

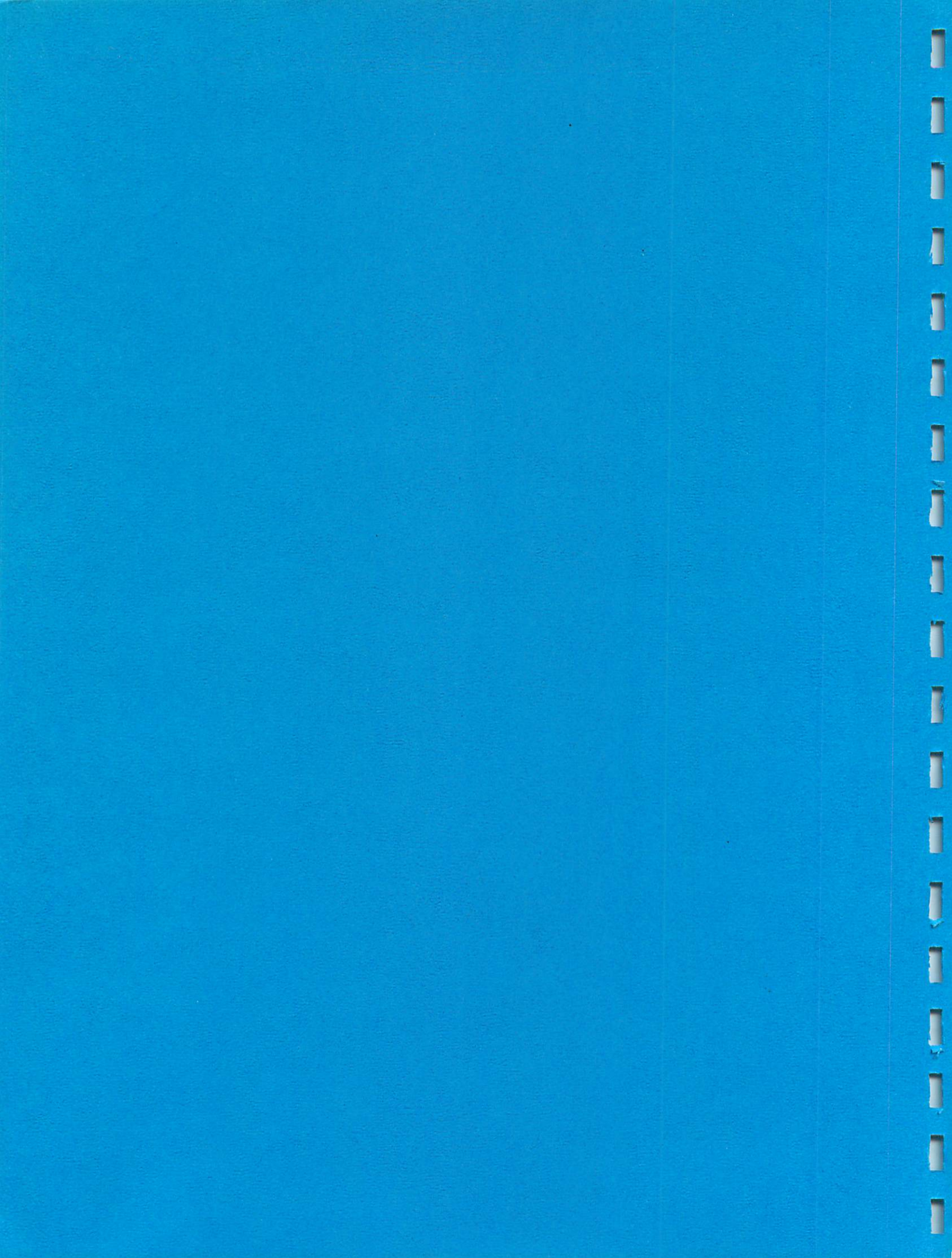
Mississippi-Alabama Sea Grant Consortium

2001-2003 Omnibus
Annual Progress Report

*for period
February 1, 2001 - January 31, 2002*



MASGP-02-009



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 which support scientific research, education and outreach efforts that foster the conservation and sustainable development of coastal and marine resources in Mississippi and Alabama. 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 (Mississippi-Alabama Sea Grant Legal Program).

This report documents progress on the 2001 Omnibus program under NOAA Grant #NA86RG0039 which began February 1, 2001, and ended on January 31, 2002. This Omnibus period is the first year of the three-year proposal package that was submitted as the 2001-2003 Omnibus Proposal. Additionally, having requested and received one-year no-cost extensions, projects included in the 1998-2000 Omnibus closed on January 31, 2001. A summary of the accomplishments of these projects is included in Appendix H.

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 the universities to produce greater benefits for the coastal communities being served. The key to achieving results is in our approach to effective partnering, efficient management and utility of program resources, and in making prudent investments in program development.

Program development funds are used to initiate single and multi-institutional projects with the intention that these seed efforts will result 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 Mississippi, Alabama, and the northern Gulf of Mexico by sponsoring workshops and symposia that bring experts together to formulate solutions.

The MASGC 2001-2003 Omnibus program started February 1, 2001. Included in this omnibus are fifteen projects: two in Advanced Technology, four in Seafood Production, three in Coastal Ecosystem Health, and six Education and Human Resources projects, as well as the Program Management and Program Development projects. A brief update on the progress of each of these projects, except for one Coastal Ecosystem Health project which doesn't begin until February 1, 2002, is included in Appendix G. Also included in the program year are four National Strategic Initiative projects as part of the Gulf Oyster Industry Initiative, one project selected for funding as part of the Minority Serving Institutions Initiative, and two projects selected for funding under the 2001 Aquatic Nuisance Species Program.

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 coasts and oceans. 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.

In June 2001, Dr. Barry Costa-Pierce resigned as the MASGC Director. Dr. LaDon Swann served as the Interim Director until May 23, 2002 when he was appointed Director by the MASGC Board of Directors. This report is the Director's report of Accomplishments and Impacts.

Funding

During program year 2001-2002 MASGC received \$1,175,000 from the National Sea Grant Office core allocation with \$1,026,385 in matching funds. In addition, MASGC had one project funded through the National Strategic Initiative for Minority Serving Institutions. This award was made to Jackson State University providing \$189,000 federal funding over a 3-year period with \$119,667 in matching funds. MASGC also sponsored seven projects through program development funds totaling \$104,680 with a \$60,960 match provided (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 2001-03 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.

The former MASGC Director, Dr. Barry Costa-Pierce, was actively involved in the central organizing committee of the EPA's Gulf of Mexico Program (GOMP) and sat as co-chair of the GOMP research committee, and was a member of the non-indigenous species committee. A joint Sea Grant-GOMP effort has pulled together stakeholders throughout the Gulf to discuss and develop plans in four priority focus areas (see <http://www.masgc.org/rschinvn/researchinventory.htm>). Involvement in this joint process has linked MASGC to new stakeholders throughout the Gulf.

Office of Alabama Programs

In May 2000, an Office of Alabama Programs was established when Dr. LaDon Swann was hired as the Associate Director for MASGC. Dr. Swann previously worked as an Aquaculture Extension Specialist with the Illinois-Indiana Sea Grant College Program located at Purdue University and the University of Illinois. The Office of Alabama Programs is located at the Auburn University Shellfish Laboratory on the campus of the Dauphin Island Sea Lab. The position is jointly funded through MASGC (49%) and Auburn University (51%) and involves administrative duties for MASGC and shellfish research for Auburn University through the Department of Fisheries and Allied Aquacultures.

Publications

This reporting period covers year one of the 2001-2003 Omnibus; therefore, a limited number of publications have been published. Several publications are at various stages of the publishing process. However, during the current reporting period, MASGC sponsored research that led to three abstracts, two presentations, and one invention disclosure. Extension, the Legal Program, and Communications production included 15 outreach publications, 7 Web pages, 5 articles, 13 presentations, 4 Legal Reporters, 18 newsletters, 3 communications products, and 4 extension publications.

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 first year of this Omnibus, MASGC sponsored research has led to the training of 1 Research Scientist, 4 Ph.D. candidates, 13 M.S. candidates, 8 J.D. candidates and 1 undergraduate student.

The MASGC Marine Science Scholars (MSS) Program provided \$5,000 fellowships to five graduate students through non-federal funds.

Exemplary Impacts

- In May 2001 the MASGC Board approved Jackson State University's (JSU) application as a member of the MASGC. JSU, an urban Minority Serving Institution (MSI) was an original member of MASGC but left the Consortium during the 1980s due to financial issues.
- MASGC organized the Open Ocean Aquaculture IV Symposium, an international scientific meeting held in St. Andrews, New Brunswick, Canada on June 17-20, 2001. The symposium featured speakers from 13 countries providing 36 presentations to 130 attendees. Twenty-two sponsors including 11 Sea Grant programs, as well as the National Sea Grant Office, helped fund this first foreign venue of the symposia series. As a result of this symposium, a proceedings is being produced (see: http://www-org.usm.edu/~ooa/ooa_iv/ooa4index.html).
- The Aquaculture Network Information Center (AquaNIC) is working in partnership with the NOAA Central Library to further the National Sea Grant sponsored Network of Aquaculture Information Systems. AquaNIC was developed in 1994 as the first U.S. aquaculture Web site and is co-hosted by the Mississippi-Alabama Sea Grant Consortium, the Illinois-Indiana Sea Grant College Program, and Purdue University. Dr. LaDon Swann, MASGC Director, is the Coordinator of AquaNIC
- In the fall of 2001, the Mississippi-Alabama Sea Grant Legal Program was notified of the success of its proposal to become the National Sea Grant Law Center.

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APPENDICES

**Appendix A - Activities Supported from Program
Development Funds**

Appendix B - Collaborating Institutions

Appendix C - Sources of Significant Non-federal Funding

Appendix D - Publication List

Appendix E - Students Supported

Appendix F - Program Awards and Honors

Appendix G - 2001-2003 Omnibus Projects

Appendix H - 1998-2000 Omnibus Projects

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Appendix A

Activities Supported From Program Development Funds

Program Year 2001

Project #	Amount Funded	Project Information
ED-2-PD	\$ 2,500	Mark T. Hamann, Ph.D., The University of Mississippi <i>A Sponge Taxonomy Workshop and Novel Approaches to the Classification of Species in the Phylum Porifera</i>
R/AT-3-PD	\$15,233	Marc Slattery, Ph.D. - The University of Mississippi <i>Hybridization in Soft Corals - Combinatorial Genetics and Drug Discovery</i>
R/ER-49-PD	\$ 9,876	J. Stephen Brewer, Ph.D. - The University of Mississippi <i>Anthropogenic Eutrophication of Salt Marsh Communities: Interactions Between Environmental Stress & Nutrient Addition</i>
R/ER-50-PD	\$23,390	Thomas P. Cathcart, Ph.D. - Mississippi State University <i>Implementation of Landscape Management and Native Planting for the Man-Made Beach in Biloxi, MS</i>
R/ER-51-PD	\$20,000	Michael J. Sullivan, Ph.D. - Mississippi State University <i>Use of ¹⁵Nitrogen Enrichment to Assess Organic Matter Production and Utilization in an Essential Fisheries Habitat</i>
R/PS-1-PD	\$12,810	Scott L. Douglass, Ph.D. - University of South Alabama <i>America's Beaches: The Causes Of and Solutions To Erosion Problems</i>
R/SP-5-PD	\$20,871	James H. Cowan, Jr., Ph.D. - University of South Alabama <i>Fisheries Habitat of Juvenile Red Snapper in the Northern Gulf of Mexico</i>

Appendix B

Collaborating Institutions

Auburn University, Auburn, Alabama

Land-grant university with the largest on-campus enrollment in the state of 22,469 students

Dauphin Island Sea Lab, Dauphin Island, Alabama

Alabama's marine education and research center with 22 member institutions

Illinois-Indiana Sea Grant College Program and Purdue University

Collaborators with MASGC in the Aquaculture Network Information Center (AquaNIC)

Jackson State University, Jackson, Mississippi

The Urban University of Mississippi, this HBCU has an enrollment of more than 6,820 students

Louisiana State University, Baton Rouge, Louisiana

Flagship institution of Louisiana, holding both land-grant and sea-grant status

Mississippi State University, Starkville, Mississippi

Land-grant university with an enrollment of more than 16,000 students

Mobile County Public School System, Mobile, Alabama

Largest public school system in Alabama with an average enrollment exceeding 66,000 students

The University of Alabama, Tuscaloosa, Alabama

Alabama's first university now has an enrollment of 19,171 students

The University of Alabama at Birmingham, Birmingham, Alabama

One of the three institutions comprising the University of Alabama system; enrollment of 15,676

The University of Florida, Gainesville, Florida

Land-grant, research university; the state's oldest, largest, and most comprehensive university

The University of Mississippi, Oxford, Mississippi

The flagship university of the state; enrollment of 14,500 students

The University of Southern Mississippi, Hattiesburg, Mississippi

Host university for Mississippi-Alabama Sea Grant Consortium; enrollment of 15,000 students

University of South Alabama, Mobile, Alabama

Only major public institution of higher learning on the upper Gulf Coast;
enrollment of 12,000 students

Appendix C
Sources of Significant Non-federal Funding
Program Year 2001

Funding Source	Amount
Mississippi State Appropriation	\$175,000
Mississippi-Alabama Sea Grant Consortium Subscriber Fees	\$112,500
TOTAL	\$287,500

Appendix F

Program Awards and Honors

Dr. D. LaDon Swann was presented with a Distinguished Service Award from the U.S. Aquaculture Society.

Appendix G

2001-2003 Omnibus Progress Reports

Advanced Technology

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 are to develop oyster cDNA microarray technology for study of genomic expression signatures (GES) in response to environmental agents; to identify genes affected by mercury, under both acute and more subtle, long-term exposures using the microarray technology; and to determine the effect of exposures to mercury on survival, growth, and reproduction.

Marine organisms respond to environmental contamination by regulating their gene expression. Each pollutant may induce a characteristic set of genes to form its genomic expression signature. Such a signature can be identified using the state-of-the-art genechip technology. The cDNA microarrays will provide advanced technological tools for study of other environmental stresses and offer highly sensitive and reliable indicators for monitoring biological impact of environmental pollution.

Two cDNA libraries have been constructed. These gene libraries represent a whole collection of all expressed genes in the gill and in the gonad, respectively. Over 1,000 expressed sequence tags (ESTs) from oysters have been sequenced. These ESTs represent more than 200 known genes and many unknown genes. The ESTs were sequenced, and then their sequences were analyzed by homology comparisons using GenBank databases at the National Center for Biotechnology Information. For the most part, the sequences were analyzed using BLAST searches. BLASTN was used to search against GenBank nucleotide sequences (DNA sequences). This BLASTN search identified oyster genes to their known counterparts from other organisms (orthologs). However, oysters belong to invertebrate animals that are quite different from vertebrate animals. Most known gene sequences in the databases are from vertebrate animals; therefore, the homology searches using BLASTN generally can only identify genes with extremely high similarity to existing genes. Next, BLASTX was used for similarity comparisons. This program allows genes to be translated into protein sequences and then conduct similarity comparison. This second step allowed identities of many more genes to be identified. Nonetheless, once again, the identities of many ESTs could not be identified at present because the lack of invertebrate sequences in the databases.

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

The primary objectives of this research project are to synthesize a library of puupehenone derivatives by combinatorial chemistry in order to optimize their anticancer and antitubercular activity, and also to synthesize puupehenone analogs with simplified structure having the same pharmacophore as the most active natural and semisynthetic analogs.

Puupehenone and its derivatives show a wide variety of biological properties, including cytotoxicity, antiviral, antifungal, antimalarial, and immunomodulatory activities. Puupehenone was found to be active against cancer cell lines and melanoma. At similar concentrations, puupehenone inhibits DNA and protein synthesis. The derivatives produced by this study are currently being tested against four cancer cell lines at Biomar S.A., Madrid, Spain, and against tuberculosis at the TAACF, Southern Research Institute in Birmingham, Alabama.

During the first year of this project, problems were encountered with re-oxidation of sulfur-containing derivatives of puupehenone. One of the objectives of this project is to re-oxidize some of the selected semi-synthetic products to puupehenone derivatives with quinine-methide moiety, in order to maintain their antitubercular activity. So far, the researchers have not been able to oxidize the sulfur-containing analogs of puupehenone without oxidizing the sulfur in the side chain. They will continue their efforts to find the selective conditions of oxidation in the coming year.

Seafood Production

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.

The objectives of this project are to evaluate and develop the state-of-the-art methodologies for rapid detection of total and pathogenic strains of *Vibrio vulnificus* and *V. parahaemolyticus* in shellfish and to evaluate methodologies for their reduction or inactivation after harvest. In addition, the effectiveness of these methodologies will be applied to oysters collected from the Gulf of Mexico at various time intervals during a 1-year period. Finally, the most effective detection and inactivation methodologies will be transferred to APHA, U.S. FDA, and other agencies including shellfish industries for validation followed by distribution of the methodologies to the shellfish industry.

A total of 160 *V. vulnificus* strains including 64 pathogenic strains were tested by multiplex PCR to determine the specificity of the selected oligonucleotide primers and the probes. The applicability of the multiplex PCR-based detection of total and pathogenic *V. vulnificus* was determined by testing the presence of this pathogen in Gulf waters and shellfish tissue homogenate.

All *V. vulnificus* strains exhibited positive PCR amplification for the *cth* gene and approximately 97% of the clinical isolates were positive for the *viuB* gene. The sensitivity of detection of this pathogen in pure culture and in Gulf water was 10 cells per mL, which is well within the FDA and APHA required detection levels.

The preparation of the targeted microbial genomic DNA from Gulf water or from the shellfish tissue that is devoid of inhibitory chemicals and compatible with the PCR reaction has been challenging to all investigators. Investigation of the best method for the detection of the targeted microorganisms in Gulf water samples has been performed by using commercially available DNA purification kits as well as the simple method of centrifugation followed by boiling the samples. So far concentration of the Gulf water sample (1 mL to 100 mL) by centrifugation followed by boiling has shown the maximum sensitivity of detection of the targeted microbial pathogen by conventional as well as by real-time PCR approaches. Evaluation of additional commercially available DNA purification kits continues.

Use of "mantle fluid" instead of the oyster tissue homogenate (which is recommended by the FDA BAM and conventionally used) for the purification of targeted microbial DNA from the shellfish has been attempted, with promising results. Work continues on the applicability of this approach for real time PCR detection of the targeted microbial pathogens.

The detection of *tdh* mRNA from *V. parahaemolyticus* by RT-PCR and NASBA procedures is being investigated. The Nucleic Acids Sequence Based Amplication (NASBA) is an enzymatic isothermal mRNA amplification method that does not require the thermocycler instrument. This approach has the ability to generate one billion amplicons from a single copy of mRNA whereas the PCR approach has the capability to produce only one million copies of amplicon. This approach has been initiated to determine if this procedure can be rapid and superior to the conventional RT-PCR method.

Detection of a specific message from the targeted microbial pathogens will allow researchers to determine whether the microbial pathogen of interest is viable in the shellfish. Determining the viability of a microbial pathogen will allow for a firm conclusion as to the safety of the shellfish for consumption. Also, this would help determine the presence of "injured" microbial pathogens that are capable of resuscitation. The message was detected from the *tdh* gene in viable *V. parahaemolyticus* using the RT-PCR approach.

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.

Current spawning data indicates that red snapper brood stock nutrition is significantly impairing the quality of eggs and larvae produced under captive conditions. One component of this project will be to evaluate the influence of selected dietary components on egg and larval quality. A second component is geared towards the development of basic nutritional data of juveniles and sub-adult fish. Such data is required not only to design nutritionally adequate diets but the data collected will also help researchers understand the growth potential of this species and their efficiency in using prepared feeds.

Broodstock were offered test diets for approximately three months and were then terminated and the ovaries were then analyzed for lipid and fatty acid content. This data will serve as baseline data to establish levels of FA in wild and laboratory maintained snapper. A second set of broodstock has been maintained on the diets for about four months and are scheduled to be cycled into summer conditions this spring.

In order to establish basic nutritional parameters for practical diet formulations, three juvenile growth trials were initiated. Two trials were run in a new semi-closed recirculation system and were designed to look at protein requirements; however, due to repeated systems problems, these growth trials could not be completed. The third growth trial in which dietary lipid levels were evaluated was successfully completed in a different recirculation system. Biochemical analyses of whole body samples are being conducted.

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.

This project was originally proposed by Dr. David R. Teichert-Coddington; however, Dr. Teichert-Coddington left the university and requested that Dr. Davis, a former co-PI become the Principal Investigator on the project.

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.

Acclimation procedures for various post-larval stages to low salinity water were developed. An effect of post-larval age on acclimation rate of shrimp to low salinity water and on minimum salinity tolerance was detected. Characterization of various waters indicates that the ionic profile of inland well waters varies considerably from site to site, even if wells are less than one kilometer apart. Due to variability in well waters, short term survival of post-larval varied among water sources and among age classes. Results of the long term growth studies support observations made during short term survival assays about the variability in water suitability for shrimp culture. Potassium and Magnesium concentrations appear to affect survival and growth.

Crude management practices for onsite nursing of post-larvals were developed and will be refined in subsequent work. The effect of the length of nursing periods on pond production and size distribution of shrimp at harvest were examined. Results of the nursing period experiment suggest that the stocking size of post-larvals into ponds affects final harvest size irrespective of nursing.

The first phase of a three tier study on the environmental impact of low salinity water seepage in aquaculture ponds was performed. First year samples of pond bottom soils were taken and surrounding shallow wells were tested. No effects of salt seepage were detected.

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, Ph.D., Chet F. Rakocinski, Ph.D., Mark S. Peterson, Ph.D., Alan M. Shiller, Ph.D., and Zhongxing Chen, Ph.D., The University of Southern Mississippi.

The objectives of this project are to collect young juvenile spotted seatrout from nine potential nursery areas extending from Grand Bay, Alabama to the Louisiana marshes east of the Mississippi River; to remove sagittal otoliths from juveniles and determine if the areas where these fish were collected can be distinguished by "elemental fingerprinting" of the otoliths; and to determine how precisely additional juveniles can be categorized based on spatial patterns of otolith microchemistry.

Sampling for juvenile spotted seatrout in Mississippi estuarine waters was conducted during September and October in Grand Bay, Pascagoula River, Back Bay, Horn Island, St. Louis Bay, Cat Island, and the Pearl River/Rigolets. Collections were also taken in Louisiana waters at the Chandeleur Islands and in the Louisiana Marshes southwest of the western end of the Mississippi Sound. A total of 236 spotted seatrout were measured, weighed, and the left and right otoliths were removed and processed. Carbon isotopes show the greatest potential

Data from Cat Island, Grand Bay, Horn Island, St. Louis Bay, and Back Bay have been analyzed. Five trace elements found to be relatively abundant in otoliths were sodium, magnesium, manganese, strontium, and barium. Molar concentrations of these elements were expressed as ratios to the molar concentration of calcium. Of these elements, manganese and barium showed significant differences between many of the regions. Data from the remaining four regions is currently being compiled.

It is very encouraging that these elements, even when used alone, provided a high degree of separation between fish collected in many of the estuarine areas analyzed to date.

Coastal Ecosystem Health

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

This project has three objectives: (1) to establish conditions for the study on effects of endocrine disrupting chemicals (EDCs) on fish reproduction in the laboratory that are relevant to field conditions; (2) to develop a fish liver cell-based screening tool for detection of (anti)estrogenic chemicals in estuarine waters and sediments; and (3) to test the hypothesis that sex reversal in a medaka strain, in which body color is sex-linked, may provide an easy, and sensitive screening tool for EDCs: the Red Fish/White Fish (RWF) assay.

Objective one, studying the effects of endocrine disrupting chemicals in fish reproduction has been completed. It was found that increasing the numbers of estradiol exposed males in breeding groups did not result in attenuation of the effect of estradiol treatment. Moreover, addition of control male fish to groups of estradiol exposed males, while keeping the total number of male fish constant, did not result in salvage of the effects of estradiol exposure. These findings suggest that "healthy" unexposed fish cannot compensate for the harmful effects of exposure to estrogenic chemicals on fish reproduction. This, in turn, implies that any individual fish that is adversely impacted by EDCs in the environment will contribute to impaired reproduction of the population as a whole.

The actual establishment of liver cell lines (objective two) from *Cyprinodon variegatus* is proceeding slightly slower than expected due to some unanticipated setbacks. Procedures for removal of livers from adult male and female *Cyprinodon* and establishment of an initial cell culture in 35 mm Petri dishes have been established and successfully accomplished on three separate occasions. Fish hepatocytes grow slowly, with a doubling time of every 2-4 days. Problems with the incubation system resulted in death of the first cell line. Subsequently, a monolayer of epithelial cells from the second hepatocyte preparation was successfully transferred from the 35 mm Petri dishes to 96 well cell culture plates using cloning rings. The cultures in the plates grew well and formed a continuous cell layer within the wells in the plates within 2-3 weeks. However, transfer of these successful cultures to 24 well cell culture plates resulted in eventual death of the cultures. The cells never attached well to form a monolayer of cells. Discussions with experts in fish liver cell culture revealed that fish hepatocytes do not grow well in 24 well culture plates. This step in expanding the cell lines has been eliminated from the original published procedure. Additionally, modifications in the procedure for transfer of cells should also help cell attachment and growth in subsequent efforts. With the experience gained in the cell culture techniques, it is anticipated that the establishment of cell lines that can be used for testing should be available within six months.

