster Products in Coastal Mississippi*. Paper presented at the Seafood Science and Technology Conference, November 3-5, 2003, Biloxi, MS.
4. *Consumer Preferences and Attitudes Toward Irradiated Oysters*. Poster presented to the Institute of Food Technology Conference, July 2003, Chicago IL.
5. *High School Aquaculture Programs in Alabama*. PowerPoint presentation to Alabama teachers participating in the High School Aquaculture Workshop, June 18, 2003, Gadsden, AL.
6. *Overview of the Mississippi-Alabama Sea Grant Extension Program*. PowerPoint presentation to the Sea Grant Program Assessment Team, May 21, 2003, Mobile, AL.
7. *High School Aquaculture Programs*. PowerPoint presentation to Sea Grant Program Assessment Team, May 21, 2003, Mobile, AL.
8. *Marketing Implications of Consumer Attitudes Toward Oysters*. Paper presented at the 95th Annual Meeting of the National Shellfisheries Association, New Orleans, LA, April 13-17, 2003.
9. *Consumer Preferences and Attitudes Toward Irradiated Oysters*. Paper presented at the 95th Annual Meeting of the National Shellfisheries Association, New Orleans, LA, April 13-17, 2003.

10. *Consumer Acceptance and Vibrio Response to Oyster Irradiation*. Paper presented to the 95th Annual Meeting of the National Shellfisheries Association, New Orleans, LA, April 13-17, 2003.
11. *Economic and Marketing Considerations of Offshore Aquaculture in the Gulf of Mexico*. Poster presented at the 3rd National Aquaculture Extension Conference, Tucson, AZ, April 8-10, 2003.
12. *Économic Feasibility of Producing Freshwater Prawn Macrobrachium rosenbergii, in the United States*. Poster presented at the 3rd National Aquaculture Extension Conference, Tucson, AZ, April 8-10, 2003.
13. *Status and Trends in Mississippi's Seafood Industry*. Invited presentation at the Mississippi Crop Improvement Association Annual Meeting, April 8, 2003, Biloxi, MS.
14. *Economic Considerations of Recirculating Saltwater Shrimp Production Systems*. Paper presented at Aquaculture America 2003, Louisville, KY, February 18-21, 2003.

EX-7 - Fisheries Extension Enhancement: An Educational Program Regarding Methylmercury in Gulf of Mexico Marine Fish. David D. Burrage, Mississippi State University Coastal Research and Extension Center, Richard K. Wallace, Auburn University Marine Extension and Research Center, and Ronald R. Lukens, Gulf States Marine Fisheries Commission.

Presentations:

1. *Methylmercury in Gulf of Mexico Marine Fish*. Agent training presentation for Florida Sea Grant Marine Extension Agents in Gainesville, Florida on October 7, 2003.
2. *Methylmercury in Gulf of Mexico Marine Fish*. Agent training presentation for Texas Sea Grant Marine Extension Agents in Houston, Texas, August 26, 2003.
3. *Methylmercury in Gulf of Mexico Marine Fish*. Agent training presentation for Louisiana Sea Grant Marine Extension Agents in Port Fourchon, Louisiana, June 25, 2003.

L-1 - Mississippi-Alabama Sea Grant Legal Program, Kristen M. Fletcher, (02/01/03 - 08/29/03) and William Hooper, (09/01/03 - 03/31/04), The University of Mississippi

Publications:

Water Log (3 issues) Kristen M. Fletcher, Sarah Elizabeth Gardner, and Josh Clemons, Editors

1. *Park Service Determines Stiltsville's Fate*. MASGP-03-012-01.
2. *Water for Endangered Silvery Minnow Considered a Beneficial Use*. MASGP-03-012-02.
3. *Water-Sharing Compact Dissolves*. MASGP-03-012-03.
4. Clemons, Josh. *Water Follies: Groundwater Pumping and the Fate of America's Fresh Waters*. Book review. *Ecological Economics* 48(3): 359-360. MASGP-04-040.

5. Clemons, Josh. *Interstate Water Wars: A Road Map for States*. Southeastern Environmental Law Journal. 12(2): 115-142. (2004). MASGP-04-033.

Presentations:

1. *The Tri-State Water Wars*. Sadie Gardner. Coastal Zone '03, Baltimore, MD, July 2003.

L-2 - Marine Habitat Conservation - Outreach and Advisory. Kristen M. Fletcher, (02/01/03 - 08/29/03) and William Hooper, (09/01/03 - 03/31/04), The University of Mississippi.

Publications:

Showalter, S. and L. Schiavinato. *Marine Protected Areas in the Gulf of Mexico: A Survey*. (2004). MASGP-03-019.

Clemons, Josh. *A Citizen's Guide to Conservation Easements in Alabama and Mississippi*. (2004). MASGP-03-018.

Presentations:

1. Fletcher, Kristen M. *Legal Aspects of Marine Reserves*. American Fisheries Society, Quebec City, Canada, August 2003.

L-3 - National Sea Grant Law Center. Kristen M. Fletcher and Stephanie E. Showalter, The University of Mississippi.

Publications:

***The SandBar* (4 issues). Stephanie Showalter, Editor.**

1. *Gradual Takings Claim Not Barred by Statute of Limitations*. Vol. 2:1. MASGP-03-010-01.
2. *Vessel Owner Awarded Over \$37 Million for Temporary Taking*. Vol. 2:2. MASGP-03-010-02.
3. *Mariana Islands Lacks Authority Over Its Submerged Lands*. Vol. 2:3. MASGP-03-010-03.
4. *Supreme Court Rules for Virginia in Potomac Conflict*. Vol. 2:4. MASGP-03-010-04.
5. *Sea Grant Law and Policy Digest*. Two issues. Available on-line only. MASGP-03-020-01 and -02.

Presentations:

1. *Aquatic Nuisance Species in the Gulf of Mexico*. Stephanie Showalter, Coastal Zone '03, Baltimore, MD, July 2003.
2. *Ethical Requirements of Attorneys*. Stephanie Showalter, Sea Grant Week, Galveston, TX, April 2003.
3. *Overview of RCRA and CERCLA*. Stephanie Showalter. Presentation to Waste Management Class, The University of Mississippi, February 2003.

ED-8-NSI - Sea Grant Marine Environmental Biotechnology Program: Southeast Education Network. Sharon H. Walker, The University of Southern Mississippi, and John J. Dindo, Dauphin Island Sea Lab.

Presentations:

1. *Chitin/Chitosan: Refuse Revisited or One Person's Trash Is Another's Treasure.* Shelia Brown, National Science Teachers Association 2004 Conference, Atlanta, GA, April 1, 2004.

Abstracts:

1. Walker, Sharon H. and Shelia A. Brown. *Chitin/Chitosan: Refuse Revisited or One Person's Trash Is Another's Treasure.* National Science Teachers Association 2004 Conference, Atlanta, GA. 1: 112.

ED-9-NSI - Sea Grant Aquatic Nuisance Species Research Program: Southeast Regional Strategic Outreach Network. Sharon H. Walker, The University of Southern Mississippi.

Presentations:

1. *Educating Middle School Students About Invasive Species.* Austin Taylor and Kay Baggett. Mississippi Academy of Sciences, Biloxi, MS, February 19, 2004.

Abstracts:

1. Taylor, Austin and Kay Baggett. *Educating Middle School Students About Invasive Species.* Mississippi Academy of Sciences, Biloxi, MS, February 19, 2004.

Workshops:

1. Baggett, Kay, *Aquatic Nuisance Species-Exotics on the Move Workshop.* Scott Aquarium, Biloxi, MS. June 23, 2004. (20 participants)

Appendix F

Students Supported

During the third year of these projects, 9 Ph.D., 9 M.S., and 6 J.D. candidates have been supported.

R/AT-1 - Identification and Isolation of Oyster Genes Resistant to Pollutants Using Genechip Technology. John Liu, David B. Rouse, Rex A. Dunham, and Richard K. Wallace, Auburn University.

1. Eric J. Peatman, M.S. *Development of Expressed Sequence Tags (ESTs) from Eastern Oyster (Crassostrea virginica): Lessons Learned from Previous Efforts.* 2004.
2. Stuart Goong, Ph. D. *Biological Impact of Mercury Exposure on Growth and Reproduction of Oysters.* (in preparation).

R/AT-2 - Design and Synthesis of New Anticancer and Antitubercular Agents Based on Marine Natural Product, Puupehenone. Jordan K. Zjawiony, and Mark T. Hamann, The University of Mississippi.

No students were supported during year three of this project.

R/CEH-2 - Detection and Action of Endocrine Disrupting Chemicals in Estuarine Ecosystems. Marius Brouwer, The University of Southern Mississippi.

1. Adam Kuhl, Ph.D., Department of Coastal Sciences. Expected graduation Fall 2004. Dissertation Title: *Brain Aromatase and Estrogen Receptor Involvement in Medaka Sex Reversal Induced by an Environmental Estrogen.*

R/CEH-3 - Patterns of Habitat Use of Gulf Sturgeon (Acipenser oxyrinchus desotoi) in the Northern Gulf of Mexico. Stephen T. Ross, The University of Southern Mississippi and William T. Slack, Mississippi Museum of Natural Science.