Newly hatched fry of the medaka d-rR strain, in which body color is sex-linked, have been exposed to five different concentrations of estradiol for two weeks. Fish were transferred to grow-out and examined for percent sex reversal once sexually mature. Complete sex reversal was observed at 2 ppb. Experiments to determine the effects of an androgenic chemical (testosterone), a xenoestrogen (o,p-DDT) and an antiestrogen (anthracene) will be completed this spring.

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.

During this project, 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.

During 2001, 32 sonic transmitters were attached to Gulf sturgeon. Four sonic tags were attached to fish as they were first moving into fresh water during March and April. The remaining tags were attached during June and July when the fish were in their summer holding area on the lower Pascagoula River.

Seaward migration of Gulf sturgeon first started in late August (one fish) following a spike in river discharge. Most fish left fresh water in October and November at an average water temperature of 23 C. The first telemetry recoveries of Gulf sturgeon in October were in the lower salinity water of the East and West Pascagoula Rivers. All telemetry stations, with the exception of those on 5/4/01, have been located using a GPS system. Coverage of nearshore areas and barrier island areas is generally good. Less effort has been devoted to the western section of Mississippi Sound and Lake Borgne because this area is also being searched by personnel from Louisiana Department of Wildlife and Fisheries. Surveys in offshore regions are being increased as well as increasing coverage within Mississippi Sound.

The data show that once Gulf sturgeon leave their river mouth estuary, they tend to be found near barrier islands or in barrier island passes. However, not all sonic-tagged Gulf sturgeon have been located once they move to salt water. This may be due to tag failure or to fish moving outside the area where the search is taking place.

Gulf sturgeon tagged in the Pearl River have been located as far east as Dauphin Island, Alabama. Gulf sturgeon from the Pascagoula River show an east-west pattern of coastal movement. Nearshore sampling is being increased, to include additional gill netting with smaller mesh nets in an effort to capture juvenile Gulf sturgeon.

Education and Human Resources

Education

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

During the 2001 project year, 37 teachers and over 500 students from 18 elementary schools participated in Sea Grant sponsored wetland learning experiences at the Environmental Studies Center. Project implementation focused on four major areas of activity: teacher training, resource development and distribution, student field trips, and maintenance of teaching exhibits.

Teachers enrolled in the project attended a 1-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. The following specific outcomes were achieved:

1. Familiarized teachers with the Environmental Studies Center's facilities, program opportunities, and instructional resources,
2. Identified Sea Grant as the funding agency and revealed complementary projects throughout the national education and human resources network for Omnibus 2001-2003.
3. Identified and reinforced the objectives of the Mobile County project (*The ABCs of Wetlands*).
4. Introduced the Project's field trip plan and engaged teachers in hands-on participation in the prescribed activity agenda.
5. Acquainted participants with materials to be used in pre- and post-field trip enrichment activities.
6. Identified and advised teachers regarding logistics for a successful field excursion (permission slips, release forms, bus acquisitions, chaperones, lunch arrangements, and other infrastructure components).
7. Completed field trip scheduling for individual class visitation to the Environmental Studies Center.
8. Evaluated the participants' basic knowledge of wetlands using pre-post testing.

Following the teacher workshop, teachers were scheduled for a return field trip to the Center with their classes highlighting wetland habitats, the many organisms they support and the causes threatening their demise. While on the field trip, the students were introduced to the unique assemblage of plants in a wetland bog, the living diversity of a bottomland forest, and living examples of birds and mammals that depend on wetlands for shelter and food. Among the animals featured were herons, brown pelicans, gulls, wood ducks, eagles, raccoons, white-tailed deer, various venomous and non-venomous snakes, and the American alligator. Using a special video system, the students were also introduced to numerous marine organisms on exhibit in the Center's saltwater teaching aquarium. Following the

video tour of the aquarium, the class concluded with a discussion on marine debris and its impact on sea life and other coastal inhabitants.

Slight alteration of the project time line was required as a result of structural problems experienced with the Center's instructional building in July 2001. Originally scheduled for August 2001, the teacher workshop was rescheduled for September 18, 2001. Roof damage resulted in condemnation of the building, necessitating removal to temporary facilities while renovation is in progress. Although in portable facilities, all physical requirements necessary to fulfill program objectives are currently in place. Completion of the renovation effort is scheduled for early fall 2002.

The 2001 project year was the first of a 3-year effort to provide some 114 Mobile County Public School System teachers from 58 elementary schools with the training and resources to incorporate the study of wetland and marine ecosystems into their science programs. Approximately one third of targeted schools, represented by 38 teachers from kindergarten through third grade, were involved in this year's work. Two teachers from each of the remaining schools are scheduled to participate in the project over the course of the next two years.

Marine Extension Program

EX-1 - Alabama Sea Grant Extension Program. Richard K. Wallace, Ph.D., and Brian E. Perkins, Auburn University.

The Alabama Sea Grant Extension conducted ongoing outreach programs in the areas of seafood technology, marine fisheries, aquaculture, and environmental.

Seafood safety was addressed through a series of Hazard Analysis Critical Control Point (HACCP) workshops conducted in Alabama, Mississippi, and Georgia in cooperation with state Sea Grant programs and health authorities. Individual assistance was provided to processors experiencing problems with FDA inspections. Consumers received up-to-date information on seafood through the newspaper column and personal contacts.

Marine fisheries and aquaculture issues were addressed through the *Sea Harvest News* newsletter, newspaper columns, and numerous personal contacts. An "Oyster Gardening" project was supported in conjunction with the Mobile Bay National Estuarine Program, the Alabama Marine Resources Division, the Alabama Public Health Department, and the Auburn University Department of Fisheries and Allied Aquacultures. A local high school aquaculture program received ongoing technical support. Opportunities for expansion of this program and development of new programs at other schools continue to be sought.

Watershed management and water quality are the focus in the environmental program area. Close cooperation with local Soil Conservation Districts has resulted in being the facilitator for the Coastal Clean Water Partnership. The Partnership, headed by a steering committee, is identifying not only stream segments for remediation, but projects that will lead to cleaner water. Local watershed organizations are being provided information on the Partnership as well as assistance in developing projects. Numerous presentations to civic groups, schools, and public officials have been made and volunteer water quality monitors trained.

EX-2 - Mississippi Sea Grant Extension Program. C. David Veal, Ph.D., Mississippi State University.

Coastal Ecosystems and Habitats

Plans for the expansion of the Master Naturalist Program to other regions of the state progressed in 2001 with the completion of a class of naturalists in the northern Delta region. The Delta Region course was conducted from February through May with 10 volunteers completing the course. The southwest region, central region (i.e., Jackson area), and additional portions of the southeast region are targeted areas for program development in 2000-2003. Equipment to support this program was also purchased in 2001, including a digital camera and digital projector that will be used to support training and curriculum development. A proposal to expand the Master Naturalist Web page was also prepared and submitted to a number of potential funding sources. In addition to training and support information, this Web page would incorporate other Master Naturalist efforts, such as the Coastal Adopt-A-Stream program, habitat inventories, and links to other partner sites. A nine-member group of Master Naturalists attended the Southern Region Volunteer Leader Forum at Rock Eagle, Georgia in October and conducted a workshop on Nature Awareness.

Dr. Mark LaSalle was designated as the Chairman of the Extension Southern Region Master Naturalist Task Force in August of 1999. This task force held its first meeting in March 2001 in Atlanta to outline its strategy for developing a regional framework for the Master Naturalist program. The task force has worked during the past 18 months to draft a strategy document that will serve to direct future development of Master Naturalist programs in other states and the coordination of programs across the region. Dr. LaSalle coordinated an oral presentation about this effort for the 2001 North American Association of Environmental Educators conference held in Little Rock, Arkansas.

The Coastal Adopt-A-Stream program, which began during 1999-2000, was expanded in 2001. An Adopt-A-Stream workshop was held in July. Five additional sites were adopted in 2001, with as many as four more to be adopted in 2002. Currently 12 sites have been adopted across the 6-coastal county region, including 7 tidal and 5 freshwater sites.

A state-level effort to establish the Mississippi Watershed Forum was initiated in 2001. Dr. LaSalle served on the planning committee for the first Mississippi Watershed Roundtable, held in Raymond, MS on September 12-13. This effort will be expanded by conducting a Coastal Basin Watershed Roundtable which will be held in March 2002. Planning for this event began in December 2001.

Economics

Educational programs are based on past, present, and future economic information needs of southern and coastal Mississippi to better manage its coastal marine resources and sustain economic growth in the coastal communities. These needs are determined through constant interaction with industry, regulators, resource managers, county agents, and extension specialists conducted during office visits, farm visits, telephone and e-mail conversations, meetings, conferences, and trade shows. The objective of the fisheries economics and marketing section is to provide economic information on the major commercial, underutilized, and bycatch species. This information is transmitted to users through extension and research reports, personal communications and telephone interviews, and website (<http://msstate.edu/dept/crec/fwmmr.html>). The aquaculture economics and marketing section provides economic, marketing, and technical information on the major commercial aquaculture species which have potential in the Mississippi Gulf Coast. Economic analyses of existing and proposed aquaculture enterprises are also conducted for certain species or production system. This information is disseminated through the monthly wholesale market reports, extension publications, presentations in workshops and

conferences, telephone interviews, farm visits, and website (<http://msstate.edu/dept/crec/awmr.html>). The public access to coastal Mississippi section provides economic, management, and technical information on public access to the Mississippi Gulf Coast beaches, piers, marinas, and artificial reefs. The following information is available at the CREC Coastal Mississippi Public Access webpage: description and location of public access, investment requirements, operating costs, pricing structure, and economic impact (<http://msstate.edu/dept/crec/access.html>). The economics of seafood processing and safety section provides economic and marketing information on commercial seafood processing in the Mississippi Gulf Coast. Expected output includes the following: processing production, plant-gate values and prices; processing, HACCP and post-harvest treatment costs; alternatives for collection, transport and disposal of processing wastes; economic impact of processing industry; foreign trade, domestic consumption, and consumer attitudes; product forms, sources, quantities and prices in domestic and foreign markets (<http://www.msstate.edu/dept/crec/esps.html>). In 2001, a major effort was begun to evaluate the economic feasibility of grow-out culture of three finfish species in the offshore waters of the Gulf of Mexico. Specifically, it aims to achieve the following objectives: to determine investment and operation costs, including input levels, prices, and yields, for commercial offshore grow-out culture of selected finfish species in the Gulf of Mexico; and to develop a marketing plan and a base model business plan for offshore grow-out culture of selected finfish species in the Gulf of Mexico.

Fisheries

Work was continued with technology transfer in the use of turtle excluder devices (TEDs) and bycatch reduction devices (BRDs) by the shrimp fleet in the northern Gulf. Most of the work consisted of one-on-one dockside visits and demonstrations in small "town hall" type meetings. Details were also provided through office visits by commercial fishermen and news releases. Information regarding TED and BRD regulations, design and availability was also distributed through a network of regional marine suppliers. Dockside visits with shrimpers were used to demonstrate how to choose, install, and correctly fish with TEDs and BRDs in order to minimize shrimp loss. Gear research and technology transfer activities address the issue of bycatch in the Gulf shrimp fishery. Reductions in unwanted bycatch of up to 50 percent with no loss in shrimp production have been documented. During 2001, Dave Burrage conducted over 70 dockside demonstrations showing fishermen how to comply with federal and state fishery management regulations while minimizing production losses and downtime. Mr. Burrage also prepared a monthly newsletter, *Gulf Coast Fisherman*, for distribution to commercial and recreational fishermen, fishery managers, educators, and seafood businesses. (Total circulation is 600, primarily in the Gulf and South Atlantic region). The newsletter is also distributed by posting on the Internet and by e-mail.

Legal

L-1 - Mississippi-Alabama Sea Grant Legal Program. Kristen M. Fletcher, LL.M., Tammy L. Shaw, J.D., Richard J. McLaughlin, J.S.D., and William Hooper, Jr., J.D., The University of Mississippi.

The staff of the Legal Program responded to a total of 31 advisory requests in 2001 (11 from Mississippi, 11 from Alabama, 6 from other states, and 3 from other countries). Constituents ranged from federal agencies to state agencies and from industry representatives to Sea Grant Extension staff. Legal Program attorneys contributed nine publications to Law Reporters and Journals and presented legal research results at eight conferences and workshops. Four issues of the *Water Log Legal Reporter* were published and distributed to over 1,000 subscribers. Eight law students were trained in legal research and writing. Legal Program attorneys taught six classes relating to the field of marine, ocean and coastal law.

The Legal Program recognizes that the importance of marine law and policy to the Gulf of Mexico depends upon national and international issues. Gulf issues analyzed by the Legal Program will have an increasingly important impact on national laws and policies, as well. The Legal Program is making efforts to increase its outreach and advisory to a national audience especially in the effort of marine habitat conservation and preservation, marine zoning, and the integration of the public trust doctrine and the public interest into coastal decision-making. The award to the University of Mississippi for the National Sea Grant Law Center will assist in these efforts and allow the Legal Program to expand its research to meet more national needs.

Ms Tammy L. Shaw left the Legal Program at the end of September. This vacancy resulted in a delay in conducting research. However, as the searches for two attorneys are in late stages, these positions should be filled soon and the Legal Program will return to its full research and advisory capacity.

L-2 - Marine Habitat Conservation: Law and Policy Outreach. Kristen M. Fletcher, LL.M., Richard J. McLaughlin, J.S.D., and Tammy L. Shaw, J.D., The University of Mississippi.

Work on this project will be directed toward identifying legal and policy issues concerning marine habitat conservation facing law makers, ocean and coastal resource managers, and user groups; to analyze Marine Reserves and Marine Protected Areas in the Gulf region and publish a book entitled *Gulf of Mexico Marine Protected Areas* that will offer extensive research on all marine protected areas and marine reserves in the Gulf of Mexico, including analysis of the enabling legislations, restrictions on uses, and enforcement within the area; to analyze the Implementation of Essential Fish Habitat Provisions and publish a law journal article which will be made available to federal agencies responsible for the conservation of Essential Fish Habitat; to analyze the use of Conservation Easements in coastal Alabama and Mississippi to determine how their use can offer protection of coastal habitats including estuaries and critical wetland areas and publish a law journal article and a practical guide to creating conservation easements in the bi-state area; to provide outreach to resource managers and Sea Grant constituent organizations with legal research on habitat-related ocean and coastal policy issues; to train law students in writing and research on marine habitat-related issues.

Research was begun on the book to be published on Marine Reserves in the Gulf of Mexico, however, Ms. Tammy L. Shaw left the Program at the end of September. This vacancy resulted in a delay in conducting research. Searches for two attorneys are in late stages and these positions should be filled soon.

Communications

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

In April 2001, the communications program launched *Sea Briefs*, MASGC's newsletter replacing the defunct *Force Five* newsletter last published in the Spring of 1998. The quarterly two-page, four-color publication focuses on delivering news highlights concerning MASGC research and outreach projects. Work also began on redesigning the MASGC Web; however, during the fall of 2001 the communications program lost its web designer midway through the redesign. With the installation of a new part-time web designer, MASGC launched a completely redesigned Web site that offered a cleaner, more colorful look, as well as being easier to navigate. At the present time, the Web site receives approximately 2,000 hits per month.

During the year, Communications participated in the following activities: Earth Day at Gulf Islands National Seashore, Mississippi Regional Science Fair, booth participant at the Coastal Development Conference along with Mississippi Extension Program personnel, Alabama Public Outreach Task Force, Alabama Deep Sea Fishing Rodeo, Mobile Boat Show, Annual Board of Directors Meeting, and Mississippi Coastal Cleanup.

In addition, the Communicator took on the following additional responsibilities: acting as Regional Representative for the Sea Grant Southeast Atlantic and Gulf Communicators Network (7 partners); MASGC Management Team member; Writer for the National Sea Grant Office's Biennial Report; Panelist for a Communications Seminar at the National Sea Grant Week Conference; and acted as representative for 12 Sea Grant Programs at Aquaculture 2002.

In other MASGC-related activities, Reid co-organized Open Ocean Aquaculture IV, an international symposium held in St. Andrews, New Brunswick, Canada. The symposium attracted 130 participants from 13 countries. At the International Marine Bioinvasions Conference held in New Orleans, LA, Reid was in charge of all media relations and marketing for the conference. Additionally, he developed a Web site for the annual Mississippi Coastal Clean-up and participated as an exhibitor at the Alabama Deep Sea Fishing Rodeo, the NOAA/Jackson State University's Expanding Opportunities in Oceanic and Atmospheric Sciences Conference, and the Atlantic Aquaculture Exposition.

The communicator also participated in the promotion and reporting of the Mobile Bay Oyster Gardening Program, culminating in a "Media Day" in which the local press and TV stations covered the harvesting of more than 30,000 oysters from the volunteers' oyster cages. Several local newspapers and a morning TV show covered the event or followed up with stories in their publications.

M/PA-1 and M/PD-1 - Program Administration and Program Development. D. LaDon Swann, Ph.D., Mississippi-Alabama Sea Grant Consortium.

The MASGC Marine Science Scholars Program provided \$5,000 support to the following graduate students through "other source" funds:

Stacy L. Harter University of South Alabama, M.S. candidate
Eric R. Hoffmayer, The University of Mississippi, Ph.D. candidate
W. Joseph Lambert, The University of Alabama, M.S. candidate
Jonathan C. Martin, University of South Alabama, M.S. candidate
Kersten N. Wheeler, The University of Southern Mississippi, M.S. candidate

Four Program Development (PD) projects were funded for a total of \$51,414 Sea Grant funds. The projects selected for funding are:

A Sponge Taxonomy Workshop and Novel Approaches to the Classification of Species in the Phylum Porifera (Education - ED-2-PD). Mark T. Hamann, Ph.D., The University of Mississippi (\$2,500).

There is a shortage of individuals trained in the methods for taxonomic identification of invertebrates; therefore, this workshop was organized to train students in sponge taxonomy and spicule preparation.

The workshop was held October 15-17, 2001 at The University of Mississippi's Department of Pharmacognosy with Dr. Michelle Kelly of the National Institute of Water and Atmospheric Research,

Auckland, New Zealand, instructing. This workshop was also sponsored by Monsanto, Sequoia Sciences, and the National Institute of Health. More than half (11) of the 21 participants have doctoral degrees.

As a result of this workshop, a need for an identification manual has been recognized. Dr. Hamann and Dr. Kelly are looking into the possibility of developing such a manual.

Hybridization in Soft Corals - Combinatorial Genetics and Drug Discovery (Advanced Technology - R/AT-3-PD). Marc Slattery, Ph.D., The University of Mississippi (\$15,233).

The objectives of this study were (1) to confirm hybridization between the soft corals *Sinularia maxima* and *S. polydactyla*, (2) to determine whether the F₁ hybrids exhibit resistance similar to or different than that of the parent species, and (3) to assess the biomedical potential of novel hybrid secondary metabolites. *Sinularia maxima* and *S. polydactyla* were spawned in the laboratory and produced F₁ hybrids. Extracts of the parent species were compared to hybrids for resistance in feeding and microbial assays. A novel hybrid metabolite was tested to determine its impact on predator deterrence. The hybrid chemistry in a number of antimicrobial assays was assessed at the National Center for Natural Products Research.

Research to date has verified that the soft coral hybrid *Sinularia maxima* and *S. polydactyla* is a product of natural reproductive crosses, and this F₁ cross is superior to either parent species with respect to predator and microbial resistance.

This work has resulted in presentations at two national meetings, a paper which is being prepared for *Nature*, and requisite data for an NSF proposal (submitted August 15, 2002).

America's Beaches: The Causes of and Solutions to Erosion Problems (Public Safety - R/PS-1-PD). Scott L. Douglass, Ph.D., University of South Alabama (\$12,810).

The objective of this project was to develop a book for laypersons that describes how sandy beaches work and how man's engineering influences them. The PI traveled to over 300 American beaches, collaborated with a wide range of professional colleagues, gave several presentations around the country, and wrote the book. *Saving America's Beaches: The Causes of and Solutions to Beach Erosion* was published during 2002 by World Scientific as Volume 19 of the Advanced Series on Ocean Engineering.

Florida Sea Grant provided support to adequately identify and incorporate the Florida experiences with beach engineering and management into the book. The University of South Alabama supported this research with a faculty service and development award (sabbatical leave).

Fisheries Habitat of Juvenile Red Snapper in the Northern Gulf of Mexico (Seafood Production - R/SP-5-PD). James H. Cowan, Jr., Ph.D., University of South Alabama (\$20,871).

The purpose of this project was to establish methods with which to judge quantitatively and critically the quality of juvenile red snapper habitat in the Northern Gulf of Mexico. The project's objectives were (1) to map benthic habitats of juvenile red snapper nursery habitats in the northern Gulf that historically have supported both high and low juvenile abundances with high resolution digital side scan sonar, and (2) to determine the quality of different habitat types based upon juvenile abundance, growth, and diet. At the time this project was funded, Dr. Cowan was with the University of South

Alabama and he was working with Dr. Will Patterson from Louisiana State University. Since then, Dr. Cowan has relocated to Louisiana State University and Dr. Patterson is now with University of South Alabama. This project continues into 2002 as a Program Development project funded to Dr. Patterson.

Four areas were selected to map with side scan sonar based on mean juvenile red snapper catch rates computed for 10 minute latitude by 10 minute longitude cells of shelf waters off Alabama/Mississippi/eastern Louisiana from the National Marine Fisheries Service's Fall Groundfish Survey (1986-2000). Two areas were mapped in spring 2001 and four areas will be mapped in the summer of 2002 using digital side scan sonar. Boxcore samples were taken based upon sediment acoustic reflectance patterns in 2001. Additional boxcore work is scheduled for August 2002. Sediment analysis of boxcore samples demonstrated that differences in sediment acoustic reflectance corresponded to differences in sediment composition: sediments with high reflectance (appear dark in side scan mosaics) were high in carbonate (shells) and organic content, while sediments with low reflectance were mostly sand and mud.

Four research cruises were conducted from August 2001 through December 2001 and two cruises will be conducted June 2002 - August 2002 to sample juvenile red snapper with otter trawls. Abundance of age-0 and age-1 red snapper was correlated to sediment composition. Diet and growth analyses are ongoing; however, qualitative differences in juvenile red snapper size distribution and gut fullness existed among different habitats.

Initially, the research team was most interested in examining juvenile red snapper habitat requirements, but preliminary results from the current study have generated interest and research directed at other species as well. For example, data from the current study are being used to examine habitat requirements of juvenile lane and vermilion snappers and also to test for differences in benthic fish community structure among the habitats that are being sampled. This expansion of the original project has provided the groundwork for the investigators to be funded by Sea Grant's National Fisheries Habitat Program to increase the scope and utility of their work.

Additionally, three PD projects that were initiated in 2000 continued into 2001:

Anthropogenic Eutrophication of Salt Marsh Communities: Interactions Between Environmental Stress & Nutrient Addition (R/ER-49-PD). J. Stephen Brewer, Ph.D., The University of Mississippi. (07/01/00 - 06/30/01).

Although final results are not yet available, preliminary results from Mississippi suggest that the responsiveness of *Spartina alterniflora* to nutrient addition depends on salinity and nutrient concentrations at the beginning of the experiment. Nutrient addition to the border between *Spartina* and *Juncus* encouraged invasion of the *Juncus* zone by *Spartina*, as seen in previous work. However, the magnitude of this response was unimodal along a soil salinity gradient in Mississippi. In other words, the invasion response to nutrient addition was highest at intermediate salinities. Responses to nutrient addition in Mississippi were lowest in areas with average salinities greater than 40 ppt or lower than 25 ppt. In addition, the invasion response to nutrient addition was much greater in plots that did not have a history of nutrient addition. The effects of salinity and nutrient addition history on responses to current nutrient addition can be distinguished from one another by tissue N concentrations. Low salinities were not necessarily associated with high tissue N concentrations, but prior nutrient addition was. *Spartina* height and the relative abundance of *Distichlis spicata*, along with tissue N in *Spartina* could potentially be used as single-measure indicators of the potential impact of nitrogen addition on invasion of the *Juncus* zone by *Spartina*.

Implementation of Landscape Management and Native Plantings for the Man-Made Beach in Biloxi, MS (R/ER-50-PD). Thomas P. Cathcart, Ph.D. and Phillip (Pete) O. Melby, M.L.A, Mississippi State University. (04/01/00 - 06/30/01 extended to 06/30/02).

The upper and mid-beach plantings and the records of labor requirements for keeping the site free of litter have been completed. Not yet completed are quantifying plant growth and survival and quantifying the effects of the plants and the absence of mechanical beach cleaning on beach erosion.

The PIs advise that there is considerable interest along the 26-mile artificial beach between Biloxi and Pass Christian in expanding the number and size of the planted areas. Although part of this support is based on the more natural appearance of the planted area, the support is partly due to the assumption that planted areas are more resistant to erosion. Much of the evidence for this, locally at least, is anecdotal. The remaining tasks of this project will provide some solid information with which to support or refute this assumption.

Use of ¹⁵Nitrogen Enrichment to Assess Organic Matter Production and Utilization in an Essential Fisheries Habitat (R/ER-51-PD). Michael J. Sullivan, Ph.D., Mississippi State University. (08/01/00 - 07/31/01).

Both objectives were successfully completed. After only one month of nutrient enrichment the PI was able to demonstrate statistically significant effects of enrichment on primary production rates of *Halodule* leaves and its attached epiphytic assemblage. It was further demonstrated the higher production rates of the epiphytes (especially in plots receiving high enrichment), the primary production component known to be a major factor responsible for the worldwide demise of seagrass beds and the major source of organic matter for animals feeding in seagrass beds. Secondly, the ¹⁵N-labeling protocol successfully produced statistically significant and differential labeling of *Halodule* leaves and epiphytes in the water column enrichment treatment. Sediment enrichment produced significant labeling of seagrass leaves as expected, but unexpectedly produced very strong labeling of the epiphytes. This result provides the ability to label epiphytes via either water column or sediment enrichment, which offers a safety valve for loss of water column enrichment tubes containing ¹⁵N-deplete fertilizer. The researcher now has a reliable and effective method to assess the impacts of eutrophication on seagrass habitats that relies on the use of ¹⁵N as a tracer. In this regard, the short-term results showed the nutrients added to *Halodule* beds indeed entered higher trophic levels of the food web. For some of the invertebrate grazers sampled, there was a difference in $\delta^{15}\text{N}$ values of 20 ‰ between animals collected in control and enriched plots.

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

Rapid Response Sampling to a Recent Non-indigenous Jellyfish Bloom (R/CEH-1). William M. Graham, Ph.D., Dauphin Island Sea Lab. (07/15/00 - 06/30/01) [\$10,000].

This award was used to facilitate a rapid response to an unprecedented jellyfish invasion. It provided the necessary resources that allowed the PI to fully appreciate the magnitude and extent of the *Phyllorhiza punctata* bloom in the summer of 2000. Since 2000, this species has not only recurred in the northern Gulf, but has established a population on the east coast in the Indian River Lagoon of Florida. Dr. Graham's lab is recognized as the world-leader in study of this phenomenon. He is involved in developing projects in Florida to understand the further spread of the species. Public outreach is one major emphasis as information is collected on spread and seasonality of this species. The PI's efforts have clearly had an impact on the public in terms of general perception of jellyfish in ecosystems as well as the role of invasive species in long-term ecological change.

This research, and its concomitant outreach efforts, has directly and indirectly led to additional state and federal research funding well in excess of \$300,000. In addition, the understanding that was developed on the invasiveness of *Phyllorhiza punctata* has emerged as a leading policy issue for the National Invasive Species Council. The PI's research on this species has been included in both Legislative and Executive testimony at the federal level. With the supplementation by additional funding, this award has resulted in over 15 national and international presentations, 1 paper that will be published in 2002, and several additional manuscripts currently in preparation.

Aquatic Nuisance Species Outreach (R/CEH-6). Richard K. Wallace, Ph.D., Auburn University. (02/01/01 - 01/31/03) [\$50,439].

The Auburn University Marine Extension and Research Center joined with the Baldwin County Cooperative Extension Service's Master Environmental Educator (BCMEE) program to permanently include an Aquatic Nuisance Species module in their curriculum. The BCMEE program is a volunteer program based on the Master Gardner program. In the first year of the program, 241 students in grades 2-12 plus 8 adults received the presentation as well as printed materials.

ANS displays were set up at events around the Coastal Alabama area. These events included the Legacy, Inc. Partnership conference, involving approximately 100 environmental educators from across Alabama, and the Mobile boat show, with thousands of attendees over 4 days. Arrangements were also made to distribute publications at the Birmingham and Huntsville boat shows.

In order to reach local dealers of aquatic plants and animals, an ongoing partnership was formed with the Weeks Bay National Estuarine Research Reserve (WBNERR). A survey was developed to assess the educational needs of the target audience and was mailed to 77 plant and animal wholesalers and retailers in Mobile and Baldwin counties in Alabama. The response to the survey (22% response rate) is guiding the educational direction of this portion of the project.

ANS educational materials were distributed to twenty marina owners and operators, charter fishermen, city planners, and state agency representatives at a workshop to encourage best management practices at marinas in coastal Alabama.

Waterproof boater “safe boxes” have been ordered and will be distributed throughout the coming months at public outreach events, including the Mobile Boat Show. The boxes read “Stop the Invasion: Don’t Spread Exotics! Wash boats, trailers, and gear”. A waterproof sticker from the Sea Grant Great Lakes Network and an information pamphlet will be distributed along with the safe boxes.

Developing a Model ‘DockWatch’ Program to Track Nuisance and Invasive Jellyfish Blooms (R/CEH-7). William M. Graham, Ph.D., and Lisa Young, M.Ed., Dauphin Island Sea Lab. (02/01/01 - 01/31/02) [\$40,000].

This funding was provided to establish a pilot study for a volunteer-based jellyfish bloom reporting system. The program utilizes a network of individual volunteers in coastal Alabama and Mississippi that make twice-weekly observations of jellyfish species in addition to routine observations of water clarity and weather conditions that might be related to the occurrence of these jellyfish. Over 50 individuals (out of 80 total observers) were trained and 40 of the 80 individuals received water testing kits.

An automated Web site was developed for identification and reporting of jellyfish by volunteers. Database management and querying protocols for use in the analysis of trends and patterns was developed. DockWatch was very successful in providing useful scientific data on local blooms of both native and non-native jellyfish in the northern Gulf of Mexico. DockWatchers were successful in identifying a small bloom of the invasive jellyfish *Phyllorhiza punctata* in Mississippi Sound in 2001. In addition, the DockWatch Web site was instrumental in the identification of a new bloom of this jellyfish in southern and northern (Atlantic side) Florida.

The PIs found the nature of the pilot study very useful. They experienced a good learning curve on the effectiveness of volunteers—the volunteers were found to be quite capable and extremely interested and motivated. Two part-time undergraduate students from the University of South Alabama’s Communications Program were used as Public Outreach Liaisons.

The program will continue with funding being provided solely by the EPA’s Gulf of Mexico Program. The new expanded DockWatch program is introducing a Web-based mapping feature using GIS technology.

Regional Teachers’ Mini-Camps for Non-indigenous Aquatic Species (ED-3). Howard D. Walters, M.Ed, The University of Southern Mississippi and John J. Dindo, Ph.D., Dauphin Island Sea Lab. (02/01/01 - 01/31/03) [\$87,365].

This project is implementing educational workshops targeted at classroom teachers who are, in turn, incorporating the latest scientific content knowledge concerning invasive species in their classroom instruction.

During year one of this project, 66 teachers participated in 4 workshops—2 at the J.L. Scott Marine Education Center and Aquarium, and 2 at the Dauphin Island Sea Lab. These participants were administered a pretest and posttest at each workshop to measure changes in content knowledge for the 20 concept areas, with select, regional questions specific to the organisms incorporated at the

Alabama/Florida workshops and at the Mississippi/Louisiana workshops. Statistical analyses of these tests indicate a significant increase in the content knowledge of the participating teachers ($t=3.2$; $df=64$ ($N-2$); $p<.05$). Further, all teachers were provided a Likert scale-type response survey to monitor perceptions of the workshop among the participants as a means to refine the workshops summatively, and to evaluate the workshops formatively at the end of the first year. These surveys indicate 98% of participants perceived the workshops as Very Valuable or Valuable, with 2% rating some facet of the workshops as of Average Value. These lower rankings were associated with housing provided to the participants, and not instructional components of the workshop. Consequently, the investigators have limited ability to address these concerns for future participants as the budget necessitates dormitory-type housing, as opposed to higher quality, but more expensive, hotel-type housing.

The PIs have made presentations at the National Marine Educators Association Annual Conference, Mississippi Science Teachers Association Annual Meeting, and the Southeast Regional Aquatic Nuisance Species Education Network. An article that summarizes the project, *Leveraging Partnerships as a Resource for Environmental Education: The Southeast Regional Aquatic Nuisance Species Education Network*, was published in 2002 in *Current: The Journal of Marine Education*. An additional expanded project, *Southeast Regional Aquatic Nuisance Species (ANS) Education and Outreach Network*, was funded through the National Strategic Initiative in Aquatic Nuisance Species.

National Strategic Initiatives

Minority Serving Institutions

Sea Grant-Minority Serving Institution Partnership Program to Strengthen Marine Science Program at Jackson State University (SG-MSI-1). Paulinus Chigbu, Jackson State University.

The objectives of this project are to increase the number of students from Jackson State University (JSU) who obtain degrees in the area of marine science and to enhance the capacity of JSU to train students in research.

Dr. Chigbu has visited a number of high schools in Jackson, including Bailey Magnet High School and Peoples Middle School, to publicize the Marine Science Program at Jackson State University. Seminars were delivered to the students, brochures were distributed, and videos presented to them. Arrangements have been made to visit more high schools before the end of the year.

More importantly, through Dr. Chigbu's interactions with undergraduates and high school students, Ambakisye-Olutosin Smith, a junior at South Pike High School in McComb, MS was able to apply for the American Fisheries Society Hutton Scholarship Program in Fisheries Biology. This student was selected for participation in the Hutton Program and gained research experience in Dr. Chigbu's laboratory.

Financial support was provided to a graduate student to work as a graduate assistant. He is working on a M.S. degree thesis examining dynamics of nearshore fishes and their interactions with mysids in Mississippi Sound. Fish and mysid samples were collected from Mississippi Sound in April and June 2001. In addition, three undergraduates are being provided support to gain research experience. The students are participating in various projects including enhancement of the Jackson State University Fish Collection through sorting, identification and preservation of fishes collected from the Mississippi Sound and the Ross Barnett Reservoir, evaluation of the effect of isoproterenol on growth of Atlantic croaker, rearing of red snapper larvae, and production of copepods for rearing red snapper larvae.

Gulf Oyster Industry Initiative

Optimum Size for Planting Hatchery Produced Oyster Seed (R/LR-46-NSI-2). Richard K. Wallace and David B. Rouse, Auburn University. (07/01/99 - 05/31/01).

The objective of this project was to determine the optimum size of hatchery produced oyster seed for planting on bay bottoms and to relate optimum size to costs of producing various size seed.

Analysis of survival for oyster seed set on whole shell from year one and the published price of oyster seed of various sizes indicated there was no advantage in paying more for larger seed. Even though the smallest seed had the lowest nominal survival, the cost per oyster after 32 weeks was still lowest for the smallest seed size (<5 mm). The cost of the largest seed (16-20 mm) after 32 weeks was about 5 times higher per oyster than the smallest seed.

The conclusions are (1) while there may be some size protection from blue crab predation, there was no size refuge from oyster drill predation over the range of sizes tested for oyster seed set on whole

shell and, in fact, oyster drills may prefer larger seed oysters; (2) that unprotected seed oysters set on micro-cultch have little chance of survival regardless of size and were preferred in predation studies; (3) that seed oysters can survive anoxic conditions for periods of 90 to 100 hours with no clear relation to size; and (4) that for the conditions encountered during this study and the range of seed oyster sizes used, there is no economic advantage in paying more for larger seed.

Evaluating Consumer Attitudes and Preferences Towards Irradiated Oysters (GMO-99-20). C. David Veal, Mississippi State University. (Project ends 09/30/02).

The objective of this project is to determine the feasibility of using irradiation processing to reduce the risk of *Vibrio* infections from oyster consumption and specifically to determine the dose of irradiation required to reduce *Vibrio* levels to non-detectable while maintaining a live oyster, to test consumers attitudes toward irradiated oysters, and to conduct a consumer panel for a triangle difference sensory evaluation.

Vibrio vulnificus was effectively reduced from 10^6 cfu/g oyster meat to nondetectable levels (<3 mpn/g oyster meat) with an exposure dose of 0.75 KGy. *Vibrio parahaemolyticus*, TX03:K6, proved to be more resistant and required 1.0 kGy for its reduction to nondetectable levels. Sensory quality was maintained with irradiation exposure up to 1.5 KGy. Higher irradiation doses increased the mortality rate and reduced shelf life. At ≥ 2 kGy, the oysters produced unpleasant yellow exudates. In summary, a 1 kGy dose reduced the *Vibrios* to nondetectable levels, and at the same time, maintained good sensory quality, a normal shelf life of 15 days, and minimum mortality.

The consumer panel met December 6, 2001. Preliminary results indicate that the panel could not detect any discernable differences between the non-irradiated and irradiated ($p < .001$). The questionnaire is undergoing data analysis.

Transferring and Adapting Existing Technology Used in Harvesting Other Shellfish Species to Oyster Farming on Privately Held Leases Along the Gulf of Mexico (GMO-99-21). C. David Veal, Mississippi State University.

The goal of this project is to evaluate the technical feasibility of harvesting Gulf of Mexico oysters, particularly from private leases in Louisiana, with hydraulic dredge equipment fabricated and assembled by Oyster Farms, Inc. of Hopedale, Louisiana and to compare the total number of marketable oysters harvested using traditional dredging and hydraulic dredging equipment.

This project began October 1, 1999 and was to be completed by September 30, 2000; however, the original PI, Dr. Custodio Fernandes left the employ of Mississippi State University in June 2000. Subsequently, Mississippi State University subcontracted with Louisiana State University for Dr. John Supan to complete the project. The current closing date for the project is April 30, 2003.

Fabrication of the hydraulic dredge by Jordan Bradford of Oyster Farms, Inc. and Bradford Seafood, Inc., is 95% complete, with only the belt drive for the engine-to-pump coupling and welding on the pump priming valve remaining to be completed prior to testing. The location of the test site has been identified on one of Oyster Farms, Inc. leases. Traditional poling, oyster dredging, and side-scan sonar were used to verify oyster abundance and bottom characteristics prior to testing.

The project is behind schedule because the PI suffered a broken back and multiple trauma during a hit and run bicycling accident on July 4, 2001; however, recovery is now complete. In addition, Mr.

Jordan Bradford of Oyster Farms, Inc. needed to wait for the settlement of a ten-year-old lawsuit that involved the lease(s) to be used for the project. The suit is currently being settled out-of-court.

Vibrio parahaemolyticus: An Annotated Bibliography (GMO-99-22). Yolanda J. Brady, Auburn University.

The objective of this project is to collect information extracted from books, technical bulletins, technical reports, official methods, etc., and compile it to an annotated bibliography of *V. parahaemolyticus* including previously unavailable information.

No report received.

Consumer Attitudes and Preferences for Oysters. (GMO-99-24). Terrill R. Hanson, Mississippi State University.

The results of this project have helped identify characteristics about oyster consumers and non-consumers that can be used to develop marketing segments and better understand consumer attitudes towards oysters. Of a survey sample of 1,376 respondents to a nationwide mail survey on seafood consumption, 43% consumed oysters at least occasionally. The average oyster consumer indicated they ate oysters 2.6 times per month. A summary of the data collected is being prepared for publication as a Mississippi State University Bulletin and will be helpful in providing general directions toward oyster marketing. More specific recommendations are being developed through an econometric analysis, which is in the journal review process now.

Results of this econometric study (House, Hanson and Sureshwaran) indicate that there are statistically significant differences between the reasons why people choose to eat oysters and the reasons oyster consumers choose how often to eat oysters. For this reason, the study breaks data into consumers of oysters and non-consumers and examines their characteristics. Targeting existing consumers for increased sales is called market penetration. Targeting non-consumers for consumption is termed market development. This study gives some indication as to the challenges the oyster industry faces pursuing both market penetration and development.

One method to increase sales is targeting existing oyster consumers (market penetration) to increase their consumption of oysters. Reasons for eating oysters included consumer enjoyment of the flavor (80% of consumers) and to add variety to the diet (37%). Oyster consumers identified the main reasons for not consuming oysters more often as price (38% of consumers indicated this was a reason for not consuming more frequently), product safety (29%), and that fresh product was not available (20%). It is likely both people indicating product safety and lack of fresh product are concerned about the safety of the product. Product safety appears to be an issue where the oyster industry can continue to improve their image among oyster consumers. Approximately 44% of oyster consumers rated oysters the least safe of all seafood products when given the choice of 4 shellfish and 8 finfish products. Further information examined the possibility of using a process such as depuration, irradiation, ozonation, or pressurization to increase consumer confidence in oysters. Overall, 43% of oyster consumers and 54% of oyster consumers concerned about product safety indicated they would increase consumption of oysters if depuration were the method used to increase the safety of oysters. When further questioned, 635 respondents indicated whether or not they would be willing to pay for a safety treatment program. Of those, 61% preferred depuration and indicated a mean willingness to pay of \$0.34 per oyster above the raw oyster price. This indicates the oyster industry may be able to increase the quality and perception of safety of oysters through a program of depuration, as well as charge for this process if the costs do not

exceed the consumer willingness to pay. Consumers did not indicate a preference or non-preference for farm-raised oysters, nor did they indicate having a farm-raised product as a reason to consume oysters or consume oysters less frequently. Further research could be conducted to see if consumers would perceive farm-raised oysters to be safer with certain advertising messages.

Finally, consumers were asked what would increase their consumption of oysters. Respondents who indicated price, product safety, and lack of availability of fresh products were most likely to indicate factors that would increase their consumption. As expected, consumers indicated a lower price would increase their frequency of consumption, but other factors, such as government safety inspection, availability of fresh products, and company safety and quality guarantees also were indicated as factors that might increase consumption for at least 20% of consumers. Again, the importance of perception of a fresh, safe product was emphasized.

Non-consumers had different reasons for not consuming oysters, mainly taste, texture, and smell, followed by product safety concerns. As flavor was the most important reason consumers ate oysters, it appears to be the biggest reason why non-consumers do not eat oysters. Although product safety is again important, it is less likely the industry would persuade non-consumers to eat oysters through the same methods as they might use to convince oyster consumers to eat more frequently. Changing non-consumer perceptions of taste, smell, and texture is likely more difficult. In focus groups, non-consumers that focused on taste, texture, and smell generally had very strong negative reactions to discussing oysters. It would appear from these results that the industry should focus expansion activities on those that currently eat oysters. Additionally, identifying characteristics about the demographics of consumers might provide insight as to what regions of the country and types of people are most likely future oyster consumers. For instance, there were larger percentages of consumers in the Southeast Atlantic, East South Central and West South Central regions of the United States, indicating that these regions are fertile grounds for targeted advertising. Oyster consumption also increased with education and in males compared to females.

Aquatic Nuisance Species

Southeast Regional Aquatic Nuisance Species (ANS) Education and Outreach Network (ED-4) 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).

This project is an expansion of the *Regional Teachers' Mini-Camps for Non-indigenous Aquatic Species (ED-3)* that was funded as part of the Gulf of Mexico/Mississippi-Alabama Sea Grant Special Competition in Education and Outreach in Aquatic Nuisance Species. Teachers will be recruited for workshop participation based upon location. The PIs from Florida, Alabama, and Mississippi will manage recruitment from their respective states. The PI from Mississippi will also recruit from Louisiana with assistance from Louisiana Sea Grant and the Louisiana Science Teachers Association. This demarcation will serve to reduce the travel expenses for this effort as teachers will attend the workshop closest to their home, thereby leveraging the efficiency of the effort.

In an effort to reach teachers in urban and rural areas who are unable to attend the coastal workshops, "traveling" workshops and exhibits will be developed and implemented at local schools in these areas of Mississippi and Alabama in each year of the effort. This component will be extended into Florida in year two.

Additionally, the PIs will identify nationally renowned scientists and educators to participate as Keynote Presenters in an online, virtual conference implemented in partnership with a private not-for-profit organization—the College of Exploration. This online workshop will enroll a national and international audience of up to 250 participants in this asynchronous, 3-week long workshop to be implemented early in year 2 of the project.

Assessing the Potential of Nuisance Jellyfish Predation on the Eggs and Larvae of Red Drum and Red Snapper in the Northern Gulf of Mexico (R/CEH-9). 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).

The objectives of this project are to (1) quantify the abundance and distribution of potential gelatinous predators and their fish egg and larval prey during the period of peak spawning of each prey species; (2) determine experimentally, using large *in situ* mesocosms enclosures, species-specific predation rates by jellyfish predators (*P. punctata*, *A. Aurelia*, and *C. quinquecirrha*), on hatchery-reared red snapper/red drum eggs and larvae; (3) compare the mesocosms-measured predation rates to predation rates calculated from jellyfish gut contents collected *in situ*; (4) combine the measured and/or calculated predation rates with data on distribution and abundance of jellyfish predators and prey to create a spatial map of predation potential; (5) determine the relative contribution of the invasive jellyfish, *Phyllorhiza punctata* to total predation potential of all jellyfish (native and introduced) species; and (6) create the frame-work for a regional scale retrospective analysis of predation potential by jellyfish predators using National Marine Fisheries Service survey (SEAMAP) data.

Aquatic Nuisance Species (ANS) Task Force

(Pass-through funding from OAR)

Deriving the Origin and Nature of the Invasive Jellyfish, *Phyllorhiza punctata*, Through Molecular Studies of Native and Non-Native Populations (R/CEH-8) 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 - 10/31/03) [\$152,210].

The primary objective of this project 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 the likelihood that the major occurrence in 2000 developed from a smaller, cryptic population in the Gulf of Mexico must be entertained. If it is found that there is significant genetic separation between Gulf and Caribbean populations, then the secondary objective is to estimate the length of time since a founding population was established in the Gulf of Mexico and to estimate the amount of background genetic exchange (i.e., dispersal) between Gulf and Caribbean populations. If no significant genetic separation of Caribbean Basin populations (including Gulf populations) to suggest reproductive isolation, then the secondary objective will be to determine whether the entire Caribbean Basin supports a single, well-mixed population.

Independent of the primary and secondary objectives, a tertiary objective is to evaluate how rapidly genetic (and possibly morphological) differentiation occurs after reproductive isolation of populations has occurred and whether morphological variations are manifest as phenotypic plasticity within a single, well-mixed population.

Despite the difficulties encountered in obtaining DNA templates from the jellyfish tissue, the aim to identify primers needed for the molecular analysis within the first year of the project has been met. Collection of samples from the Caribbean Basin were not able to be collected during year one due to a delay encountered in obtaining a post-doctoral fellow. Samples from three populations from the western Pacific (i.e., Eastern Australia) and one population from Western Australia have been obtained. Collecting trips over June - August 2002 will provide the necessary tissue samples from the Caribbean and from the eastern and central Pacific populations. Tissue samples have also been collected from Brazil on the PI's behalf. If a population of significant size appears in Brazil over the next year, a collecting trip will be conducted.

Due to the global scale of this project, cooperative support from a number of institutions has been necessary. Cooperative support has been received from the University of New South Wales, Sydney, Australia; Curtin University of Technology, Perth, Western Australia; and James Cook University, Cairns, Queensland. These institutions have provided laboratory facilities and expertise during collection trips and assistance with molecular analyses. Further support is expected from these institutions and from the University of Puerto Rico, the University of Hawaii, Monterrey Bay Aquarium Research Institute and the University of São Paulo during future research trips.

Appendix D

Publication List

This reporting period covers year one of the 2001-2003 Omnibus; therefore, a limited number of publications have been published. Several publications are at various stages of the publishing process. However, during the current reporting period MASGC sponsored research that led to three abstracts, two presentations and one invention disclosure. Extension, Legal Program, and Communications production included 15 outreach publications, 7 Web pages, 5 articles, 13 presentations, 4 Legal Reporters, 18 newsletters, 3 communications products, and 4 extension publications.

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.

Presentation:

Mitochondrial Genes are Expressed at Unusually High Levels in the Gill of Oysters (Crassostrea virginica) As Analyzed by Expressed Sequence Tags. Xianzhou Song, Jinian Feng, Xianchao Wei, Ping Li, Chongbo He, Richard Wallace, Rex Dunham, David Rouse, and Zhanjiang (John) Liu. Presented at the International Conference of Plant, Animal, and Microbial Genome X recently held in San Diego. A poster was presented in the conference and an abstract was published.

Use of ¹⁵Nitrogen Enrichment to Assess Organic Matter Production and Utilization in an Essential Fisheries Habitat (R/ER-51-PD). Michael J. Sullivan, Mississippi State University.

Presentation:

Relative Importance of Seagrass versus Epiphytes in Food Webs Based on Long-Term ¹⁵N-Enrichment. Troy R. Mutchler, M.J. Sullivan, B. Fry, and P.V. Zimba. Presented at the biennial meeting of the Estuarine Research Federation held November 4-8, 2001 in St. Pete Beach, Florida.

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

Abstracts:

1. American Society for Microbiology (2002). Poster Title: *Detection of pathogenic Vibrio parahaemolyticus O3:K6 in Gulf water using conventional and real-time PCR.* Michael L. Myers and Asim K. Bej.
2. Alabama Academy of Science (2001). Powerpoint Presentation. Abstract Title: *Serum-Induced Response of Vibrio vulnificus.* Michael L. Myers and Asim K. Bej.

3. Alabama Academy of Science (2002). Powerpoint Presentation. Abstract Title: *Real-time PCR Detection of Vibrio parahaemolyticus O3:K6*. Michael L. Myers and Asim K. Bej.

Invention Disclosures:

The UAB Research Foundation (UABRF): UAB Intellectual Property Disclosure (IPD), October 18, 2001. Title: Use of specific DNA sequences for PCR-based detection of *Vibrio parahaemolyticus*.