1. Ryan J. Heise, Ph.D., Department of Biological Science. August 2003. Dissertation title: *Migratory Patterns of Gulf Sturgeon, Acipenser oxyrinchus desotoi, within the Pascagoula River Drainage and Mississippi Sound.*
2. Mark A. Dugo, M.S., Department of Biological Science. August 2003. Thesis title: *Population Structure of Gulf Sturgeon, Acipenser oxyrinchus desotoi, as Inferred from Microsatellite Markers, with Emphasis on the Fine-scale Population Structure of the Pascagoula River Drainage, Mississippi.*
3. Bryant Bowen, M.S., Department of Biological Science. Expected graduation May 2005. Thesis title: *Population Genetics of Alabama Shad.*

R/CEH-4 - *Relative Importance of Seagrass versus Epiphytes in Food Webs Based on Long-Term ¹⁵N-Enrichment.* Michael J. Sullivan, Mississippi State University, and Brian Fry, Louisiana State University.

1. Troy R. Mutchler, Ph.D., Department of Biological Sciences. Degree will be awarded December 2004. Dissertation title: *Relative Importance of Seagrass versus Epiphytes in Food Webs Based on Long-Term ¹⁴N-Enrichment.*
2. Andy Sanderson, M.S., Department of Biological Sciences. Expected graduation December 2004. Thesis title: *Effects of Nutrient Enrichment on the Invertebrate Populations of a Seagrass Bed.*
3. Philip Bucolo, M.S., Department of Biological Sciences. Expected graduation May or August 2005. Thesis title: *Effects of Nutrient Enrichment on the Primary Production and Photopigments of Sediment Microalgae in Halodule wrightii Beds of Big Lagoon, Perdido Key, Florida.*

R/SP-1 - *Evaluation and Applications of Methodologies for Rapid Detection and Elimination/Reduction of Vibrio vulnificus and V. parahaemolyticus in Shellfish.* Asim K. Bej, The University of Alabama at Birmingham.

1. Amy Rizvi, M.S., Department of Biology. *Rapid Detection of Pathogenic Vibrio parahaemolyticus in Shellfish and Gulf of Mexico Water Using Multiplexed and Conventional and Real-time PCR.* 2004.
2. Gitika Panicker, Ph.D., Department of Biology. *Molecular Analysis and Detection of Vibrio vulnificus in Its Quiescent and Active State.* 2004.

R/SP-2 - *Nutritional Strategies for the Maturation and Rearing of Red Snapper.* D. Allen Davis and R.P. Phelps, Auburn University.

1. Christopher Miller, M.S. August 2003. Department of Fisheries and Allied Aquacultures. *The Effects of Dietary Protein and Lipid on Growth and Body Composition of Juvenile Red Snapper, Lutjanus campechanus.*
2. Nick Papanikos, Ph.D., Department of Fisheries and Allied Aquacultures. Expected graduation 2004.
3. Herbert Quintero, Ph.D., Department of Fisheries and Allied Aquacultures. Expected graduation 2008.

R/SP-3 - *Development of Techniques for Inland Saltwater Shrimp Farming.* D. Allen Davis and David B. Rouse, Auburn University.

1. Robby Mays, M.S. August 2003. Department of Fisheries and Allied Aquacultures. *Production and Marketing of Farfantepenaeus aztecus for the Live Bait Market.*
2. Oscar Zelaya, Ph.D., Department of Fisheries and Allied Aquacultures. Expected graduation 2004.
3. Jesus Vener, Ph.D., Department of Fisheries and Allied Aquacultures. Expected graduation 2006.

R/SP-4 - Fisheries Recruitment in the Northcentral Gulf of Mexico: Can Important Geographic Sources of Juvenile Nursery Habitat be Determined Using Otolith Microchemistry? Bruce H. Comyns, Chet F. Rakocinski, Mark S. Peterson, Alan M. Shiller, and Zhongxing Chen, The University of Southern Mississippi.

No students were supported during this reporting period since the project was continuing under a no-cost extension.

L-1 - Mississippi-Alabama Sea Grant Legal Program. Kristen M. Fletcher, (to September 2003). Stephanie E. Showalter, The University of Mississippi.

The following Juris Doctor candidates were supported by the Legal Program. Year of expected graduation follows the candidate's name.

1. Tracy Bowles, J.D., May 2004.
2. Jennifer Lindsey, J.D., May 2004.
3. Joseph Long, J.D., May 2004.
4. Jason Saverese, J.D., May 2004.
5. Leah Huffstatler, J.D., May 2005.
6. Luke Miller, J.D., May 2005.

GMO-99-25 - Selecting for Tolerance to Low Oxygen in the Eastern Oyster (*Crassostrea virginica*). Richard K. Wallace and David B. Rouse, Auburn University.

1. Courtney Ford, M.S., Department of Fisheries and Allied Aquacultures.