L-1 - Mississippi-Alabama Sea Grant Legal Program, Kristen M. Fletcher, LL.M., The University of Mississippi

Publications:

Water Log (4 issues) Tammy L. Shaw and Kristen M. Fletcher, Editors

1. *Supreme Court Invalidates Corps' Migratory Bird Rule*. MASGP-01-004-01.
2. *Sierra Club Challenges the Big Sunflower River Project*. MASGP-01-004-02.
3. *Supreme Court Determines Wetlands Landowner Development Rights*. MASGP-01-004-03.
4. *\$5 Billion Punitive Damages Against Exxon Deemed Excessive*. MASGP-01-004-04.
5. NEWSREEL - Newsletter for the Environmental Section of the Mississippi Bar - Issues 8:1 and 8:2
6. Christopher J. Bridger, Barry A. Costa-Pierce, Clifford A. Goudey, Robert R. Stickney, Kristen M. Fletcher, John R. Gold, Don H. Lewis, Jeffrey Lotz, Benedict C. Posadas, Erinn Neyrey, Ian Workman, Tim Reid, Cynthia Moncrieff, Robert Vega, D. LaDon Swann, and Sharon Walker, *Sustainable Offshore Aquaculture Development in the Gulf of Mexico*, World Aquaculture (2001). MASGP-01-016.
7. Tammy L. Shaw, *Up from the Depths: The Changing Face of Maritime Salvage and Shipwreck Law*, Proceedings of Coastal Zone '01 Conference (2001).
8. Kristen M. Fletcher, *Will U.S. Foreign Policy Migrate with the Whales? A Critique of U.S. Foreign Policy and the Rapidly Changing International Whaling Regime*, published in *Environmental Change and U.S. Foreign Policy* (2001).
9. Kristen M. Fletcher, *When Economics and Conservation Clash: Challenges to Economic Analysis in Fisheries*. *Environmental Law Reporter* (2001). (This article was nominated by *Natural Resources Law Review* as one of the top ten environmental law articles of 2001.)

NEWSREEL Articles:

Kristen Fletcher, *Federal Legislative Update 2001*, 9:1 NEWSREEL 3 (2002).

Kristen Fletcher, *Federal Legislative Update 2000*, 8:1 NEWSREEL 6 (2001).

Tammy L. Shaw, *EPA Not Required to Consider Implementation Costs*, 8:1 NEWSREEL 3 (2001).

Conference Presentations:

Kristen M. Fletcher - World Aquaculture Society Conference, Orlando, FL
Law Association for Women Roundtable, University of Mississippi
Open Ocean Aquaculture IV Conference, New Brunswick, Canada
Coastal Zone '01, Cleveland, OH

Tammy L. Shaw - Law Association for Women Roundtable, University of Mississippi
Coastal Zone '01, Cleveland, OH
Alabama Coastal Planning Commission Workshop on Wetlands

Richard J. McLaughlin - University of Mississippi Faculty Forum on Terrorism

L-2 - Marine Habitat Conservation - Outreach and Advisory. Kristen M. Fletcher, LL.M., The University of Mississippi.

Publications:

1. Kristen M. Fletcher, *Legal and Policy Challenges of Marine Protected Areas*, Proceedings of Coastal Zone '01 Conference (2001).

NEWSREEL Articles:

Roy A. Nowell, Jr. and Kristen Fletcher, *Supreme Court Determines Wetlands Landowner Rights*, 9:1 NEWSREEL 1 (2002).

Kristen Fletcher, *Court Finds Fish Habitat Evaluation Inadequate*, 7:4 NEWSREEL 5 (2000).

Water Log also included the following articles on Marine Habitat Conservation:

Clinton Creates Coral Reef Reserve (Issue 20:4);
Court Finds Essential Fish Habitat Evaluation Inadequate (20:4);
EPA Proposes "Special Ocean Sites" (21:1);
FERC Approves Natural Gas Pipeline through Gulf Marine Habitat (21:1);
"Deep Ripping" in Wetlands Prohibited by the Clean Water Act (21:3);
U.S. Recovers for Sanctuary Damage in State Waters (21:3).

Conference Presentations:

Kristen M. Fletcher - Coastal Zone '01, Cleveland, OH; Presentation entitled *Legal and Policy Challenges of Marine Protected Areas*. This PowerPoint presentation was posted to the Mississippi-Alabama Sea Grant Legal Program Web site.

In addition, Coastal News Articles were posted regularly to the Web. The following addressed marine habitat policy issues:

Corps of Engineers Rules on Hydroelectric Dams (January)
EPA Proposes "Special Ocean Sites" (February)
Deepwater Rigs in Gulf Reach a Record Number (April)
Oil and Gas Leases in the Eastern Gulf of Mexico (April)

President Bush Supports Marine Protected Areas (June)
Congress Bans New Drilling in Great Lakes (November)

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

Publications:

Sea Briefs (two issues) Tim Reid, Editor

1. *Current Gulf of Mexico Research Now Available on Web.* MASGP-01-003-01.
2. *Strategic and Implementation Plans Lay Out New Priorities.* MASGP-01-003-02.
3. Reid, T. *Publication Policy and Requirements.* MASGP-01-010.
4. Bridger, C.J. and Timothy H. Reid, editors. *Open Ocean Aquaculture IV: From Research to Commercial Reality.* Symposium Program and Abstracts. June 17-20, 2001. St Andrews, New Brunswick, Canada. MASGP-01-006.
5. Bridger, Christopher J., Barry A. Costa-Pierce, Clifford A. Goudey, Robert R. Stickney, Kristen M. Fletcher, John R. Gold, Don H. Lewis, Jeffrey Lotz, Benedict C. Posadas, Erinn Neyrey, Ian Workman, Tim Reid, Cynthia Moncrieff, Robert Vega, D. LaDon Swann, and Sharon Walker, *Sustainable Offshore Aquaculture Development in the Gulf of Mexico*, World Aquaculture (2001). MASGP-01-016.

Communications Products:

Alabama Sportfishing 36-inch adhesive boat Tape Measure - MASGP-01-009.

Mobile Bay Watershed Poster. MASGP-01-025.

Aquatic Nuisance Species Fisherman/Boater Locksafes.

EX-1 - Alabama Sea Grant Extension Program. Richard K. Wallace, Ph.D., and Brian E. Perkins, Auburn University.

Publications:

1. Wallace, R. K. 2001. *Cultivating the eastern oyster, Crassostrea virginica*). SRAC 432. Southern Regional Aquaculture Center.
2. Wallace, R. K., L. Swann, D. Strum, and H. Hall. 2001. *Selecting an oyster gardening site on Mobile Bay.* ANR-1207. MASGP-01-005.
3. Scanlan, J.A., E. Brantley, and R.K Wallace. 2001. *The citizen's guide to reducing polluted runoff in coastal Alabama.* ANR-1215. MASGP-00-012.
4. Scanlan, J.A., E. Brantley, and R.K Wallace. 2001. *Healthy waters, healthy communities: a call to action.* MASGP-00-008.

Sea Harvest News (4 issues) Richard K. Wallace

5. *NMFS Proposes to Register Gulf Blue Crab and Gill Net Fishermen.* MASGP-01-002-01.
6. *Bayou LaBatre Back in Top Ten.* MASGP-01-002-02.
7. *TED Changes Proposed.* MASGP-01-002-03.
8. *Correction to Proposed TED Description.* MASGP-01-002-04.

EX-2 - Mississippi Sea Grant Extension Service. C. David Veal, Ph.D., Mississippi State University.

1. Bridger, C. J., B. A. Costa-Pierce, C. A. Goudey, R. R. Stickney, K. M. Fletcher, J. R. Gold, D. H. Lewis, J. Lotz, B. C. Posadas, E. Neyrey, I. Workman, T. Reid, C. Moncrieff, R. Vega, D. L. Swann, and Sharon Walker, *Sustainable Offshore Aquaculture Development in the Gulf of Mexico.* World Aquaculture, (2001). MASGP-01-016.

2. Burrage, D. 2001. *Upper Pascagoula River Fishing Waters Guide.* Revision and update of MCES publication 878.

3. Burrage, D. 2001. *Wolf River and East St. Louis Bay Fishing Waters Guide.* Revision and update of MCES publication 876.

4. Burrage, D. 2001. *Jourdan River and West St. Louis Bay Fishing Waters Guide.* Revision and update of MCES publication 875.

5. Burrage, D., J. Guyton, and R. Kastner. 2002. *Non-Indigenous Species Activities for Youth.* Publication 2286. MASGP-97-030.

6. Burrage, D. *Mississippi Tide Tables.* MCES Pub. 850. MASGP-01-008.

7. Burrage, D. 2001. *Ansley Fishing Waters Guide.* Revision and update of MCES publication 874.

8. Posadas, B. C. 2001. *Summary of Current Fishery Statistics in Mississippi, 1998-2000.* Mississippi State University. (<http://msstate.edu/dept/crec/fwmr.html>)

9. Posadas, B. C. 2001. *Comparative Economic Analysis of Using Constructed Wetlands in Recirculating Catfish Pond Production.* Journal of Applied Aquaculture, 11(3): 1-20.

10. Posadas, B. C., C. Bridger and B. Costa-Pierce. 2001. *Economic Potential of Offshore Aquaculture in the Gulf of Mexico.* Pages 84-85 in C. J. Bridger and T. H. Reid (ed.s). Open Ocean Aquaculture IV, Symposium Program and Abstracts. MASGP-01-006.

Gulf Coast Fisherman (12 issues) Dave Burrage, Editor

11. *New DMR Director.* MASGP-01-001-01.

12. *Grouper Fishery Closure.* MASGP-01-001-02.

13. *Lower Fees for Some Louisiana Non-resident Licenses.* MASGP-01-001-03.

14. *New Federal King Mackerel Regulations*. MASGP-01-001-04.
15. *Texas Shrimp Association Petitions for Gulf Snapper Closure*. MASGP-01-001-05.
16. *License Reminder*. MASGP-01-001-06.
17. *Commerce Secretary Announces New Council Appointments*. MASGP-01-001-07.
18. *Asper Named CMR Chairman*. MASGP-01-001-08.
19. *New Mississippi Trawl Door Size Limits*. MASGP-01-001-09.
20. *Above Average Oyster Harvest Predicted for Mississippi*. MASGP-01-001-10.
21. *Mississippi Oyster Season Opens*. MASGP-01-001-11.
22. *TED Modifications Update*. MASGP-01-001-12.

Presentations

1. Burrage, D.D. "2001 Mississippi Shrimp Season Situation and Outlook." Invited presentation at the Texas Shrimp Association Annual Conference, May 18, 2001, South Padre Island, Texas.
2. LaSalle, M. W. and C. Z. Hollomon. Community-Based Environmental Coordination in South Mississippi. Presentation to the 2001 North American Association of Environmental Educators Conference, Little Rock, Arkansas.
3. LaSalle, M. W., et al (members of the Extension Southern Region Master Naturalist Task Force). The Master Naturalist Volunteer Concept. Presentation to the 2001 North American Association of Environmental Educators Conference, Little Rock, Arkansas.
4. LaSalle, M. W. Emergent Marsh Systems. Invited presentation to the Singing River Symposium, Moss Point, Mississippi.
5. Posadas, B. C., C. Bridger and B. Costa-Pierce. Economic Potential of Offshore Aquaculture in the Gulf of Mexico. Paper presented to Open Ocean Aquaculture IV: An International Symposium, St. Andrews, New Brunswick, Canada, June 17-20, 2001. Abstract published.

Appendix E

Students Supported

During the first year of these projects, 1 Research Scientist, 4 Ph.D., 13 M.S., and 8 J.D. candidates, and 1 undergraduate student have been supported.

R/AT-1 - Hybridization in Soft Corals - Combinatorial Genetics and Drug Discovery. Marc Slattery, Ph.D., The University of Mississippi.

1. Erica Marsh, M.S.
2. Haidy Kamel, M.S.
3. Dr. Deborah J. Gochfield, Research Scientist.

R/ER-49-PD - Anthropogenic Eutrophication of Salt Marsh Communities: Interactions Between Environmental Stress and Nutrient Addition. J. Stephen Brewer, Ph.D., The University of Mississippi.

1. Blake Hardin, Undergraduate in Biology. Graduated May 2001.

R/ER-51-PD - Use of ¹⁵Nitrogen Enrichment to Assess Organic Matter Production and Utilization in an Essential Fisheries Habitat. Michael J. Sullivan, Ph.D., Mississippi State University.

1. Troy R. Mutchler, Ph.D. candidate, Department of Biological Sciences. Degree expected May 2004.

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.

Two graduate students were supported for the optimization of the DNA extraction methods, the conventional and the real-time PCR reactions, and the applications of the multiplex PCR approach on the Gulf water and the oyster samples.

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

1. Christopher Miller, M.S. Department of Fisheries and Allied Aquacultures, Expected graduation 2003.
2. Mike Ross, M.S. Department of Fisheries and Allied Aquacultures, Expected graduation, May 2002.

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

1. Antonio Garza de Yta, M.S. Department of Fisheries and Allied Aquacultures, Graduated. Thesis title: *Influence of Nursery and Feed Management on Pond Production of Litopenaeus vannamei*.
2. Robby Mays, M.S. Department of Fisheries and Allied Aquacultures, Expected graduation 2003.
3. Oscar Zelaya, Ph.D., Department of Fisheries and Allied Aquacultures, Expected graduation 2004.

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, Ph.D., The University of Southern Mississippi.

1. Glenn Zapfe, M.S., Department of Coastal Sciences, Expected graduation Spring 2002.
2. Nicole Crochet, M.S., Department of Coastal Sciences, Expected graduation Spring 2002.
3. Gretchen Waggy, M.S., Department of Coastal Sciences, Expected graduation 2003.

R/SP-5-PD - Fisheries Habitat of Juvenile Red Snapper in the Northern Gulf of Mexico. James H. Cowan, Jr., Ph.D., University of South Alabama.

1. Jared Jackson, M.S., Department of Marine Sciences. Expected graduation May 2003.

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

1. Ryan J. Heise, Ph.D., Department of Biological Sciences, Expected graduation December 2002. 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 Sciences, Expected graduation August 2003. Thesis title: *Use of Microsatellite DNA Markers to Determine Population Structure of Gulf Sturgeon in the Pascagoula River, Mississippi*.

L-1 - Mississippi-Alabama Sea Grant Legal Program. Kristen M. Fletcher, LL.M., 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. John Treadwell, J.D., 2002
2. Stacy Prewitt, J.D., 2001
3. Craig Pake, J.D., 2002
4. Sadie Gardner, J.D., 2002
5. Yoshi Takamatsu, J.D., 2002
6. Jason Dare, J.D., 2003

In addition, Program attorneys taught classes to law students of the University of Mississippi School of Law and at the University of Hawaii Law School. They also trained law students in legal writing and research.

L-2 - Marine Habitat Conservation: Law and Policy Outreach. Kristen M. Fletcher, LL.M., The University of Mississippi.

1. David Harris, J.D., 2002
2. Roy Nowell, J.D., 2002

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Appendix H

1998-2000 Omnibus - Completion Reports

Research - Seafood Resource Management and Production

R/LR-41 - Development of a Method for Controlling the Molt Cycle of the Blue Crab, *Callinectes sapidus*. R. Douglas Watson, Ming Luo, and Stephen A. Watts, The University of Alabama at Birmingham.

This research has answered fundamental questions about the neuroendocrine regulation of development in this abundant and economically important group of organisms. In addition, study of the X-organ/Y-organ axis has provided insights into general questions about the regulation of steroidogenesis and the structure and function of neurosecretory cells. Using techniques of modern molecular biology, two antipeptide antibodies and polyclonal antisera that bind MIH and hold promise as potential injectants for inducing molting in crustaceans have been generated.

Recombinant MIH suitable for crystallization and subsequent studies designed to reveal the three-dimensional structure of MIH have been generated. Completion of these studies would permit structure-based design of an MIH inhibitor.

Prokaryotically expressed rMIH was not suitable for crystallization. To solve this problem, a baculovirus expression system was utilized to generate rMIH. Polyclonal antisera raised against prokaryotically expressed rMIH appeared to bind MIH and structurally similar member(s) of the CHH family of peptides. Consequently two MIH-specific antipeptide antibodies were produced. Purification of rMIH expressed using recombinant baculovirus was complicated by the presence of a ~10 kDa viral protein (bigrou body protein) normally expressed in baculovirus-infected cells. Methods were developed to resolve fibrous body protein from rMIH.

R/LR-42 - Assessment of Sea Urchins as Fishery and Aquaculture Candidates in the Gulf of Mexico Stephen A. Watts and James B. McClintock, The University of Alabama at Birmingham, and John M. Lawrence, The University of South Florida.

This project involved assessing *Lytechinus variegatus* as a fishery and aquaculture candidate by (1) optimizing roe production in adults and somatic growth in juveniles, and (2) developing a demonstration culture system for land-based aquaculture.

Studies were completed that examined the effects of several different diets on roe production and quality. These data indicate that the constituents in the diet will influence primarily the quality of the roe, generally influencing roe color (an important consideration in roe markets). Proximate analysis indicated that carbohydrate and lipid did not vary with practical diets with similar levels of proximate constituents, but that protein levels increased in roe in individuals fed formulated feeds. Sugar content of roe, which may influence taste, varied considerably depending on the size of the gonad. Sugar metabolism deserves further consideration.

Analysis of the effects of frequency of feeding on feeding rate, absorption efficiency and roe production was completed. These data indicate that individuals fed food at least once daily maximized roe production over those fed every other or every fourth day.

Ammonia tolerance was determined for *Lytechinus variegatus*. Results indicated that the urchin was very sensitive to ammonium concentrations, which has great implications in aquaculture using recirculating systems.

The larval cycle can now be completed in 100% artificial seawater. This has never been accomplished with any sea urchin species and represents a fundamental advancement with significant ramifications. A water purification system was utilized that includes sediment and charcoal prefilters, reverse osmosis membranes, and deionization canisters with anion and cation resins, creating an ultra-pure water source. This water source, when adjusted to salinity with Instant Ocean sea salts, has provided excellent results in terms of survivorship and growth. The development of seed stock for growout can now be accomplished away from the coast without a dependence on natural seawater. Furthermore, the researchers have been able to obtain larvae from animals held in culture for almost a year, indicating freedom from restriction to natural reproductive cycles for obtaining seedstock. These are perceived as very significant accomplishments.

Studies have been completed in which the effects of qualitatively different diets on gonad production were examined. Gonad quality varied directly with the proximate constituents in the diet, i.e., the proximate content of the roe changed with the diet. Diets high in protein produced roe that was high in protein: diets high in carbohydrate produced roe that was high in carbohydrate. These data indicate that the organic content of the roe and taste will be able to be manipulated. An evaluation of the cellular content of the gonads was completed. Whereas the gonads are a combination of storage cells (nutritive phagocytes) and gametes (eggs or sperm), it was found that the higher levels of protein promoted gamete growth and development. This is one of the first demonstrations that nutrition can influence gamete output and deserves further investigation. Gamete output can greatly influence the quality and taste of the roe.

Collections of the sea urchin *Lytechinus variegatus* were initiated in March 1998 nearshore Venice and Egmont Key, and at two sites approximately 10 miles offshore Anclote Key. Collection of the sea urchin *Arbacia punctulata* have also been made. Although *A. punctulata* is a non-commercial species, it co-occurs with *L. variegatus* and has the potential to be an important competitor. The growth rates of these populations were followed. The seasonal reproductive cycle was followed by measuring the gonad index (the relative size of the gonad) as well as histologically. The latter is important as the gonads are marketable as roe when they contain nutritive cells and not gametes. In contrast, they are marketable for research in developmental biology when they contain gametes. The amount and kinds of food eaten have been reported.

A population of *L. variegatus* was monitored off the coast of Panama City, Florida. This study revealed that episodic, above-average rainfall events can transiently reduce the salinity in near shore habitats, and can cause serious declines in sea urchin populations. These populations may take several years to recover. These data suggest that management strategies for potential fisheries include provisions for catastrophic declines in urchin populations due to episodic environmental events.

Somatic growth of juveniles in response to dietary protein was evaluated. This is important as the time to marketable size needs to be as short as possible. In a study performed at The University of Alabama at Birmingham that examined the effects of protein of juvenile growth it was determined that at levels less than 23% protein, over 50% of the individuals died within 14 weeks. Those fed 32 and 50% survived well and grew at similar rates. Gonads were produced in lab-reared animals at a smaller

diameter than observed in similar sized individuals collected from the field, suggesting the feeds promote gonad growth even at an early age. This is of significance if you are attempting to produce gonads at a younger age, i.e., a lesser period of growout would be needed. The studies at Georgia Southern University were done with very small individuals, soon after metamorphosis. Individuals (600-700 μm diameter) fed the artificial feed grew to 37 mm by the end of 28 weeks, much greater than the 6.8 mm diameter reported after 30 weeks for individuals fed a natural algal diet. Large individuals maintained under aquaculture conditions with the artificial feed produce gametes the entire year. Although this is desirable for aquaculture of sea urchins for research purposes, it will be necessary to suppress gametogenesis for roe production for the market.

Analysis of the effects of carotenoids in the feed on feeding rate, absorption efficiency, and roe production was completed. Carotenoids did not enhance gonad production in *L. variegatus*. However, oxycarotenoids fed to adult sea urchins were found to positively influence the quality of the gametes and, consequently, the larvae obtained from these adults. These findings have implications in the design of feeds for sea urchins.

An evaluation of the gametic cycle was performed over several reproductive seasons. *L. variegatus* can produce gametes throughout the spring and summer (over an approximately 6 month period). Nutritive storage occurs primarily in the late fall. These data will be useful in management considerations of the species.

The optimal rearing temperature has been established for *L. variegatus*. Gonad production is greatest at the median seasonal field temperature (ca. 22 C in the northern Gulf of Mexico). Gonad production efficiency was inversely proportional to temperature. Gamete development is inhibited at colder temperatures (16 C). These data suggest that temperature can be manipulated to enhance gonad production and reduce food cost for urchins in culture.

R/MT-39 - Field Applications of Multiplex PCR to Monitor Microbial Contamination in Shellfish in the Gulf of Mexico. Asim K. Bej, The University of Alabama at Birmingham.

This study involved the evaluation of the applicability and usefulness of a multiplex PCR-based rapid detection methodology to determine the occurrence and distribution of *Escherichia coli* as a microbial indicator of fecal contamination, along with the detection of other microbial pathogens such as *Vibrio cholerae*, total and clinically important strains of *S. typhimurium*, *V. vulnificus*, and *V. parahaemolyticus* simultaneously in shellfish (oysters) from the Gulf of Mexico.

Oysters from the Gulf of Mexico were transported to the laboratory on ice and processed by the recommended standard methods described by the American Public Health Association. As a first step to achieve the proposed objectives, the following steps were performed on the shellstock: (1) sample processing, in which methodologies were compared for recovery of template DNA for PCR amplification of the targeted genes; (2) improvement of the multiplex PCR reaction parameters to achieve amplification of all respective target genes with the highest sensitivity; and (3) gene probe colorimetric hybridizations to determine the distribution and enumeration of the clinically significant virulent strains of *V. vulnificus* and *V. parahaemolyticus*.

After optimization, multiplex PCR amplification was applied for the detection of the aforementioned microbial pathogens in shellfish samples collected over a 1-year period of time from the Gulf of Mexico and local retail seafood stores. Detection by multiplex PCR included target-genes representing an indicator microorganism, *E. coli*, pathogenic *E. coli*, total and pathogenic strains of *V. vulnificus*, *V. parahaemolyticus*, *S. typhimurium* and *V. cholerae*.

Purification of total DNA from oyster tissue homogenates by "cell lysis method" and "Chelex® 100 method" was compared for the best results. Multiplex PCR amplification of all targeted genes from microbial pathogens of interest were carried out in a PCR reaction consisting of equimolar quantities of oligonucleotide primers, dNTPs, PCE reaction buffer, and a thermostable DNA polymerase using a DNA thermal cycler. The identity of the PCR amplified DNA was determined by agarose gel electrophoresis and GeneComb colorimetric hybridization methodologies.

This project has been successfully completed and all data have been evaluated. Detection of microbial pathogens in shellfish using multiplex PCR amplification of the targeted genes could be a rapid and effective alternative method to the time-consuming conventional microbiological culture-based approach. The current study demonstrated that the multiplex PCR approach could be effectively applied to "real" field samples. After publication of all the data generated from this study, the PI hopes to bring the applicability of this approach to the attention of interested biotechnology companies for possible commercial products.

The applicability of the multiplex PCR-based detection of total and pathogenic *Vibrio parahaemolyticus* in shellfish has been included in the U.S. Food and Drug Administration's (FDA) *Bacteriological Analytical Methods*, 2001; and the American Public Health Association's (APHA) *Compendium of Methods for the Microbiological Examination of Foods*, 4th Edition, 2001.

R/LR-43 - Nutritionally Complete, Low Cost Artificial Diets for the Culture of Fish and Crustacean Larvae. Louis R. D'Abramo and Randal K. Buddington, Mississippi State University.

This project sought to develop a nutritionally complete, low cost, formulated, microparticulate diet that would effectively serve as a complete or partial replacement for live food.

A multi-stage technique for the preparation of a microparticulate diet has been successfully developed and refined. Gut analysis of larvae of the freshwater shrimp, *Macrobrachium rosenbergii*, indicated that the diet is readily consumed. The diet has successfully served as a complete substitute for live *Artemia* nauplii from day 7 of the 30 day larval cycle of the freshwater shrimp. Survival and growth achieved with the microparticulate diet are comparable to what is achieved with live food.

The diet offers much potential in application to the culture of other species of larval crustaceans and fish. Recently, studies have been conducted with the culture of striped bass and haddock larvae. Although growth and survival have not been equivalent to that of live *Artemia* nauplii, there is potential for improvement through modifications to the diet. A low moisture form of the diet has also been developed and, if successful, would permit a longer shelf life because it can be stored frozen. The paste form of the diet may also serve as the best vehicle for feeding juvenile sea urchins and has been shown to be readily consumed by juvenile abalone.

Research - Coastal Ecosystem Health and Management

R/ER-38 - Effects of Endocrine-Disrupting Chemicals on Reproductive Function of Fish.
Marius Brouwer, The University of Southern Mississippi.

A wide range of chemicals introduced by man into the aquatic environment may be producing adverse effects of reproduction of fish by disrupting endocrine system function. Impaired reproduction

caused by endocrine-disrupting chemicals (EDCs) and subsequent decline in populations may have serious consequences for commercial and sports fisheries. There is, therefore, a strong need to develop biomarkers which can be measured easily, economically, and on a large scale, and which can be used as a predictive indicator of EDC-mediated impaired reproductive function.

The first objective of this project was to test the hypothesis that vitellogenin in serum of fish can be used as a predictive indicator of impaired reproductive function caused by environmental (anti)estrogens. This objective has been met using the Japanese medaka and the sheepshead minnow as the experimental animals. The PI has demonstrated that vitellogenin in male serum of both freshwater and saltwater fish is correlated with impairment of reproductive function.

The second objective was to examine the hypothesis that the effects of exposure to estrogenic and antiestrogenic chemicals are synergistic, and thus especially harmful to reproduction of fish. Male sheepshead minnows were exposed to octylphenol (an estrogenic chemical) and female fish were exposed to cadmium (a suspected anti-estrogenic chemical). No correlation between cadmium exposure and vitellogenin in female fish was observed. Breeding pairs composed of male fish exposed to highest octylphenol concentration, and female fish exposed to highest cadmium concentration failed to produce any fertilized eggs.

The third and final objective was to test the hypothesis that vitellogenin in caged fish (*Cyprinodon variegatus*) can be used as an indicator of biologically harmful concentrations of endocrine-disrupting chemicals in estuarine ecosystems. A three week field exposure was set up near Keegan wastewater treatment plant outfall in the Biloxi (MS) Back Bay. No difference in vitellogenin in male or female fish from the different exposure sites was observed. However, a significantly higher total egg production per female per collection day (~45percent) was observed at the furthest site from the outfall.

R/LR-44 - Transfer of Sexing Technology to the Kemp's Ridley Sea Turtle International Recovery Program. Thane Wibbels, The University of Alabama at Birmingham.

The Kemp's ridley is the most endangered sea turtle in the world. There is an intense conservation effort aimed at protecting nesting females, eggs, and hatchlings on its nesting beach. The Kemp's ridley has temperature-dependent sex determination which can produce highly biased sex ratios. Biased sex ratios have the potential of negating the beneficial effects of conservation programs. The results of the current research allow the International Kemp's Ridley Recovery Program to monitor hatchling sex ratios, and thus, provide a basis for evaluating if incubation temperatures need to be altered in order to optimize the recovery of the Kemp's ridley.

Overall, the data collected at Rancho Nuevo indicate that both males and females were produced during the 1998 through 2000 nesting season, but a significant female bias existed. The data from all three nesting seasons consistently indicate the production of a significant female bias. In fact, approximately 70% of the nests which were monitored were predicted to produce 100% females, and many others produced female biases. It is plausible that this female bias is also indicative of previous years, since the main egg corral has been in the same general location for several decades. It is possible that a female bias has the potential of enhancing future egg production and thus the recovery of this severely endangered species. These sex ratio data have been presented and utilized at each year's Kemp's Ridley Working Group Meeting when developing management strategy for upcoming nesting seasons. Considering that infertility does not appear to be a problem, the recovery program is currently continuing to utilize the same locations for egg corrals.

A variety of techniques for estimating hatchlings sex ratios were evaluated during this project. The most practical technique proved to be the use of small computerized data loggers which could be inserted into nests to monitor incubation temperature. The nest temperature data was then used to predict sex ratios. This technology has been implemented on a wide variety of sea turtle nesting beaches including collaborations with the National Park Service in the U.S. Virgin Islands, the National Marine Fisheries Service in Hawaii and in Florida, the U.S. Geological Survey in Texas, U.S. Fish and Wildlife Service in Alabama, Georgia Southern University, Quintana Roo State Government in Mexico's Yucatan, and with the Division of the Environment in the Republic of the Seychelles.

During this study, the histological analysis of gonads from hatchlings (which were found dead in the nests from natural causes) was also evaluated as a potential sexing technique. This technique proved to be an effective means of sexing individual turtles, even with turtles that may have been dead for several days prior to preservation. Further, this technique provided an independent method of validating our predictions based on incubation temperature. This technique is being used to sex turtles from collaborative projects in Mexico, Florida, and Georgia.

A safe method for obtaining blood samples from hatchling turtles was developed and field tested. The technique provides a safe and simple means of obtaining a small blood sample from hatchlings which can then be used for genetic studies, physiological studies, and sexing studies. This technique has been subsequently used by other sea turtle researchers.

A large amount of time and effort has been spent developing and evaluating blood-based sexing techniques for hatchlings sea turtles. A testosterone-based method for juvenile sea turtles has been validated, but to date an accurate and practical method for hatchlings has not been found. However, efforts are continuing with a molecular-based technique.

R/ER-39 - *Recruitment Dynamics and the Effects of Environmental Variation on Early Growth and Survival of Important Estuarine Fishes.* Mark S. Peterson, Chet F. Rakocinski, and Bruce H. Comyns, The University of Southern Mississippi.

Coastal wetlands of Mississippi, Alabama, and Louisiana provide important nursery habitats for many fisheries species. These areas are impacted by encroaching coastal development, and will certainly be further affected by future changes in hydrology. The objective of this project is to quantify how environmental fluctuations affect early growth and survival of commercially important fishes using nursery habitat.

The scope of the spot collections was reevaluated to determine how to select specimens to examine growth variation over the entire three month study period of 1999 at Front Beach, Ocean Springs, MS. It was recognized that roughly 20 randomly selected specimens from each collection could comfortably provide enough growth history information to relate with 2 weeks of prior variation in physical conditions. In all, there were 15 collections each comprising fish samples from 5 stations within the study period from which to choose specimens for examining growth variation. It was decided that 148 additional specimens (not including 269 already processed) representing 8 of the collections taken between February 9 and April 29, 1999 would be processed for otoliths in order to complete the picture of early growth variation at the Ocean Springs site. Techniques for reading and interpreting otoliths have been established. Initial inspection of otoliths from lab-reared spot indicated the presence of daily otolith growth increments. These daily increments were not distinctive in otoliths from lab-reared croaker.

Although size/frequency distributions of juvenile spot were highly variable, sequential distributions (pooled from several sampling sites within a location) from several sampling dates showed

growth rates of young juveniles to be approximately 1mm d⁻¹. In addition, lengths of 150 juveniles from each size/frequency distribution were randomly selected to provide standardized data from which mortality estimates are being calculated using several methodologies.

Research - Advanced Technology for Human Health, Commercial and Environmental Applications

R/MT-40 - Isolation and Purification of Bioactive Compounds from Echinoderms Utilizing a Novel Biofouling Assay. Charles D. Amsler and James B. McClintock, The University of Alabama at Birmingham.

The objectives of this project were to isolate and characterize natural bioactive compounds from Gulf of Mexico echinoderms, to apply novel micro-behavioral assays for biofouling by invertebrates and bacteria to make purification efforts much more efficient, and to develop similar micro-behavioral assays for biofouling by macroalgae and to apply these assays in purification efforts.

Computer-assisted motion analysis protocols have been developed for image capture and for processing of swimming path data for the bacterial model, *Deleya marina*, and the macroalgal models, *Ectocarpus siliculosus* and *Hincksia irregularis*. The new settlement assays for *Ectocarpus siliculosus* and a related alga, *Hincksia irregularis*, developed in the first year of this project, were optimized. These assays have been used to document anti-spore settlement bioactivity in three pure compounds previously isolated from a Gulf of Mexico echinoderm by the investigators' Italian collaborator, Dr. Franco Zollo. Of the two algal species (which are closely related), *Hincksia irregularis* has proven the most efficient laboratory model because it produces spores in greater numbers and more reliably and so all of the present algal spore work utilizes this species. Natural antifouling compounds have been purified from four species of echinoderms: the ophiuroids *Astrocyclus caecilia* and *Astroporpa annulata* and the asteroids *Astropectin articulatus* and *Luidia clathrata*. Extracts from *Astrocyclus caecilia*, *Astropectin articulatus*, and *Luidia clathrata* have been assayed for settlement inhibition of macroalgal spores and all have activity in the classical assays.

Motion analysis bioassay-guided purification protocols have been used to purify fractions containing bioactive compounds. As expected, these assays have proved to be effective with very small quantities of extract and so have made true bioassay-guided purification possible. One of the several significant strengths of this approach is that it makes it practical to extract fractions without bioactivity on their own and test for interactive effects. In fact, the researchers have identified just such interactive effects and followed their chemistry. Extracts of *Luidia clathrata* have been used in motion analysis assays with *Balanus amphitrite*. Extracts from *Astrocyclus caecilia* have also been assayed against larvae from *Balanus amphitrite* and appear to be both active and non-toxic in preliminary assays.

The investigators have been unable to obtain the asteroid *Goniaster tessellatus*, which was the only one of their target species well suited for further development of the bacterial assay because it is the only one from which crude extracts were found to be active and non-toxic in a previous study. Several potential alternative, non-toxic bacterial settlement inhibitors have been identified. Dr. Mikel Beccero, a postdoctoral student, began working with the PIs in January 2000 and developed the *Balanus amphitrite* motion analysis assay. Unfortunately, for personal reasons, Dr. Beccero had to return to Spain in October and has apparently made no progress writing his results. Dr. Beccero was replaced by a laboratory technician with invertebrate larvae experience and continued the larval work. Problems caused by multiple environmental influences on algal spore settlement that were encountered during assay

development allowed the PIs to make a number of important new observations about the basic biology of this process. These observations are important components of two submitted papers.

R/ER-40 - Use of Chemical Priming for Enhancing the Bioremediation Potential of Heavy PAH Contaminated Sediments. Mark E. Zappi , Mississippi State University.

The purpose of this project was to develop the use of chemical oxidizers as a means of priming the aerobic biotreatment of hotspot sediments contaminated with heavy polycyclic aromatic hydrocarbons.

Significant time was spent on the evaluation of biological treatment of PAHs (polycyclic aromatic hydrocarbons) within a sediment sample received from New York Harbor. Results indicated that few PAH active organisms appeared within the sediment. The PI initiated development of seeding protocols for exotic organisms obtained from Dr. Lewis Brown of the Biological Sciences Department at Mississippi State University. Oxidation experiments indicated that the catalase reservoirs within the New York sediment were far greater than those encountered with up-land sediments. Estimation of hydrogen peroxide degradation was completed. The extent of PAH oxidation was analyzed. A second PAH contaminated sediment was obtained from Wayne State University.

Work continued with both in-land and marine sediments because of the ease of availability of the local sediments and soils. Work also continued with various groups on the combining of chemical oxidation techniques with biotreatment. The PI initiated research on the use of this approach for TNT contaminated soils from Volunteer Army Ammunition Plant located in Chattanooga, TN.

R/MT-41 - Semisynthetic and Microbial Transformations of Marine Natural Products for Technological Development in Human Health and Agriculture. Jordan K. Zjawiony, Mark Hamann, and Marc Slattery, The University of Mississippi.

The primary objectives of this project were the semi-synthetic modifications and microbial transformations of three marine natural products—puupehenone, sarcophine, and pukalide—in order to obtain new pharmaceutical and agrochemical agents.

During the first year of this project problems were encountered with isolation of pukalide from the soft coral *Leptogorgia virgulata* collected from the Mississippi-Alabama Gulf Coast in 1996. It became apparent that samples of *Leptogorgia virgulata* from this collection did not contain any substantial amounts of pukalide that could be utilized in further semi-synthetic or microbial studies. Because of the problems encountered with isolation of pukalide from *Leptogorgia virgulata*, the researchers decided to abandon this prototype from further studies and focused on puupehenone and sarcophine.

Puupehenone and its derivatives show a wide variety of biological properties, including cytotoxicity, antiviral, antifungal, antimalarial, and immunomodulatory activities. Puupehenone was found to be active against cancer cell lines, such as P-388, A-549, HT-29, and melanoma. At similar concentrations puupehenone inhibits DNA and protein synthesis and also inhibits β -1, 3-glucanase.

The derivatives produced by this study were tested against four cancer cell lines at Biomar S.A., Madrid, Spain, and against tuberculosis at the TAACF, Southern Research Institute in Birmingham, Alabama. The data obtained so far from antitumor assays against P-388 (mouse lymphoma), A-549 (human lung carcinoma), HT-29 (human colon carcinoma), and MEL-28 (human melanoma) indicate that

puupehenone derivatives resulted from addition of oxygen nucleophiles at carbon atom C-15 have significant antitumor activity, comparable with that of puupehenone itself. These results are prompting the researchers to extend semisynthetic transformations of puupehenone into derivatives bearing electronegative substituents such as oxygen, nitrogen, and sulfur. The antituberculosis assays data obtained so far have shown that puupehenone exhibits a significant activity against H37Rv strain of *Mycobacterium tuberculosis*. Interestingly, compounds with catechol moiety such as 15-oxopuupehenol do not show a significant activity. These observations create a need for the semisynthesis of puupehenone derivatives with quinone-methide moiety, substituted at carbon atom C-15.

Puupehenone sulfide derivatives were tested for their cytotoxicity at the National Research Center for Natural Products and against four cancer cell lines at Instituto Biomar S.A., Madrid, Spain, as well as against tuberculosis at the TAACF, Southern Research Institute in Birmingham, Alabama. Cytotoxicity tests proved that the hypothesis regarding the relation between toxicity and substitution at C-15 was generally true. A significant majority of tested compounds showed to have much lower toxicity than that of puupehenone. It can now be said with high probability that cytotoxicity of puupehenone is most probably related to its relatively high reactivity toward thiol groups in receptor proteins and it can be removed by blocking the reactive center at C-15. This can be easily done by conjugate addition of sulfur and other nucleophiles.

Sarcophine. Sarcophine derivatives obtained in the process of microbial transformation were tested for inhibition of TPA-induced JB6 cell transformation, which correlates well with tumorigenesis inhibition. Two known cembranoids, Sarcophytol A and B isolated from the Okinawan soft coral *Sarcophyton glaucum* have been reported to possess potent inhibitory activities against various classes of tumor promoters. Sarcophytol A mediated dose-dependent diminution of 12-*O*-tetradecanoylphorbol 13-acetate (TPA)-induced transformation of JB6 cells. When evaluated for potential to inhibit TPA-induced JB6 cell transformation, several of the sarcophine metabolites mediated inhibitory responses greater than sarcophytol A or sarcophine, most notably 7 α -hydroxy- $\Delta^{8(19)}$ -deepoxysarcophine, which was comparable to 13-cis-retinoic acid. These studies provide a basis for further development of novel furanocembranoids as anticancer agents.

Sarcophine derivatives obtained in selenium dioxide oxidation reactions were tested for activity as potential calcium channel blockers at Viatch Laboratories, Ivoryton, CT, a Division of Cognetix Inc., Salt Lake City, UT. Sarcophine, 13S(β)-hydroxysarcophine, and sarcophine-20-carboxyaldehyde were tested for effects on membrane potential and intracellular calcium level. All of them showed similar effects at high concentrations. At this concentration there was a profound depolarization of the preparation accompanied by a large drop in intracellular calcium. At concentrations between 10 fg/ml and 100 ng/ml, 13S(β)-hydroxysarcophine produced a sustained hyperpolarization of the preparation. Over this same concentration range 13S(β)-hydroxysarcophine produced a small decrease in intracellular calcium followed by a transient increase and finally a decrease in intracellular calcium. These results are intriguing and will require further biological studies of these derivatives.

Sarcophine and seven products of selenium dioxide oxidation reactions were sent to Dr. Takao Konoshima from Kyoto Pharmaceutical University in Japan for inhibition of Epstein-Barr Virus (EBV) early antigen (EA) activation assay in vitro that represents potential chemopreventive activity of the tested compounds. The results of this assay have shown that five of the researchers' derivatives have inhibitory effects stronger than sarcophytol A. The strongest inhibitory effect (more than 96% inhibition at 1000 mol ratio) on the EBV-EA activation induced by TPA was shown for one of the compounds with an open-lactone ring. Therefore, these compounds might be valuable as potential cancer chemopreventive agents.

Education, Training, and Human Resources

E/O-62 - *Making Aquatic Connections (Project MAC)*. David L. Scott, Mobile County Public School System and Richard K. Wallace, Auburn University.

The objectives of this project were to (1) extend aquatic environmental education opportunities to marine and advanced biology students and teachers throughout the Mobile County Public School System; (2) provide inservice training and support materials to all participating teachers in the content, application and delivery of all project components; (3) conduct field trip experiences at the Environmental Studies Center aimed at enriching the Alabama Course of Study in Science; (4) develop and maintain instructional resources to support the implementation of project field activities and interactive learning experiences; and (5) provide classroom support services and materials for successful pre-field trip preparation and extension of on-site field study through follow-up data analysis and interpretation.

During the 2000 project year, 12 teachers representing ten of Mobile County's 15 public high schools engaged their students in Sea Grant sponsored field study activities at the Environmental Studies Center. Three hundred ninety-eight students participated in water quality analysis and habitat studies during fall semester. The project was extended through spring semester, 2001, with more than four hundred additional students enrolled. This year brings the total number of teachers involved in the 3-year project period to 20 and the total student count to over 3,200.

Inservice training for participating teachers was provided through a workshop conducted in August of 2000, at which support materials for execution of project activities were distributed. Training in the use and application of these materials was an integral part of the workshop agenda. Resource speakers from Auburn University's Marine Education and Research Center (AUMERC) presented information on the analysis and interpretation of water quality data and current trends in the Dog River watershed. Special emphasis was given to interpretation of data from key sampling sites in the Hall's Mill Creek sub-basin in which the Environmental Studies Center is located. The August 2000, workshop culminated the project's teacher training component, which was carried out at the beginning of the school year in each of the three project years. In each workshop, stress was placed on strengthening effectiveness of the delivery of program content and methodology. Activities were conducted that (1) familiarized each teacher with the ESC's facilities, program opportunities, and instructional resources, (2) identified the project goals and objectives, (3) introduced materials to be used in pre- and post-field trip enrichment activities, (4) engaged participants in hands-on activities to be conducted in the field trip program, (5) addressed the key logistical concerns for a successful field trip, and (6) introduced evaluation strategies to assess program effectiveness and student achievement. Workshop evaluation results revealed a rating of "excellent" or "good" on all questions, with an average of 83% or more falling in the "excellent" category.

In the third year of the project, field excursions to the Environmental Studies Center were conducted during the fall semester and were extended through the spring semester for all project teachers and students. The focus of field study included water quality analysis, habitat investigation, and a study of wildlife indigenous to coastal Alabama. The students sampled Pine Lake, a freshwater impoundment of Campground Creek, for dissolved oxygen, turbidity, nitrates, temperature and pH. Results were used to draw inferences regarding the water quality of the Dog River watershed and its impact on Mobile Bay. Plants associated with the lake and other wetlands were collected, identified, and preserved for future reference back at the local school. The students also toured the Center's live animal exhibits to see, first-hand, many birds and mammals commonly encountered in the wetlands of coastal Alabama.

E/O-60 - Marine Meteorology for Middle School. Sharon H. Walker, The University of Southern Mississippi and David McCarren, Naval Oceanographic Office, Stennis Space Center.

This project was designed to (1) provide participating teachers with an increased knowledge base and understanding of meteorological concepts and applications, (2) provide teachers with hands-on meteorological (weather monitoring) equipment and the ability to implement the use of the equipment in the classroom, and (3) engage students of participating teachers in hands-on meteorological activities providing them opportunities for observation and the taking and recording of scientific data.

This workshop was implemented under the title *Project Marine Discovery: Teachers' Mini-Camp for Meteorology* from November 6-11, 2000. Personnel of the J.L. Scott Marine Education Center and Aquarium and Navy Lt. Michael McFarland provided primary instruction to 16 teachers from Mississippi and Alabama. Evaluations of the workshop were strongly positive, and several of the teachers have registered for subsequent, additional workshops

Eighteen teachers were initially booked for this workshop. Unfortunately, budget cutbacks and testing for two of the Alabama teachers caused these two individuals to withdraw from the workshop at the last minute.

A new opportunity which has grown out of this project is the design and installation of a new Wave Tank exhibit at the J.L. Scott Marine Education Center and Aquarium (MEC&A). This exhibit is currently allowing visiting teachers and students to access portions of the ocean science/weather science/meteorology science content taught during the workshop, i.e., ocean wave formation and movement toward land. Further, a related project, Sea Grant HazNet, has been extended and combined with weather science content from this project.

A/O-9-MS - Mississippi Sea Grant Extension Program. C. David Veal, Ph.D., Mississippi State University.

The objectives of this project were to increase knowledge and skills by the transfer of information and technology to and from those with an interest in coastal and marine resources. The long-range goals of the Mississippi Sea Grant Advisory Service Program are to (1) familiarize a wider segment of the educational community and general public with the Sea Grant concept; (2) carry out intensive educational programs for specific audiences including, but not limited to, fisheries, seafood industry, coastal developers, resource managers, government, youth, educators, and the general public; (3) seek means for developing stronger working relationships with government and non-government groups and agencies; and (4) develop more efficient program planning, problem. and audience identification procedures.

Aquaculture extension provided economic, marketing, and technical information on the major commercial aquaculture species which have potential in the Mississippi Gulf Coast. Economic analyses of existing and proposed aquaculture enterprises are also conducted for certain species or production system. This information is disseminated through the monthly wholesale market reports, extension publications, presentations in workshops and conferences, telephone interviews, and farm visits.

"Public Access to Coastal Mississippi" provided economic, management, and technical information on public access to the Mississippi Gulf Coast beaches, piers, marinas, and artificial reefs. The following information is available at the CREC Coastal Mississippi Public Access webpage: description and location of public access, investment requirements, operating costs, pricing structure, and economic impact.

Commercial fisheries extension continued gear research and technology transfer activities to address the problem of bycatch in the Gulf shrimp fishery. Reductions in unwanted bycatch of up to 70 percent with no loss in shrimp production have been documented. Gear testing protocols were developed, statistical analyses were conducted, and written reports regarding gear performance were prepared. The shrimp processing wastes disposal project provided information on the disposal and/or use of by-products from seafood processing plants on Mississippi's Gulf Coast. Waste disposal is a recurring problem, which the industry has traditionally solved on an ad hoc basis using the lowest cost alternative available. Collection and utilization is expensive and disposal in landfill space has been restrained. One alternative is to convert the solid waste into meal which can be sold as a feed additive for broiler chickens, fish, and aquacultural commodities.

Beginning in August 1999, efforts were initiated to select and adopt several stream sites across coastal Mississippi in conjunction with the Mississippi Department of Environmental Quality's Adopt-A-Stream program. A special instructional class was arranged in August 1999 for members of the Coastal Master Naturalist group and interested SMEACO members. Based on this effort, plans progressed in 2000 for the adoption of eight stream sites, including four freshwater and four tidal systems. Based on the lack of a strategy by the DEQ for sampling tidal systems, the DEQ asked us to develop a tidal water option for their program. The proposal for a tidal option and a modified freshwater option was approved by the DEQ in September 2000, resulting in two new Adopt-A-Stream kits developed especially for use in the coastal region of the state. The new Coastal Tidal Kits and Coastal Freshwater Kits were available for use in 2001. Both kits included the addition of a test for nitrate and phosphate, as well as materials to test for fecal coliform bacteria. The tidal kit also included a refractometer to measure salinity. Kits and materials were provided by the DEQ for each stream adopted.

Support was given to county and area Extension field staff in providing marine and coastal resource educational programs at the local level by supplying educational materials, current research-based subject matter information, and on-site program delivery, as requested.

A media directory was prepared for five Gulf of Mexico states to be used in regional aquatic nuisance species (ANS) outreach programs. This directory provides contact information on radio, television, and newspaper personnel specializing in environmental and outdoor issues. This directory helped establish a network through which the general public could be taught how to stop the spread of ANS in the Gulf of Mexico drainage basin.

A/O-9-AL - Alabama Sea Grant Extension Program. Richard K. Wallace and Brian E. Perkins, Auburn University.

The objectives of this project were to provide science-based information to the fishing industry and the larger community of coastal citizens, managers, and elected officials; to identify and communicate problems to appropriate research interests; and to assist stakeholders through informal education opportunities in making informed decisions on the use and development of coastal marine resources.

In the area of Seafood Technology, accomplishments concerned seafood safety training and compliance assistance related to FDA's HACCP-based inspection regulation (21 CFR Part 123). Five Basic Seafood HACCP Courses were supervised and taught at which 108 persons from 84 processing firms received FDA-recognized certificates. The seafood technologist helped 4 Blue Crab processors with a combined annual production of \$750,000 respond to FDA's "Untitled Letters" (in which deficiencies were noted), correct them and maintain the jobs of approximately 100 Asian and Black

minority employees. In addition, he helped mediate a dispute between FDA and the Alabama seafood industry about the manner in which 21 CFR Part 123 was being enforced.

While inspecting fish and seafood firms during the first two years following imposition of its HACCP Rule, FDA became particularly dissatisfied with the industry's compliance with the more basic Sanitation Standard Operating Procedures (SSOPs) upon which the HACCP Rule is (at least in part) based. The Association of Food and Drug Officials (AFDO)/Seafood HACCP Alliance developed the Sanitation Control Procedures (SCP) Course in response to this educational need. The Seafood Technologist received the SCP Trainer Certificate and, in turn, helped 18 inspectors with the Texas Department of Health receive their SCP Trainer Certificates.

The Seafood Technologist organized or participated in 155 directed meetings and workshops that were attended by approximately 684 people. Fifty presentations were delivered to groups totaling approximately 900 attendees. The following are examples of accomplishments resulting from directed meetings and workshops:

- Continued to provide assistance to Blue Crab processors related to package labeling issues.
- Continued participation in monthly meetings of the Mobile Area Chamber of Commerce Seafood Task Force (six occasions).
- Continued helping processors respond to FDA's "untitled letters."
- One hundred and two industry and regulatory agency personnel received AFDO/ Seafood HACCP Alliance Basic HACCP certificates.

Other accomplishments:

- The Dog River Project finished its third year by completing the Dog River Management Plan. The Plan will be printed and distributed to citizens, elected officials and agencies in 2001 and will provide the basis for future actions to protect water quality in the watershed. The project continued to support the Dog River Revival citizens group by assisting with meetings, contributing to the newsletter, organizing the Dog River clean up (228 volunteers and 11,000 lbs of trash), supervising water quality monitoring, making presentations to stakeholders and interested parties. New initiatives included creation of a Watershed Guardian Program which rewards homeowners and developers for using best management practices. The Program was recognized by the Mayor of Mobile at a City Council meeting.
- Continued involvement with the South Mobile County Education Foundation and its support of a high school aquaculture program. The program has educated over 200 students and student interest in the program remains strong. The program has been important for educating a traditional fishing community about aquaculture and has provided educational opportunities for elected officials and other leaders.
- We continued the Legacy sponsored project which provided a Mobile Bay field trip experience on our 33 foot vessel for 150 Mobile county school students and several other groups.
- Assisted Grass Roots Inc. by arranging their educational program to be downlinked at six County Extension Offices. One hundred realtors viewed the program "Water Runs Downhill" and received continuing education credit.
- 156 newspaper columns (estimated circulation 130,000).

- Cooperation and coordination with 20 organizations and agencies.
- Personal contacts including telephone calls and mailings of materials with over 87,000 constituents.
- Contact with approximately 2,500 citizens through presentations or meetings.
- Distribution of numerous information pamphlets, information sheets, or specially prepared materials.

R/SL-4 - Mississippi-Alabama Sea Grant Legal Program. John A. Duff, Kristen M. Fletcher, Tammy L. Shaw, Richard J. McLaughlin, William Hooper, Jr., The University of Mississippi.

The Sea Grant Legal Program provided outreach and advisory service on marine policy and law issues to a host of Sea Grant and other affiliated institutions. Agency officials, policymakers, and the general public were informed of developments in coastal and marine resource issues through publications including the quarterly newsletter, *Water Log*, which is distributed to over 1,000 subscribers and is now available to internet users via the World Wide Web. At the end of 1999, Mr. John Duff left the Legal Program and was replaced as director by Ms. Kristen M. Fletcher.

Examples of the legal research service provided by the Legal Program:

- Request from Oregon for authorities and contacts in Mississippi and Alabama regarding permitting and lease fees (if any) for laying fiber optic cable over state submerged lands.
- Requests for information on net ban laws and regulations from New Jersey and Florida.
- Disposal of shrimp by-products.
- Request from Massachusetts regarding public trust doctrine issues related to aquaculture.
- Request from Knauss Fellow of Senator Wyden's staff for information on the Oil Pollution Act and money available for natural resources damages for an oil spill off the Oregon coast.
- Request from Congressional Research Service regarding recent developments in marking and identifying origins of Pacific Salmon Stocks.
- Request from Mississippi Department of Marine Resources, for recently enacted legislation governing aquaculture regulation and jurisdiction in Mississippi.
- Request from Alabama Marine Extension Service, for a review of FDA policies and seafood regulations in blue crab processing plants.
- Request from Counsel at the Naval Meteorology & Oceanography Command, Stennis Space Center, regarding liability for defective nautical charts.
- Request for information on offshore mineral development issues to Continental Shelf Associates, Inc.

- Request from Ben Sherman and the National Fisherman Magazine regarding information on the Magnuson Act and its reauthorization.
- Request from Alabama Marine Extension Service for information on Essential Fish Habitat.
- Request from Department of Marine Resources for a summary of casino-related cases from Mississippi courts since the advent of gaming in the state.
- Request from Dauphin Island Sea Lab for information regarding establishing a Voluntary Conservation Easement Program in Mississippi.

An article by Fletcher, *If You Can't Beat 'em, Eat 'em: Legal Methods to Control Aquatic Nuisance Species in the Gulf of Mexico*, presented the background of aquatic nuisance species in the Gulf states and methods used to control the spread of such species. The article outlined the issues involved in creating a Regional Nuisance Species Management Plan and individual state plans including resource shortages as well as enforcement concerns and lack of political will. The article was able to review the effectiveness of the state laws and the prospect of the development of a Gulf-wide management plan that can address the problems of current aquatic nuisance species and present preventative measures for possible future invasions.

Richard McLaughlin published an article, *Sovereignty, Utility, and Fairness: Using U.S. Takings Law to Guide the Evolving Utilitarian Balancing Approach to Global Environmental Disputes in the WTO*, which reviewed the United States' use of trade restrictions as a fundamental instrument of international fisheries and marine conservation policy. McLaughlin analyzed the most recent decisions of the WTO and suggested that rather than use the case-by-case analysis generally employed, future WTO decisions regarding trade and environmental issues should be determined using a utilitarian approach to determine whether trade restrictions are in violation of international law and policy.

The impacts of the construction of a 744 mile natural gas pipeline from the Gulf coasts of Mississippi and Alabama across the Gulf to the Gulf coast of Florida was researched by Fletcher and Research Associate David Harris. The purpose of the pipeline is to supply natural gas transportation service for up to 1.1 billion cubic feet per day to sites of future gas powered electric generation plants projected to be needed in Florida over the next 30 years. The project generated concern because it affects marine reserves and Essential Fish Habitat (EFH). Fletcher and Harris used the project as a basis to evaluate the interaction of environmental analysis under the National Environmental Policy Act, EFH provisions under the Magnuson Act, and marine reserves that are being created in the region.

The Legal Program serves as a legal research service in assisting Sea Grant and government affiliated agencies. Requests for legal program research have increased significantly in recent years. The requests tend to be from the Gulf region but included 15 requests from outside of the 5 Gulf of Mexico states.

M/PC-1 - Mississippi-Alabama Sea Grant Communications Program. Timothy H. Reid, Mississippi-Alabama Sea Grant Consortium.

Since the Communications position at MASGC was vacant from June of 1998 through October of 1999, the Communications Program required basic structural rebuilding. Visits were made to most of the member campuses to meet with researchers, public relations officers, communications advisory committee members, and faculty. Numerous important contacts were made with newspaper and TV

representatives from Alabama and Mississippi, as well as other regional, national, and international media, including several scientific journal representatives. Relationships have been established with local and state agencies through participation in civic groups such as the South Mississippi Environmental & Agricultural Coordination Organization (SMEACO), South Alabama Public Outreach Task Force, and the Mississippi Marine Debris Task Force.

Several one-pagers/fact sheets were developed, including one for Marine Biotechnology, two for the Offshore Aquaculture Consortium, and one regarding the jellyfish invasion. Collaborative projects included a 20-page World Aquaculture Society booklet; a NOAA spotlight feature; a press release/press kit for the Marine Bioinvasions Conference; coordinated and hosted a Southeast region Sea Grant booth and display at the Gulf of Mexico Symposium; coordinated and hosted a booth and display at the World Aquaculture Society Conference in Orlando, FL, that represented 13 different Sea Grant programs; and coordinated and hosted a joint MASGC/Mississippi Sea Grant Extension Program booth at the Mississippi Department of Marine Resources Coastal Development Conference.

Participation in public/educational/scientific events included such activities as Earth Day held at the Gulf National Seashore in Ocean Springs, MS and another Earth Day celebration held at Keesler Air Force Base in Biloxi, MS; open house at the Mobile County Schools' Environmental Education Center, Mobile, AL; Mississippi Regional Science Fair; Mobile (AL) Regional Science Fair; South Mississippi Environmental & Agricultural Coordination Organization (SMEACO); served as a mentor for a student in the Gulf Coast Research Laboratory/Mississippi Gulf Coast Community College Internship Program; attended the Wetlands Conference held at The University of Mississippi and the NOAA/Jackson State University Expanding Opportunities Conference.

In cooperation with the development of offshore cage aquaculture in the Gulf of Mexico, Reid and Mr. Chris Bridger, the project manager, planned and coordinated the international conference on Open Ocean Aquaculture, OOA IV which was held in June of 2001 at St. Andrews, New Brunswick, Canada. Products produced included the initial announcement, the call for abstracts, registration form, informational packet that went out to prospective attendees/sponsors, and the symposium Web site design.

Publication List for 1998-2000 Omnibus Projects

During this Omnibus period, MASGC sponsored research that led to 2 patents, 37 journal articles with an additional 17 articles in preparation, in review or in press, 52 invited papers and/or presentations, 8 technical reports, 23 abstracts, 1 book, and 7 book chapters. Extension and Legal Program production included 43 outreach publications, 15 presentations, 3 abstracts, 3 workshops, 12 Legal Reporters, and 47 newsletters.

R/LR-41 - Development of a Method for Controlling the Molt Cycle of the Blue Crab, *Callinectes sapidus*. R. Douglas Watson, Ph.D., Ming Luo, Ph.D., and Stephen A. Watts, Ph.D., The University of Alabama at Birmingham.

Manuscripts:

1. Watson, R.D., Lee, K.J., Qiu, S.Q., Luo, M., Umphrey, H.R., Roer, R.D., and Spaziani, E. (2001) *Molecular Cloning, Expression, and Tissue Distribution of Crustacean Molt-inhibiting Hormone*. Amer. Zool. 41:407-417.
2. Watson, R.D., Lee, K.J., Borders, K.J., Lilly, K.Y., and Dircksen, H. (2001) *Molt-inhibiting Hormone Immunoreactive Neurons in the Eystalk Neuroendocrine System of the Blue Crab, Callinectes sapidus*. Arthropd Struct. Devel. 30:69-76.
3. Lee, K.J. and Watson, R.D. (2002) *Expression of Crustacean (Callinectes sapidus) Molt-inhibiting Hormone in Insect Cells Using Recombinant Baculovirus*. J. Exp. Zool. 292:41-51.

Papers In Press:

1. Lee, K.J. and Watson, R.D. *Antipeptide Antibodies for Detection of Crustacean (Callinectes sapidus) Molt-inhibiting Hormone*. Peptides (In press).

Abstracts:

1. Borders, K.J., Lilly, K.Y., Dircksen, H., Lee, K.J., and Watson, R.D. (1999) *Immunocytochemical Investigation of the Molt-inhibiting Hormone Neuroendocrine Axis of the Blue Crab, Callinectes sapidus*. Amer. Zool. 39:27A.
2. Watson, R.D. (1999) *Molecular Cloning, Expression, and Tissue Distribution of Crustacean Molt-inhibiting Hormone*. Amer. Zool. 39:86A.
3. Han, D.W. and Watson, R.D. (2000) *Presence and Potential Roles of G-proteins in Y-organs of the Blue Crab, Callinectes sapidus*. J. Ala. Acad. Sci. 71:6.
4. Han, D.W. and Watson, R.D. (2000) *Presence and Potential Roles of G-proteins in Y-organs of the Blue Crab*. Amer. Zool. 40:1043.
5. Lee, K.J. and Watson, R.D. (2000) *Production of Antipeptide Antibodies for Detection of Crustacean Molt-inhibiting Hormone*. Amer. Zool. 40:1100.

6. Han, D.W. and Watson, R.D. (2001) *Assessment of the Role of G-proteins in Regulation of Ecdysteroidogenesis in Blue Crab (Callinectes sapidus) Y-organs*. J. Ala. Acad. Sci. 72:85.
7. Han, D.W. and Watson, R.D. (2001) *Cell Signaling Pathways for Ecdysteroidogenesis in Blue Crab Y-organs*. American Zoologist 41:1465.

Abstracts In Press

1. Han, D.W. and Watson, R.D. *Cell Signaling Pathways for Ecdysteroidogenesis in Blue Crab Y-organs*. J. Ala. Acad. Sci. (in press).

R/LR-42 - Assessment of Sea Urchins as Fishery and Aquaculture Candidates in the Gulf of Mexico. Stephen A. Watts, Ph.D., James B. McClintock, Ph.D., The University of Alabama at Birmingham, and John M. Lawrence, Ph.D., The University of South Florida.

Manuscripts:

1. Lawrence, J.M. and A. Bazhin. 1998. *The Use of Life-history Characteristics to Evaluate the Potential of Sea Urchins for Aquaculture*. Journal of Shellfish Research. 17(5), 1515-1522.
2. McBride, S.C., J.M. Lawrence, A.L. Lawrence and T.J. Mulligan. 1998. *Growth, Feeding Rate, and Feeding Efficiency of Small Sea Urchins (Strongylocentrotus franciscanus) Fed Prepared Feeds of Three Protein Levels*. Journal of Shellfish Research. 17(5), 1563-1570.
3. Watts, S.A., S.A. Boettger, J.B. McClintock and J.M. Lawrence. 1998. *Gonad Production in the Sea Urchin Lytechinus variegatus Fed Prepared Diets*. J. Shellfish Res. 17(5), 1591-1595.
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9. Lawrence, J.M., and J. Herrera. 2000. *Stress and Deviant Reproduction in Echinoderms*. Zool. Stud. 39: 151-171.

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13. Lawrence, J.M. (Editor) 2001. *Edible Sea Urchins: Biology and Ecology*. Elsevier Science Press, Amsterdam. 437 pp.
14. Lawrence, J.M. 2001. Edible sea urchins. In: *Edible Sea Urchins: Biology and Ecology*, J.M. Lawrence (ed.). Elsevier Press.
15. Lawrence, J.M., and T.S. Klinger. 2001. *Digestion*. In: *Edible Sea Urchins: Biology and Ecology*, J.M. Lawrence (ed.). Elsevier Press.
16. Lawrence, J.M., and Y. Agatsuma. 2001. *The Ecology of Tripneustes*. In: *Edible Sea Urchins: Biology and Ecology*, J.M. Lawrence (ed.). Elsevier Press.
17. Marsh, A. and S.A. Watts. 2001. *Energy Metabolism and Gonad Development*. In: *Edible Sea Urchins: Biology and Ecology*, J.M. Lawrence (ed.). Elsevier Press.
18. Olave, S., E. Bustos, J.M. Lawrence, and P. Cárcamo. 2001. *The Effect of Size and Diet on Gonad Production by the Chilean Sea Urchin Loxechinus albus*. J. World Aquacul. Soc. 32, 210-214.
19. Tajima, K., and J.M. Lawrence. 2001. *Disease*. In: *Edible Sea Urchins: Biology and Ecology*, J.M. Lawrence (ed.). Elsevier Press.
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12. Hammer, H.S., S.A. Watts, J.B. McClintock, J.M. Lawrence and A.L. Lawrence. 1999. *Dietary Protein Affects Consumption, Gonad Production and Survivorship in the Echinoid Lytechinus variegatus*. Amer. Zool. 39 (5), 95A.
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18. McBride, S. J. Lawrence, A. Lawrence and T. Mulligan. 1999. *Ingestion, Absorption and Gonadal Production of the Sea Urchin Strongylocentrotus franciscanus Fed Different Ratios of a Prepared Diet*. XIX Congreso de Ciencias del Mar, Antofagasta.
19. Olave, S. E. Bustos, P. Carcamo and J. Lawrence. 1999. *Efecto de la Alimentacion Artificial Sobre el Rendimiento Gonadico del Erizo Loxechinus albus (Molina, 1782) en Distintos Rangos de Tamano*. XIX Congreso de Ciencias del Mar, Antofagasta.
20. Wallace, B.D., Cunningham, A.W., M.S. Vickery, S.A. Watts, J.B. McClintock and J.M. Lawrence. 2000. *Understanding Early Life History Strategies During Culture of the Sea Urchin, Lytechinus variegatus*. J. Ala. Acad. Sci. 71, 2.
21. Hammer, H.S., S.A. Watts, J.B. McClintock, J.M. Lawrence and A.L. Lawrence. 2000. *The Effects of Dietary Protein on the Production and Proximate Composition of Gonads in the Sea Urchin Lytechinus variegatus*. J. Ala. Acad. Sci. 71, 3.
22. Hammer, H.S., S.A. Watts, J.M. Lawrence, A.L. Lawrence and J.B. McClintock. 2001. *The Effects of Dietary Protein on the Production and Proximate Composition of Gonads in the Edible Sea Urchin, Lytechinus variegatus*. World Aquaculture Society, Orlando, Florida.
23. Wallace, B.D., H. Hammer, S.A. Watts, J.M. Lawrence and A.L. Lawrence. 2001. *The Effects of Dietary Protein on Growth of Juvenile Sea Urchins*. World Aquaculture Society, Orlando, Florida.
24. Watts, S.A., M.S. Vickery, M. Becerro, B. Wallace and J.M. Lawrence. 2001. *Problems Associated with Settlement, Metamorphosis and Post-metamorphic Growth of Lytechinus variegatus in Culture*. World Aquaculture Society, Orlando, Florida.
25. Hammer, H.S., S.A. Watts, J.M. Lawrence, A.L. Lawrence and J.B. McClintock. 2001. *The Effect of Dietary Protein Concentration on Gonad Composition and Gametic Condition in the Sea Urchin, Lytechinus variegatus*. Society for Integrative and Comparative Biology. pg. 212.
26. Wallace, B.D., H.S. Hammer, S.A. Watts, J.M. Lawrence and A.L. Lawrence. 2001. *The Effect of Dietary Protein Concentration on the Growth of Juveniles of the Sea Urchin Lytechinus variegatus*. Society for Integrative and Comparative Biology. pg. 417.
27. Cunningham, A.W., B.D. Wallace, S.A. Watts, J.M. Lawrence and A.L. Lawrence. 2001. *Diet Affects Gonad Development in Female Juvenile Sea Urchins (Lytechinus variegatus)*. J. Ala. Acad. Sci. 72 (2), 99.
28. Worrell, R.L., S.A. Watts and B. Gower. 2001. *Glucose Levels in the Coelomic Fluid Vary with Diet in the Sea Urchin Lytechinus variegatus*. J. Ala. Acad. Sci. 72 (2), 95.

29. Wallace, B.D., H.S. Hammer, S.A. Watts, J.M. Lawrence and A.L. Lawrence. 2001. *Dietary Protein Influences Body Components During Growth in the Sea Urchin Lytechinus variegatus*. J. Ala. Acad. Sci. 72 (2), 98.
30. Worrell, R.L., S.A. Watts and B. Gower. 2001. *Glucose Levels in the Coelomic Fluid Vary with Diet in the Sea Urchin Lytechinus variegatus*. 2001 North American Echinoderm Conference, University of Maine.
31. Wallace, B.D., A.W. Cunningham, H.S. Hammer, S.A. Watts, J.M. Lawrence and A.L. Lawrence. 2001. *The Effect of Protein on Gonad Development in Small Sea Urchins (Lytechinus variegatus)*. 2001 North American Echinoderm Conference, University of Maine.
32. Hofer, S. and S.A. Watts. 2002. *The Effect of Temperature on Consumption and Growth in the Sea Urchin Lytechinus variegatus*. J. Ala. Acad. Sci.
33. Cunningham, A. and S.A. Watts. 2002. *Preliminary Description of the Reproductive Cycle of the Sea Urchin Lytechinus variegatus from a Sheltered Bay in Florida*. J. Ala. Acad. Sci.

R/MT-39 - Field Applications of Multiplex PCR to Monitor Microbial Contamination in Shellfish in the Gulf of Mexico. Asim K. Bej, Ph.D., The University of Alabama at Birmingham.

Technology Transfer:

Transfer of technology to FDA Seafood Laboratories at Dauphin Island, AL and Bothell, WA on the oligonucleotide primers, probes and methodologies for multiplex PCR amplification for the detection of total and pathogenic *Vibrio parahaemolyticus* in shellfish. This approach is being included in the FDA *Bacteriological Analytical Methods*, 2001; and APHA *Compendium of Methods for the Microbiological Examination of Foods*, 4th Edition, 2001.

Manuscripts:

1. Michael C.L. Vickery, N. Harold, Asim K. Bej. 2000. *Cluster Analysis of AP-PCR Generated DNA Fingerprints of Vibrio vulnificus Isolates from Patients Fatally Infected After Consumption of Raw Oysters*. Letters in Applied Microbiology. 30:258-262.
2. G.E. Kaufman, M.L. Myers, C.L. Pass, A.K. Bej, and C.A. Kaysner. *Molecular Analysis of Vibrio parahaemolyticus Isolated from Human Patients and Shellfish During U.S. Pacific North-west Outbreaks*. Letters in Applied Microbiology. 34:155-161. (2002).
3. Jeffrey W. Carroll, Madalina C. Mateescu, Kiran Chava, Asim K. Bej, Rita R. Colwell. *Response and Tolerance of Toxigenic Vibrio cholerae 01 to Cold Temperatures*. Antonie van Leeuwenhoek 79:377-384. (2001).
4. Christina L. Pass, Greer Kaufman, Asim K. Bej, and Charles A. Kaysner. *Identification of Plasmids and Hemolysin Genes in Vibrio parahaemolyticus Isolated from 1994 and 1997 U.S. Pacific Northwest Outbreaks*. (In review).
5. Christina L. Pass, William Burkhardt, Kevin Calci, Angelo DePaola, and Asim K. Bej. *Occurrence and Distribution of Vibrio vulnificus in Gulf Coast Oysters Using Multiplex PCR Amplification on of cth and viuB* (In preparation).

6. Asim K. Bej, William Burkhardt, Kevin Calci, and Angelo DePaola. *Multiplex PCR Amplification for the Detection of Total and Pathogenic Escherichia coli from Gulf Coast Oysters*. (In preparation).
7. Christina L. Pass, William Burkhardt, Kevin Calci, and Angelo DePaola. *Application of Multiplex PCR Amplification to Determine the Occurrence and Distribution of Vibrio parahaemolyticus in Shellfish Collected from the Gulf of Mexico*. (In preparation).
8. Greer Kaufman and Asim K. Bej, *Comparisons of Methods for Purification of Total Nucleic Acids from Microorganisms in Shellfish for PCR Amplification*. (In preparation).
9. Greg McKee, Jeff Carroll, Asim K. Bej. *Application of Multiplex PCR Amplification to Determine the Occurrence and Distribution of Total and Pathogenic Salmonellae in Shellfish from Gulf of Mexico*. (In preparation).

Abstract:

Christina L. Pass, LCDR William Burkhardt, Kevin Calci, Angelo DePaola, and Asim K. Bej. *Occurrence and Distribution of Vibrio vulnificus in Gulf Coast Oysters Using Multiplex PCR Amplification of cth and viuB*. Abstract presented at the 99th Annual Meeting for the American Society of Microbiology, Chicago, Illinois. 1999.

R/LR-43 - Nutritionally Complete, Low Cost Artificial Diets for the Culture of Fish and Crustacean Larvae. Louis R. D'Abramo and Randal K. Buddington, Mississippi State University.

Invention Disclosures:

A Microparticulate Microbound Diet for the Culture of Larval Fish and Crustaceans. Disclosure No. 01-0116-01; Docket No. 2342-147-27 PCT; based upon U.S. Provisional Patent Application No. 60/279,434; International Patent Application 01-1029-17 (PCT), March 29, 2002.

Manuscript:

1. Kovalenko, E. E., L. R. D'Abramo, C. L. Ohs and R. K. Buddington. 2002. *A Successful Microbound Diet for the Larval Culture of the Freshwater Prawn Macrobrachium rosenbergii*. Aquaculture, in press.

R/ER-38 - Effects of Endocrine-Disrupting Chemicals on Reproductive Function of Fish. Marius Brouwer, Ph.D., The University of Southern Mississippi.

Manuscripts:

1. Gronen, S.N., Denslow, N., Manning, S., Barnes, S., Barnes, D., and Brouwer, M. 1999 *Serum Vitellogenin Levels and Reproductive Impairment If Male Japanese Medaka (Oryzias latipes) exposed to 4-tert-octylphenol*. Environ. Health Perspect. 107: 385-390.

Invited papers:

1. Brouwer, M., and Gronen, S. 1998. *Effect of Octylphenol on Serum Vitellogenin, Reproductive Capacity and Offspring of Male Fish*. NIEHS workshop on unique marine/freshwater models for environmental health research.
2. Brouwer, M. 2001. *Endocrine Disruption in the Japanese Medaka*. International Workshop on Standardization of Endocrine-Disrupters Testing in Medaka. Nagoya Japan.

Abstracts:

1. Gronen, S., and Brouwer, M. 1998 *Reproductive and Biochemical Effects of 4-tert-octylphenol on Small Fish* J. Miss. Acad. Sci 43: 20
2. Gronen, S., and Brouwer, M. 1998 *Effect of Octylphenol on Serum Vitellogenin, Reproductive Capacity, and Offspring of Male Medaka Fish*. Soc. Env. Tox. Chem. Abstract Book: 187.
3. Karels, A., and Brouwer, M. 2000. *Reproductive Effects of Estrogenic Chemicals on Sheepshead Minnows*. J. Miss. Acad. Sci. 45: 20.

R/LR-44 - Transfer of Sexing Technology to the Kemp's Ridley Sea Turtle International Recovery Program. Thane Wibbels, Ph.D., The University of Alabama at Birmingham.

1. Hanson, J., Wibbels, T., and Martin, R. E. (1998) *Predicted Female Bias in Hatchling Sex Ratios of Loggerhead Sea Turtles from a Florida Nesting Beach*. Canadian Journal of Zoology 76: 1850-1861.
2. Wibbels, T., Rostal, D., and Byles, R. (1998) *High Pivotal Temperature in the Sex Determination of the Olive Ridley Sea Turtle from Playa Nancite, Costa Rica*. Copeia. 1998: 1086-1088.
3. Wibbels, T., Hanson, J, Balazs, G., Hillis-Starr, Z-M., Phillips, B. (1998) *Blood Sampling Techniques for Hatchling Cheloniid Sea Turtles*. Herpetological Review 29: 218-220.
4. Wibbels, T., Hillis-Starr, Z-M., and Phillips, B. (1999) *Female-biased Sex Ratios of Hatchling Hawksbill Sea Turtles from a Caribbean Nesting Beach*. Journal of Herpetology 33: 142-144.
5. Wibbels, T., Wilson, C., and Crews, D. (1999) *Mullerian Duct Development and Regression in a Turtle with Temperature-dependent Sex Determination*. Journal of Herpetology 33: 149-152.
6. Wibbels, T., Owens, D., and Limpus, C. (2000) *Sexing Juvenile Sea Turtles: Is There an Accurate and Practical Method?* Chelonian Conservation and Biology. 3: 756-760.
7. Geis, A., Wibbels, T., Phillips, B., Hillis-Starr, Z., Meylan, A., Meylan, P., Diez, C., VanDam, R. (2002) *Use of Serum Testosterone to Evaluate the Sex of Juvenile Hawksbill Sea Turtles Inhabiting Buck Island Reef National Monument*. Proceedings of the 20th International Sea Turtle Symposium, Orlando, FL. February 29th-March 4th, 2000. NOAA Publication NMFS-SEFSC-477, pages 157-158.
8. Wibbels, T. 2002. *Critical Approaches to Sex Determination*. In: *The Biology of Sea Turtles*, Volume 2. (Lutz, P., Musick, J.A., and Wyneken, eds). CRC Press, Boca Raton, FL (in press).

Technical Reports:

1. Hanson, J. and Wibbels, T. (1998) *Examination of Steroid Hormone Levels in Hatchlings Sea Turtle Blood and Chorioallantoic Fluid*. Proceedings of the 17th Annual Sea Turtle Symposium. Feb. 1997, Orlando, FL. NOAA, Technical Publications NMFS-SEFSC 415: 186-188.
2. Hanson, J., Wibbels, T., and Martin, R.E. (1999) *Use of Miniature Temperature Data Loggers to Estimate Sex Ratios of Hatchling Loggerhead Sea Turtles*. Proceedings of the 18th International Sea Turtle Symposium. Feb. 1998, Mazatalan, Mexico. NOAA, Technical Publications NMFS-SEFSC 436, 136-137.
3. Wibbels, T., and LeBouef, R. (1999) *Development and Evaluation of a Sexing Technique for Hatchling Sea Turtles*. Proceedings of the 18th International Sea Turtle Symposium. Feb. 1998, Mazatalan, Mexico. NOAA, Technical Publications NMFS-SEFSC 436, pp 292-293.
4. Wibbels, T. (1999). *Diagnosing the Sex of Sea Turtles in Foraging Habitats*. In: *Research and Management Techniques for the Conservation of Sea Turtles*. K. Eckert, K. Bjorndal, and A. Abreu, M. Donnelly (eds), IUCN/SSC Marine Turtle Specialist Group Publication No. 4.
5. Wibbels, T., Balazs, G.H., Parker, D.M., and Hanson, J. (2000) *Sand Temperatures of Green Turtle Nesting Beaches in the Hawaiian Archipelago*. In: Proceedings of the 19th International Sea Turtle Symposium. March. 1999, Padre Island, TX, USA. NOAA, Technical Publications NMFS-SEFSC-443, pp 131-133.
6. Wibbels, T., Márquez-M. R. , Garduño-D., M., Burchfield, P., and Peña-V., J. (2000) *Incubation Temperature in Kemp's Ridley Nests During the 1998 Nesting Season*. In: Proceedings of the 19th International Sea Turtle Symposium. March. 1999, Padre Island, TX, USA. NOAA, Technical Publications NMFS-SEFSC-443, pp133-134.
7. Wibbels, T., Márquez-M., R., Garduño, M., Burchfield, P., and Pena, J. *Incubation Temperatures in Kemp's Ridley Nests During the 1999 Nesting Season*. Proceedings of the 19th International Sea Turtle Symposium. March 2000, Orlando, FL, NOAA, Technical Publications NMFS-SEFSC (in press).
8. Geiss, A, Wibbels, T., Márquez-M.R., Garduño-D., M., Burchfield, P., and Peña-V. J. *Predicted Sex Ratios of Hatchling Kemp's Ridelys Produced in Egg Corrals During the 1998, 1999, and 2000 Nesting Seasons*. In Proceedings of the 21st International Sea Turtle Symposium. February 2001, Philadelphia, PA. NOAA, Technical Publications NMFS-SEFSC (in press).

Abstracts:

1. Wibbels, T., Balazs, G.H., Ellis, D.M., and Hanson, J. (1998) *Evaluation of Sand Temperatures on Nesting Beaches for the Hawaiian Green Turtle*. American Zoologist 38: 108A.
2. T. Wibbels, Mackey, W.R., Hillis-Starr, Z.M., and Phillips, B. (1999) *Hurricanes and Hawksbill Sea Turtle Sex Ratios*. American Zoologist 39: 27A.
3. Geiss, Al, Wibbels, T., Márquez-M. R. , Garduño-D., M., Burchfield, P., and Peña-V., J. (2000) *Evaluation of Hatchling Kemp's Ridley Sex Ratios Using Nest Incubation Temperatures at Rancho Nuevo, Mexico*. Proceedings of the 2001 Annual Meeting of the Society of Integrative and Comparative Biology. pp 196.

4. Geis, A., and Wibbels, T. (2000). *Validation of a Nonlethal Sexing Technique for Hawkbill Sea Turtles*. Journal of the Alabama Academy of Science 71: 11.

Invited Seminars:

1. Birmingham Chapter of Sigma Xi, Seminar Title: *Sex and the Sea Turtle*
Held at UAB, January 13, 1998.
2. Birmingham Chapter of the National Audubon Society, Seminar Title: *Conservation of the Endangered Sea Turtles*. Held at the Birmingham Zoo, June 18, 1998.
3. Birmingham Herpetological Society, Seminar Title: *Recent Studies of the Kemp's Ridley Sea Turtle in Mexico*. November 2, 1998
4. Auburn University, Department of Zoology and Wildlife, Seminar Topic: *Temperature Dependent Sex Determination in Reptiles*. March 12, 1999
5. Sigma Xi Research Society, Birmingham Chapter, Seminar Topic: *Biology and Conservation of the Kemp's Ridley Sea Turtle*. May 15, 2001.

R/ER-39 - Recruitment Dynamics and the Effects of Environmental Variation on Early Growth and Survival of Important Estuarine Fishes. Mark S. Peterson, Ph.D., Chet F. Rakocinski, Ph.D., and Bruce H. Comyns, Ph.D.

Manuscripts:

1. Peterson, M.S., C.F. Rakocinski, B.H. Comyns, and G.L. Fulling. 2000. *Laboratory Growth Responses of Juvenile Mugil sp. to Temperature and Salinity: Delineating Optimal Field Growth Conditions*. Proceedings of the Gulf and Caribbean Fisheries Institute 51: 341-352.
2. Rakocinski, C.F., B.H. Comyns, and M.S. Peterson. 2002. *Relating Environmental Fluctuation and Early Growth of Estuarine Fishes: Ontogenetic Standardization*. Transactions of the American Fisheries Society 129: 210-221.
3. Rakocinski, C.F., B.H. Comyns, M. S. Peterson, and G.A. Zapfe. 2002. *Field Growth Responses of Juvenile White Trout (Cynoscion arenarius) to Continuous Variation in Physical Habitat Conditions*. Proceedings of the Gulf and Caribbean Fisheries Institute. 53:623-635.

Presentations:

1. Peterson, M.S., C.F. Rakocinski, B.H. Comyns, and G.L. Fulling. 2000. *Recruiting Into a Variable Environment: Landscape Patterns in Potential Nursery Habitat*. MS-AFS Chapter meeting, 16-18 February, Biloxi, MS [Invited symposium presentation: Fisheries Recruitment].
2. Peterson, M.S., C.F. Rakocinski, B.H. Comyns, and G.L. Fulling. 2000. *Recruitment Into Spatially Variable Coastal Landscapes: Comparison of Laboratory and Field Growth Responses of Juvenile Mugil sp.* ASIH, 80th annual meeting, 14-20 June, LaPaz, Mexico.

3. Rakocinski, C.F., B.H. Comyns, M.S. Peterson and G.A. Zapfe. 2000. *Field Growth Responses of Juvenile White Trout (Cynoscion arenarius) to Continuous Variation in Physical Habitat Conditions*. GCFI, 53rd annual meeting, 5-10 November, Biloxi, MS.

R/MT-40 - Isolation and Purification of Bioactive Compounds from Echinoderms Utilizing a Novel Biofouling Assay. Charles D. Amsler, Ph.D. and James B. McClintock, Ph.D., The University of Alabama at Birmingham.

Manuscripts:

1. Amsler, C.D., K.L. Shelton, C.J. Britton, N.Y. Spencer & S.P. Greer. 1999. *Nutrients Do Not Influence Swimming Behavior or Settlement Rates of Ectocarpus siliculosus Spores (Phaeophyceae)*. Journal of Phycology 35: 239-244.

2. De Marino, S., M. Iorizzi, F. Zollo, C.D. Amsler, S.P. Greer. & J.B. McClintock. 2000. *Starfish saponins, LVI. Three New Asterosaponins from the Starfish Goniopecten demonstrans*. European Journal of Organic Chemistry 2000: 4093-4098.

3. Amsler, C.D. & K.B. Iken. 2001. *Chemokinesis and Chemotaxis in Marine Bacteria and Algae*. In: *Marine Chemical Ecology*, J.B. McClintock & B.J. Baker (eds.). CRC Press, Boca Raton, Florida. pp. 413-430.

4. Iken, K.B., C.D. Amsler, S.P. Greer, & J.B. McClintock. 2001. *Quantitative and Qualitative Studies of the Swimming Behavior of Hincksia irregularis (Phaeophyceae) Spores: Ecological Implications and Parameters for Quantitative Swimming Assays*. Phycologia 40: 359-366.

5. Greer, S.P. & C.D. Amsler. 2002. *Light Boundaries and the Coupled Effects of Surface Hydrophobicity and Light on Spore Settlement in the Brown Alga Hincksia irregularis (Phaeophyceae)*. Journal of Phycology 38: 116-124.

Three additional manuscripts are in active preparation as of 7 May 2002. Two other manuscripts are anticipated during 2002. Additional papers describing new chemical compounds resulting from this work are likely in the future but are dependant on chemical structure analysis to be done by collaborating natural products chemists.

Abstracts:

1. Greer, S.G., C.D. Amsler, and J.B. McClintock. 1998. *Luidia clathrata Extracts Causing Inhibition of Brown Algal Spore Settlement*. Gulf of Mexico Science 16:119.

2. Stanko, J.P., S.P. Greer, J.B. McClintock, and C.D. Amsler. 1998. *Antifouling Activity of Ophiuroid Body-wall Extracts*. American Zoologist 38: 55A.

3. Greer, S.P. and C.D. Amsler. 1999. *The Effects of Irradiance and Surface Hydrophobicity on Spore Settlement in the Brown Alga Hincksia irregularis*. Journal of Phycology 35 (sup.): 12-13.

4. Stanko, J.P., S.P. Greer, J.B. McClintock, and C.D. Amsler. 1999. *Body-wall Extracts of Astrocyclus caecilia (Echinodermata) Inhibit Brown Algal Settlement on Varied Substrates*. Journal of the Alabama Academy of Science 70: 6.

5. Greer, S.P. and C.D. Amsler. 1999. *Effects of Irradiance on the Settlement of Hincksia irregularis (Phaeophyceae) Spores*. Journal of the Alabama Academy of Science 70: 8.
6. Iken, K.B., C.D. Amsler, S.P. Greer, and J.B. McClintock. 2000. *Quantitative and Qualitative Studies of the Swimming Behavior of Hincksia irregularis Spores (Phaeophyceae)*. Journal of Phycology 36 (sup.): 32-33.
7. Iken, K.B., S.P. Greer, C.D. Amsler, and J.B. McClintock. 2000. *A Novel Biofouling Assay Using Computer-assisted Motion Analysis of Hincksia irregularis Spore Swimming*. Journal of Phycology 36(sup.): 33.
8. Greer, S.P. and C.D. Amsler. 2001. *Effects of Surface Hydrophobicity and Light on Spore Settlement in Hincksia irregularis (Phaeophyceae)*. Journal of Phycology 37(sup.): 20.

R/MT-41 - Semisynthetic and Microbial Transformations of Marine Natural Products for Technological Development in Human Health and Agriculture. Jordan K. Zjawiony, Ph.D., Mark T. Hamann, Ph.D., and Marc Slattery, Ph.D., The University of Mississippi.

Manuscripts:

1. J. K. Zjawiony, P. Bartyzel, and M. T. Hamann, *Chemistry of Puupehenone: 1,6-Conjugate Addition to Its Quinone-Methide System*, J. Nat. Prod., 1998, 61, 1502-1508.
2. El Sayed, K. A., Hamann, M. T., Wadding, C. A., Jensen, C., Lee, S. K., Dunstan, C. A., Pezzuto, J. M., *Structurally Novel Bioconversion Products of the Marine Natural Product Sarcophine Effectively Inhibit JB6 Cell Transformation*. J. Org. Chem. 1998, 63, 7449-7455.

Additional manuscript is prepared for publication in *Journal Natural Product*: Isamu Katsuyama, Hesham Fahmy, Jordan K. Zjawiony, Sheiref I. Khalifa Raouf W. Kilada, Takao Konoshima, Midori Takasaki and Harakuni Tokuda, *Semisynthesis of New Sarcophine Derivatives with Chemopreventive Activity*, Journal Natural Products, 2002, ready to be submitted, after patent application.

Invited Papers:

1. J. K. Zjawiony, *Semisynthetic and Microbial Transformations of Marine Natural Products, Answers from the Sea - Biotechnology, Marine Natural Products and Pharmaceuticals Workshop on Bio '98 International Biotechnology Meeting & Exhibition, New York, NY, June 14-18, 1998.*
2. J. K. Zjawiony, *Chemical and Microbial Transformations of Marine Natural Products, Invited Lecture, Department of Chemistry, University of Memphis, Memphis, TN, October 16, 1998.*
3. J. K. Zjawiony, *Chemical and Microbial Transformations of Marine Natural Products, Invited Lecture, Division of Earth and Physical Sciences, University of Texas at San Antonio, San Antonio, TX, February 16, 1999.*
4. J. K. Zjawiony, *Chemical Transformations of Marine Natural Products, Invited Lecture, Department of Synthetic Organic Chemistry, Faculty of Pharmaceutical Sciences, Nagoya City University, Nagoya, Japan, May 31, 1999.*

5. J. K. Zjawiony, *Development of New Antifungal Drug Candidates from Natural Products*, Invited lecture, International Symposium on Recent Developments in the Discovery of Biologically Active Natural Products, 4th Annual Convention of the Natural Products Society of the Philippines and the 21st Annual Convention of the Philippine Environmental Mutagen Society, University of Philippines, Diliman, Quezon City, Philippines, December 6-8, 1999.
6. J. K. Zjawiony, *New Applications of Chromatographic Methods and Materials in Natural Products Chemistry*, Invited lecture, 2nd International Symposium on Chromatography of Natural Products, Medical University of Lublin, Lublin-Kazimierz Dolny, Poland, June 14-16, 2000.
7. J. K. Zjawiony, *Chemistry and Biological Activity of Copryrine Alkaloids*, Invited Lecture, Department of Pharmacognosy, Medical University of Poznan, Poznan, Poland, June 19, 2000.
8. J. K. Zjawiony, I. Katsuyama, M.T. Hamann, D. Gochfeld and J. Hu, *Conjugate Addition of Sulfur Nucleophiles to Marine Natural Product Puupehenone*, 2000 International Chemical Congress of Pacific Basin Societies, Honolulu, Hawaii, December 14-19, 2000.
9. Isamu Katsuyama, and Jordan K. Zjawiony, *Allylic Oxidation of Sarcophine and Its Derivatives*, 10th International Symposium on Marine Natural Products, Nago, Okinawa, Japan, June 24-29, 2001.

A/O-9-MS - Mississippi Sea Grant Extension Program. C. David Veal, Ph.D., Mississippi State University.

Publications:

1. Bridger, C. J., B. A. Costa-Pierce, C. A. Goudey, R. R. Stickney, K. M. Fletcher, J. R. Gold, D. H. Lewis, J. Lotz, B. C. Posadas, E. Neyrey, I. Workman, T. Reid, C. Moncrieff, R. Vega, D. L. Swann and S. Walker. *Sustainable Offshore Aquaculture Development in the Gulf of Mexico*, World Aquaculture (2001). MASGP-01-016.
2. Burrage, D., and B. C. Posadas. 1999. *Economics of Marine Resources*. In Della McCaughan (ed) *Marine Resources and History of the Mississippi Gulf Coast*. Volume 3. MASGP-98-022.
3. *Mississippi Tide Tables 2001*. Dave Burrage. MASGP-00-013.
4. *Mississippi Tide Tables 2000*. Dave Burrage. MASGP-99-006.
5. *Mississippi Tide Tables 1999*. Dave Burrage. MASGP-98-007.
6. Posadas, B. C. and M. W. LaSalle. 1998. *Research into Wetlands Could Help Water Quality*. In *The Catfish Journal*, 12(8): 8-9. MASGP-98-023.

Abstracts:

1. Long, R. D., S. C. Walters, M. W. LaSalle, and B. C. Posadas. 2001. *Pond Production of Striped Mullet Mugil Cephalus for Both Meat and Roe*. Books of Abstracts, Aquaculture 2001, World Aquaculture Society, Baton Rouge, Louisiana.
2. Posadas, B. C., C. Bridger and B. Costa-Pierce. 2001. *Economic Potential of Offshore Aquaculture in the Gulf of Mexico*. Pages 84-85 in C. J. Bridger and T. H. Reid (ed.s). *Open Ocean Aquaculture IV*,

Symposium Program and Abstracts, Mississippi-Alabama Sea Grant Consortium, Ocean Springs, Mississippi. MASGP-01-006.

3. Walters, S. C., R. D. Long, M. W. LaSalle, and B. C. Posadas. 2001. *Assessment of Natural Foods Available to and Utilized by Pond-cultured Freshwater Prawn Macrobrachium Rosenbergii*. Books of Abstracts, Aquaculture 2001, World Aquaculture Society, Baton Rouge, Louisiana.

Newsletters:

Gulf Coast Fisherman. (35 issues) Dave Burrage, Editor:

- "Federal Rule Changes for Gulf Mackerel" MASGP-00-001-01.
- "Longline Closure Update" MASGP-00-001-02.
- Not Issued - MASGP-00-001-03.
- "New Fishing Regulation Pamphlets Available" MASGP-00-001-04.
- "Alabama Oyster Legislation" MASGP-00-001-05.
- "New TED Rules Proposed" MASGP-00-001-06.
- "Louisiana License Increase" MASGP-00-001-07.
- "Jellyfish Invasion" MASGP-00-001-08.
- "Fishery Management Hearings Slated In Biloxi" MASGP-00-001-09.
- "Court Finds NMFS in Violation of Environmental Laws" MASGP-00-001-10.
- "Sea Turtle Regulations Affect Other Fisheries Too" MASGP-00-001-11.
- "Red Snapper Update" MASGP-00-001-12.
- "Gulf Coast Fisherman Available On-Line" MASGP-99-001-01.
- "Red Snapper Commercial Landings" MASGP-99-001-02.
- "Red Snapper Update" MASGP-99-001-03.
- "1999 Shrimp Season Forecast" MASGP-99-001-04.
- "Mississippi Scenic Rivers" MASGP-99-001-05.
- "Mississippi Shrimp Season" MASGP-99-001-06.
- "Gulf of Mexico Marine Reserves Workshops Slated" MASGP-99-001-07.
- "Red Snapper Update" MASGP-99-001-08.
- "Daley Declares \$19 Million Fisheries Disaster in North Carolina" MASGP-99-001-09.
- "Red Snapper Update" MASGP-99-001-10.
- "Red Snapper Update" MASGP-99-001-11.
- "Federal Rule Changes for Gulf Mackerel" MASGP-99-001-12.
- "Red Snapper Update" MASGP-98-002-01.
- "Red Snapper Update" MASGP-98-002-02.
- "Gulf Commercial King Mackerel Fisheries Reopened" MASGP-98-002-03.
- "Recreational Fishing Statistics" MASGP-98-002-04.
- "Red Snapper Update" MASGP-98-002-05.
- "New Louisiana Transport License Available" MASGP-98-002-06.
- "Shrimp Season Off to a Good Start" MASGP-98-002-07.
- "Non-Native Species" MASGP-98-002-08.
- "NMFS Releases Remaining Red Snapper TAC" MASGP-98-002-09.
- "Red Snapper Update" MASGP-98-002-10.
- "SFA Amendment Hearings Slated" MASGP-98-002-11.

Presentations:

1. Posadas, B. C., M. LaSalle, and C. D. Veal. 1998. *Benefits and Costs of Using Constructed Wetlands in Finfish Aquaculture*. Paper presented at the World Aquaculture Society and National Shellfisheries Association Annual Conference, Las Vegas, NV.
2. Posadas, B. C., M.W. LaSalle and C. D. Veal. 1999. *Benefits and Costs of Using Constructed Wetlands in Recirculating Catfish Pond Production*. Paper presented at Aquaculture America '99, Tampa Convention Center, Tampa, Florida, January 30, 1999.
3. LaSalle, M. W., B. C. Posadas and C. D. Veal. 1999. *Use of Constructed Wetlands in Improving Water Quality in Recirculating Catfish Pond Production*. Paper presented at Aquaculture America '99, Tampa Convention Center, Tampa, Florida, January 30, 1999.
4. Burrage, D. *Matching Development to Demand for Recreational Boating Facilities*. Invited presentation at the Department of Marine Resources Coastal Marina Workshop, April 14, 1999, Biloxi, Mississippi.
5. LaSalle, M. W. and C. Z. Hollomon. 2000. *The Master Naturalist Training Program*. Presentation to the 2nd National Extension Natural Resources Conference, Lake Tahoe, Nevada.
6. Hollomon, C. Z. and M. W. LaSalle. 2000. *Coastal Wetland Diversity Workshop: A Training Program for Teachers*. Poster presentation to the 2nd National Extension Natural Resources Conference, Lake Tahoe, Nevada.
7. Walters, C. S., R. D. Long, M. W. LaSalle, B. C. Posadas. 2000. *Use of Natural Foods by Pond-cultured Freshwater Prawn Macrobrachium rosenbergii*. Poster presentation at Aquaculture America 2000, New Orleans, LA.
8. Posadas, B. C. *Economic Implications of Using Horizontal Substrates in Freshwater Prawn Pond Production*. Paper presented at Aquaculture America 2000, New Orleans Marriott Hotel, New Orleans, Louisiana, February 3, 2000. Abstract published.
9. Burrage, D. "The National Sea Grant College Program" - Presented to the Gulfport Propeller Club, Gulfport, Mississippi, March 11, 2000.
10. Burrage, D. "2000 Mississippi Shrimp Season Situation and Outlook." Invited presentation at the Texas Shrimp Association's Annual Conference, May 4, 2000, Galveston, Texas.
11. Burrage, D. "Incorporating Coastal Recreational Fishing Access into Public/Private Sector Development Planning." Invited presentation at RecFish 2000, June 25, San Diego, California.
12. Burrage, D. "Sport Fishing Opportunities for Mississippi Youth" - Presented in cooperation with Area Extension Agent - Health Education at "Save our Kids" meeting in Bay St. Louis, Mississippi, July 21, 2000.
13. Posadas, B. C., S. C. Walters and R. D. Long. 2001. *Pond Grow-out Culture of Freshwater Prawn Macrobrachium rosenbergii with Different Feed Type, Feeding System and Protein Level*. Power Point Presentation. Mississippi State University, Coastal Research and Extension Center, Biloxi, Mississippi. <http://msstate.edu/dept/crec/fwpres.html>.

14. Posadas, B. C., S. C. Walters and R. D. Long. *Pond Grow-out Culture of Freshwater Prawn Macrobrachium rosenbergii with Different Protein Levels*. Paper presented at Aquaculture 2001, Coronado Springs Resort, Orlando, Florida, January 21-26, 2001. Abstract published.

15. Posadas, B. C., C. Bridger and B. Costa-Pierce. *Economic Potential of Offshore Aquaculture in the Gulf of Mexico*. Paper presented at Open Ocean Aquaculture IV: An International Symposium, St. Andrews, New Brunswick, Canada, June 17-20, 2001.

Workshops and Symposia:

“Boating Safety” - Held annually at various Mississippi coast locations. This is a “hands-on” program conducted with cooperation from the U.S. Coast Guard Auxiliary Flotilla 57 and the U.S. Coast Guard Marine Safety Office in Mobile, Alabama. Target audience is recreational boaters. Participants learn by demonstration the proper use of the VHF marine radio, pyrotechnic signaling devices, marine fire extinguishers, PFDs and life rafts, and Coast Guard pumps. There is also a demonstration in the proper way to retrieve a person who has fallen overboard and how to prepare for a helicopter evacuation. This is a “beyond the basics” course designed for individuals who own the required equipment but have never been called upon to use it. Attendance is limited and averages 25 annually.

“Sport Fishing” - Annual program held in cooperation with the Jackson County Extension agent. We arrange for local experts such as light tackle guides and charter boat captains to come and share their knowledge of catching fish in Mississippi coastal waters. Local marine equipment and fishing tackle dealers donate door prizes. Target audience is residents new to the coast or new to the sport of fishing. Attendance averages 250.

“Recreational Shrimping” - Annual program for coastal residents to teach them how to shrimp with a 16-foot trawl. There is a section on gear design, rigging and adjustment taught by the Harvesting Systems Branch of the National Marine Fisheries Service Pascagoula Laboratory. Biologists from the Mississippi Department of Marine Resources are also on hand to update participants on the shrimp harvest forecast. A section on cleaning and freezing the catch is conducted by one of the coast Extension Home Economists. Attendance averages 50 annually for the program.

An Annual Open House is conducted at the Mississippi State University Coastal Aquaculture Unit to allow sponsors, supporters, researchers, specialists, fish farmers, environmentalists to visit with staff and tour facilities and experiments.

A/O-9-AL - Alabama Sea Grant Extension Program. Richard K. Wallace, Ph.D., and Brian E. Perkins, Auburn University.

Publications:

1. Richard K. Wallace and Kristen M. Fletcher. *Understanding Fisheries Management* MASGP-00-005.
2. Richard K. Wallace. *Healthy Waters, Healthy Communities: A Call to Action*. MASGP-00-008.
3. Jody A. Scanlan. *The Citizen's Guide to Reducing Polluted Runoff in Coastal Alabama*. MASGP-00-012.
4. Richard K. Wallace. *The Jubilee Phenomenon*. Update. MASGP-99-005.

5. Richard K. Wallace. *Ballast Water Management: The Right Thing To Do*. (Poster) MASGP-99-007.
6. Jody A. Scanlan. *Activities You Can Do Within Your Watershed*. MASGP-99-008.
7. Jody A. Scanlan. *Strategic Planning*. MASGP-99-009.
8. Jody A. Scanlan. *Watershed and Other Terminology*. MASGP-99-010.
9. Jody A. Scanlan. *Dog River Watershed*. MASGP-99-011.
10. Jody A. Scanlan. *Get to Know Your Watershed*. MASGP-99-012.
11. Jody A. Scanlan. *Three Mile Creek Watershed*. MASGP-99-013.
12. Richard K. Wallace and F. Scott Rikard. *Growing Bull Minnows in Alabama*. MASGP-98-004.
13. Richard K. Wallace, William Hosking, and J.J. Bachant, *Aquatic Nuisance Species in Alabama*. MASGP-98-005.

Newsletters

Sea Harvest News. (12 issues) Richard K. Wallace:

- “Keeping TED Flaps Tight” MASGP-00-002-01.
- “New Alabama Trip Ticket in Place” MASGP-00-002-02.
- “Bill Hosking to Retire” MASGP-99-003-01.
- “Louisiana Hang Logs Available” MASGP-99-003-02.
- “Alabama Number Two in Crabmeat Production” MASGP-99-003-03.
- “Gulf Council in Gulf Shores September 13-16” MASGP-99-003-04.
- “Ocean Debris” MASGP-98-001-01.
- “Gulf Council in Mobile, September 14-17” MASGP-98-001-02.
- “BRD Problem” MASGP-98-001-03.
- “TED Exemption for Alabama Inshore Waters” MASGP-98-001-04.
- “Public Hearings” MASGP-98-001-05.
- “BRD Requirements Extended and Amended” MASGP-98-001-06.

R/SL-4 - Mississippi-Alabama Sea Grant Legal Program. Kristen M. Fletcher, LL.M., Tammy Shaw, J.D., Richard J. McLaughlin, J.S.D., and William Hooper, Jr., J.D., The University of Mississippi.

Manuscripts

1. John A. Duff and Kristen Fletcher, *Augmenting the Public Trust: The Secretary of State's Efforts to Create a Public Trust Ecosystem Regime in Mississippi*. 67 Mississippi Law Journal 645-694. (1998).
2. Kristen M. Fletcher, *The 49th Annual Meeting of the International Whaling Commission: A Prelude to the Next Fifty Years*. Journal of International Wildlife Law & Policy 134. (1998). MASGP-97-035.
3. Kristen M. Fletcher, *Will U.S. Foreign Policy Migrate with the Whales? A Critique of U.S. Foreign Policy and the Rapidly Changing International Whaling Regime*. Published in Environmental Change and U.S. Foreign Policy. (1998).

4. Kristen M. Fletcher, *The Implementation of Magnuson: A Red Snapper Case Study*. Published in Proceedings of the Marine Technology Society 1998 Annual Meeting. MASGP-98-017.
5. Kristen M. Fletcher, *Gambling with Our Coast: the Public Trust Doctrine and Mississippi's Gulf Coast*. Published in The Coastal Society Proceedings. July 1998.
6. Kristen M. Fletcher and Rebecca Jordan, *Mississippi Land Swap Makes Public Trust History*. published in 16th International Conference of the Coastal Society, July 12-15, 1998. MASGP-98-015.
7. Richard J. McLaughlin, *Implications of US Trade Sanction Measures in Light of World Trade Organization Membership*. Proceedings of the Law of the Sea: A 'Year of the Ocean Symposium' and presented at Boalt Hall School of Law, University of California at Berkeley. October 1998.
8. John A. Duff, *Negotiating International Transboundary Resources under the Endangered Species Act*, published in Ocean and Coastal Law Journal
9. Kristen M. Fletcher, *Painting the Picture: Legal Methods to Control Exotic Species in the Gulf of Mexico*, published in Ocean and Coastal Law Journal.
10. Richard J. McLaughlin. *Sovereignty, Utility, and Fairness: Using U.S. Takings Law to Guide the Evolving Utilitarian Balancing Approach to Global Environmental Disputes in the WTO*. Oregon Law Review 78(4): 855-940. (1999). MASGP-98-021.
- 11 John A. Duff, *Royalty Relief Act Spurs Oil and Gas Exploration in Deep Waters of the Gulf of Mexico: United States Ratifies Maritime Boundary Treaty with Mexico*, published in Ocean Yearbook, Volume 14. University of Chicago Press. 1999. MASGP-98-016.
12. Review by John A. Duff, *Review of "Beyond the Law of the Sea: New Directions for U.S. Oceans Policy" by George V. Galdorisi and Kevin R. Vienna*. Ocean Development and International Law 30(1): 82-87. (1999).
13. Kristen M. Fletcher, *The Perilous Condition of the Red Snapper in the Gulf: Fact or Fiction?*, published in Proceedings of the Louisiana Environment Conference March 1999.
14. John A. Duff, *Should You Have a Constitutional Right to Fish?*, published in Proceedings of the Coastal Zone '99 Conference July 1999.
15. Kristen M. Fletcher, John A. Duff, *Property Rights and Takings Legislation in the Gulf States: Just the Beginning or Is the Revolution Over?*, Monograph Publication (2000). MASGP-00-011
16. Richard K. Wallace and Kristen M. Fletcher, *Understanding Fisheries Management*, Second edition of *Fisheries Management for Fishermen*. 2000. MASGP-00-005.
17. Kristen M. Fletcher. *If You Can't Beat 'em, Eat 'em: Legal Methods to Control Aquatic Nuisance Species in the Gulf of Mexico*. Ocean and Coastal Law Journal. 2000.
18. Kristen M. Fletcher and Tammy L. Shaw. *Property Rights and Taking Legislation in the Gulf States: Just the Beginning or Is the Revolution Over?* Monograph Publication (2000).
19. Kristen M. Fletcher and Sharonne O'Shea, *Essential Fish Habitat: Does Calling it Essential Make it So?* 30 Environmental Law Review (2000). MASGP-00-006.

20. Kristen M. Fletcher, *States Assuming Responsibility Over Wetlands: State Assumption as a Regulatory Option for Protection of Wetlands*. published in Sustainability of Water and Wetland Resources Conference Proceedings. 2001.

21. Kristen M. Fletcher, *A Legal Primer: An Introduction to Wetlands Law and Regulation and its Practical Impacts*. Published in Sustainability of Water and Wetland Resources Conference Proceedings 2001.

22. Kristen M. Fletcher. *Overview of U.S. Wetlands Law and Regulation*. To be published in a book by Island Press. 2001.

Legal Reporters:

Water Log (12 Issues) Kristen M. Fletcher, Editor:

- "Supreme Court Rejects State's Maritime Laws." MASGP-00-004-01.
- "Public Trust Doctrine Protects Beach Access." MASGP-00-004-02.
- "Corps Must Prepare Environmental Impact Statements for Mississippi Casinos." MASGP-00-004-03.
- "Clinton Creates Coral Reef Reserve." MASGP-00-004-04.
- "Alabama Determines Landowner Rights." MASGP-99-004-01.
- "Monterey Must Pay for Restricting Coastal Development." MASGP-99-004-02.
- "Clinton Extends U.S. Contiguous Zone." MASGP-99-004-03.
- "Mississippi and Alabama Reach TMDL Consent Degrees." MASGP-99-004-04.
- "Horn Island Owner Prevails in Fifth Circuit." MASGP-98-003-01.
- "Bycatch Reduction Device Required in Gulf." MASGP-98-003-02.
- "Clinton, Gore Call for Ocean Protection." MASGP-98-003-03.
- "Fifth Circuit Considers Standing." MASGP-98-003-04.

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Students Supported During 1998-2000 Omnibus Projects

Over the 3-year period of these projects, a total of 2 post-docs, 12 Ph.D., 19 M.S., 17 J.D. and 40 undergraduate students have been supported.

R/LR-41 - Development of a Method for Controlling the Molt Cycle of the Blue Crab, *Callinectes sapidus*. R. Douglas Watson, Ph.D., Ming Luo, Ph.D., and Stephen A. Watts, Ph.D., The University of Alabama at Birmingham.

1. Kara J. Lee, (Ph.D., 2001) Department of Biology, Dissertation: *Neuroendocrine Regulation of Crustacean Molting: Studies of the Molt-inhibiting Hormone of the Blue Crab, Callinectes sapidus*.
2. Deug-Woo Han, Department of Biology, Current Ph.D. student.
3. Kevin J. Borders, Department of Biology, Undergraduate Honors Research student. 1999). Honors Research Project: *Structure of the Molt-inhibiting Hormone (MIH) Neuroendocrine Axis in the Blue Crab (Callinectes sapidus)*.

R/LR-42 - Assessment of Sea Urchins as Fishery and Aquaculture Candidates in the Gulf of Mexico. Stephen A. Watts, Ph.D., James B. McClintock, Ph.D., The University of Alabama at Birmingham, and John M. Lawrence, Ph.D., The University of South Florida.

1. Kristina Wasson-Bladder, Department of Biology, The University of Alabama at Birmingham, Ph.D., completed March 1999. Dissertation title: *Reproduction and Sex Steroids in Lytechinus variegatus Larmack (Echinoidea: Echinodermata)*.
2. Hugh Hammer, Department of Biology, The University of Alabama at Birmingham, Ph.D., started fall 1998. Currently working on projects related to gonad production in *Lytechinus*
3. Minako Vickery, Department of Biology, The University of Alabama at Birmingham, Ph.D., completed 2001. Dissertation title: *A Comparative Study of the Incidence of Asexual Reproduction in Echinoderm Larvae*.
4. Brenda Wallace, Department of Biology, The University of Alabama at Birmingham, M.S. 2001. Thesis title, *The Effects of Dietary Protein Concentration on Feeding and Growth of Small Lytechinus variegatus*.
5. Mickie Powell, Department of Biology, The University of Alabama at Birmingham, Ph.D. candidate, helping with some of the physiological studies.
6. Adele Cunningham, Department of Biology, The University of Alabama at Birmingham, Ph.D., working on gametogenesis in *L. variegatus*.
7. Jenni Wheeler, Department of Biology, The University of Alabama at Birmingham, B.S. student.
8. Audrey Richards, Department of Biology, The University of Alabama at Birmingham, B.S. student.

9. Scott Hofer, Department of Biology, The University of Alabama at Birmingham, M.S. candidate, working on the effects of temperature.
10. Rebecca Worrell, Department of Biology, The University of Alabama at Birmingham, B.S. Honors student.
11. Katie Gibbs, Department of Biology, The University of Alabama at Birmingham, M.S. candidate, working on gametogenesis in response to temperature.
12. Melanie Rose, Department of Biology, The University of Alabama at Birmingham, B.S. Honors student.
13. L.R. Plank., Department of Biology, The University of South Florida, M.S. 2000. Thesis title: *The Effect of Dietary Carotenoids on Roe Production in the Sea Urchin*.
14. Sophie Hill, Department of Biology, The University of South Florida, Ph.D. 2000. *A Comparison of the Reproductive Response to Stress by Two Species of Sea Urchins*.
15. J.C. Cobb, Department of Biology, The University of South Florida, M.S. 2001. Thesis in preparation: *A Comparison of the Diets of Inshore and Offshore Populations of Lytechinus variegatus and Arbacia punctulata on the Central Florida Gulf Coast*.
16. E. Eigenburg, Department of Biology, The University of South Florida, B.S. student.
17. M. Kastura, Department of Biology, The University of South Florida, B.S. student.
18. E. Amato, Department of Biology, The University of South Florida, B.S. student.
19. J. Angrosino, Department of Biology, The University of South Florida, B.S. student.

R/MT-39 - Field Applications of Multiplex PCR to Monitor Microbial Contamination in Shellfish in the Gulf of Mexico. Asim K. Bej, Ph.D., The University of Alabama at Birmingham.

One graduate student and a part-time undergraduate research assistant were supported for the optimization of the DNA extraction methods, the PCR reactions, and applications of the multiplex PCR approach on the field oyster samples.

R/LR-43 - Nutritionally Complete, Low Cost Artificial Diets for the Culture of Fish and Crustacean Larvae. Louis R. D'Abramo, Ph.D. and Randal K. Buddington, Ph.D., Mississippi State University.

1. Ekaterina Kovalenko, Department of Wildlife and Fisheries, M.S. (Aquaculture Science), 2001. Thesis title: *Development and Evaluation of Formulated Diets for Larval Culture of the Freshwater Prawn, Macrobrachium rosenbergii*.

R/ER-38 - *Effects of Endocrine-Disrupting Chemicals on Reproductive Function of Fish.* Marius Brouwer, Ph.D., The University of Southern Mississippi.

1. Suzanne Nichole Gronen, Department of Marine Sciences, M.S. May 2000. Thesis title: *Effects of Endocrine Disrupting Chemicals on Development of Reproductive Organs and Reproductive Function in the Teleost Fish, Oryzias latipes.*
2. Arthur Alan Karels, Department of Coastal Sciences, M.S. December 2000. Thesis title: *Reproductive Effects of Estrogenic and Antiestrogenic Chemicals on Sheepshead Minnow (Cyprinodon variegatus) Along with Partial Isolation and Sequence of its Estrogen Receptor.*

R/LR-44 - *Transfer of Sexing Technology to the Kemp's Ridley Sea Turtle International Recovery Program.* Thane Wibbels, Ph.D., The University of Alabama at Birmingham.

1. Alyssa Geis, Department of Biology, M.S. in Biology, May 2001. Thesis: *Evaluation of Sex Ratios in the Kemp's Ridley Recovery Program.* Ms. Geis is continuing with a Ph.D. program examining long-term variation in hatchling sex ratio produced in the Kemp's Ridley Recovery Program.
2. JoAnne Hanson, Department of Biology, M.S. in Biology, December 1998. Thesis title: *Development of Methods for Estimating Hatchling Sea Turtle Sex Ratios.*
3. Walter Randall MacKey, Department of Biology, B.S. with Honors, May 1999. Project title: *Hurricanes and Hawksbill Sea Turtle Sex Ratios on Buck Island, U.S. Virgin Islands.*

The following senior undergraduate students conducted "Undergraduate Research BY 398" under Dr. Wibbels direct supervision in the Department of Biology. Title of their research project: *Evaluation of Incubation Temperatures in Kemp's Ridley Nests During the 1998-2000 Nesting Seasons.*

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| 4. Elizabeth Herren | 16. Lee Ellis |
| 5. Mike Bieda | 17. Sierra Hulsey |
| 6. Natalie Lenoir | 18. Kira Martin |
| 7. Isadore Toledo | 19. Angelia Myrick |
| 8. Rene Messier | 20. David Rey |
| 9. Carolyn Aiello | 21. Branden Sanderlin |
| 10. Zack Musgrave | 22. Rina Kara |
| 11. Jenny Springfield | 23. Hemal Patel |
| 12. Heather Rimer | 24. Amber Park |
| 13. Benjamin Foo | 25. Tim Priestley |
| 14. Andy Bass | 26. Joe Cox |
| 15. Molly Knudson | 27. Walt Doty |

R/ER-39 - *Recruitment Dynamics and the Effects of Environmental Variation on Early Growth and Survival of Important Estuarine Fishes.* Mark S. Peterson, Ph.D., Chet F. Rakocinski, Ph.D., and Bruce H. Comyns, Ph.D., The University of Southern Mississippi.

1. Glen Zapfe - M.S. May 2002- September-December 2000 (100%); January 2001 (50%).
2. Christa Woodley - M.S. May 2001 - October-December 2000 (50%).

R/MT-40 - Isolation and Purification of Bioactive Compounds from Echinoderms Utilizing a Novel Biofouling Assay. Charles D. Amsler, Ph.D. and James B. McClintock, Ph.D., The University of Alabama at Birmingham.

1. Stephen Greer, Department of Biology, Ph.D. candidate. Expected completion Fall 2002. Thesis: *Behavioral Analysis of Macroalgal Settlement and the Effects of Echinoderm Secondary Metabolites on Settlement.*
2. Jason Stanko, Department of Biology, Ph.D. program; has left this project.
3. Dr. Katrin Iken, Department of Biology, Postdoctoral Research Associate. (April 1999-December 2001).
4. Dr. Mikel Becerro, Department of Biology, Postdoctoral Research Associate (January 15 through October 1, 2000 only).

R/ER-40 - Use of Chemical Priming for Enhancing the Bioremediation Potential of Heavy PAH Contaminated Sediments. Mark E. Zappi, Ph.D., Mississippi State University.

Winnie Wang, Department of Chemistry, M.S. May 1999.

Ian Kennedy, Department of Chemistry, M.S. candidate.

J. Darnell, Department of Chemistry, Undergraduate student, partial support.

R/MT-41 - Semisynthetic and Microbial Transformations of Marine Natural Products for Technological Development in Human Health and Agriculture. Jordan K. Zjawiony, Ph.D., Mark T. Hamann, Ph.D., and Marc Slattery, Ph.D., The University of Mississippi.

1. John Bowling, M.S., Department of Pharmacognosy.
2. Nirmal Pugh, Ph.D., Department of Pharmacognosy.
3. Cheryl Frankfater, Ph.D., Department of Pharmacognosy.
4. Tyler Hodges, M.S., Department of Pharmacognosy
5. Wentao Jin, M.S., Department of Pharmacognosy.
6. Jennifer Bullock, M.S., Department of Psychology.
7. Vernon Rayford, School of Pharmacy, Honors College, Undergraduate student.
8. Trenika Mitchell, School of Pharmacy, Undergraduate student
9. Marcus Rogers, Department of Mathematics, Undergraduate student.
10. Nataliya Karnaukh, Department of English, Undergraduate student.

R/SL-4 - Mississippi-Alabama Sea Grant Legal Program. Kristen M. Fletcher, LL.M., Tammy L. Shaw, J.D., Richard J. McLaughlin, J.S.D., and William Hooper, Jr., J.D., The University of Mississippi.

1. Lanny Acosta, J.D., 1998.
2. Ashley Amos, J.D., 1999.
3. Bernard Booth, J.D., 1999.
4. Susan Bruknke, J.D., 1999.
5. Rebecca Jordan, J.D., 1999.
6. Jason McCormack, J.D., 1999.
7. Brad Rath, J.D., 1999.
8. Tammy Shaw, J.D., 1999.
9. Elizabeth Speaker, J.D., 1999.
10. Jonathan Huth, J.D., 2000.
11. Tim Peebles, J.D., 2000.
12. Ginger Weston, J.D., 2000.
13. Stacy Prewitt, J.D., 2001.
14. Jimmy Hall, J.D., 2001.
15. April Roberts, J.D., 2001.
16. David Harris, J.D., 2002.
17. John Treadwell, J.D., 2002.

In addition, Program attorneys taught classes to law students of the University of Mississippi School of Law, the University of Hawaii Law School, and the Institute of Marine Sciences of The University of Southern Mississippi. They also trained law students in legal writing and research.

M/PA-1 and M/PD-1 - Program Administration and Program Development. Barry A. Costa-Pierce, Mississippi-Alabama Sea Grant Consortium.

The MASGC Marine Science Scholars Program provided a total of \$105,000 support to the following graduate students through a competitive process. Recipients were selected by the members of the Fellowship Committee, consisting of representatives from each of the member institutions. Funding for the fellowships came from "other source" funds:

1. Rachell E. Booth, The University of Southern Mississippi, Ph.D.

2. Kenneth P. Grembowicz, The University of Southern Mississippi, M.S.
3. Suzanne N. Gronen, The University of Southern Mississippi, M.S.
4. Robin K. McCall, The University of Southern Mississippi, Ph.D.
5. Gregory L. Fulling, The University of Southern Mississippi, Ph.D.
6. Mary Lisa Kellogg, University of South Alabama, Ph.D.
7. Julien Richard Lartigue, University of South Alabama, Ph.D.
8. Jessica R. McCawley, University of South Alabama, M.S.
9. Ann Marie Moore, The University of Southern Mississippi, M.S.
10. Troy R. Mutchler, Mississippi State University, Ph.D.
11. Rita B.J. Peachey, University of South Alabama, Ph.D.
12. Virginia R. Shervette, The University of Southern Mississippi, M.S.
13. Rachel Ann Syring, The University of Southern Mississippi, M.S.
14. Jody A. Bruton, University of South Alabama, Ph.D.
15. Stephen A. Bullard, The University of Southern Mississippi, M.S.
16. Melaura M. Cranford, University of South Alabama, M.S.
17. Leslie J. Gallagher, University of South Alabama, M.S.
18. Glenn M. Hendrix, The University of Southern Mississippi, M.S.
19. Nirmal D. Pugh, The University of Mississippi, Ph.D.
20. Dena G. Vincent, The University of Southern Mississippi, M.S.
21. Jennifer M. Walker, The University of Alabama, Ph.D.

The Mississippi-Alabama Sea Grant Consortium had three representatives selected as part of the Sea Grant Federal Fellowship Program - Dean John A. Knauss Marine Policy Fellow:

1998 - Ms. Nikkola Garber, The University of Southern Mississippi
assigned to the office of Senator Ron Wyden

2000 - Ms. Kelly M. Shotts, University of South Alabama
assigned to NOAA's Office of Policy and Strategic Planning

2000 - Mr. Edward G. Stets, University of South Alabama
assigned to U.S. Environmental Protection Agency's Coastal Management Branch Office