# Mississippi-Alabama Sea Grant Consortium

# 1998-2000 Omnibus Annual Progress Report

*(Revised)*

*for period*
*February 1, 2000 - January 31, 2001*

MASGP-01-013

# *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 (Mississippi Sea Grant Extension Service) and Mobile, Alabama (Alabama Sea Grant Extension Program); and a legal program located at The University of Mississippi (Mississippi-Alabama Sea Grant Legal Program.)

This report documents progress on the 2000 Omnibus program under NOAA Grant #NA86RG0039 which began February 1, 2000, and ended on January 31, 2001. This Omnibus period is the third year of the three-year proposal package that was submitted as the 1998-2000 Omnibus Proposal.

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.

Mississippi-Alabama Sea Grant initiated the 2000 Omnibus with a total of 18 Omnibus projects comprised of ten research projects, two extension projects, one legal project, one communications project, two education projects, as well as the Program Management and Program Development projects. All of these projects are in year three of multi-year proposals except for one education project that began February 1, 1999 and is in the second and last year. Although these projects were scheduled to close January 31, 2001, most have requested and received one-year no-cost extensions. The program year began with four National Strategic Initiative projects as part of the Gulf Oyster Industry Initiative. Later in the year, a project was selected for funding as part of the Minority Serving Institutions Initiative.

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 H.

# 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 interest 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 is currently serving as the Interim Director. This report is the Interim Director's report of Accomplishments and Impacts. The report would not have been possible without the support of MASGC administrative staff, especially Mrs. Diane Butler, Programs Officer.

## Funding

During program year 2000-2001 MASGC received $1,110,000 from the National Sea Grant Office core allocation with $662,479 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 8 projects through program development funds totaling $120,440 with a $101,757 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 5 awards of approximately $40,000 each. The required match of one non-federal dollar for every two dollars of federal funding was applied.

The MASGC Director was actively involved in the central organizing committee of the EPA's Gulf of Mexico Program (GOMP) and sits as co-chair of the GOMP research committee, and is 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 Swan 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

During the current reporting period MASGC sponsored research that lead to 30 journal articles, 2 invited papers, 7 technical reports, 6 abstracts, and 7 presentations. Extension and Legal Programs production included 25 outreach publications, 21 Web pages, and 18 newsletters. To place our publications in perspective, MASGC sponsored research and outreach over our three year omnibus lead to a yearly average of 4 peer reviewed journal articles, 8.5 outreach publications and 10 scientific presentations.

## 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." Over the three year period of our Omnibus cycle, including the current reporting period, MASGC sponsored research lead to the training of 2 post-docs, 13 Ph.D., 19 M.S., 17 J.D. and 32 undergraduate students.

The MASGC Marine Science Scholars (MSS) Program provided $5,000 support to 8 graduate students through non-federal funds. A portion of the $40,000 needed to fund the 8 MSS was obtained through two $5,000 donations from the International Paper Corporation and Chevron.

Two graduate students from MASGC member schools successfully competed for the Dean John A. Knauss Marine Policy Fellowship Program. These students were Ms. Kelly M. Shotts, University of South Alabama, who was assigned to NOAA's Office of Policy and Strategic Planning and Mr. Edward G. Stets, University of South Alabama, who was assigned to the U.S. Environmental Protection Agency's Coastal Management Branch Office.

## Mid-cycle Response to MASGC's 1998 PAT

The Program Assessment of the Mississippi-Alabama Sea Grant Consortium (MASGC) was conducted on June 15-18, 1998. Although the overall rating of MASGC was "good", significant improvements were recommended in (1) "Organizing and Managing for Success" and (2) "Outreach" (extension services and communications). Substantial progress has been made in these two areas in the two years since the MASGC Program Assessment. The interim report for the National Review Panel, the National Sea Grant Office, and the Board of Directors of MASGC details this progress. Two key areas worthy of review from this report include improvements in "Organizing and Managing for Success" and "Outreach." Since its inception, the MASGC administrative office has been located at The University of Southern Mississippi's Gulf Coast Research Laboratory. On the advice of the MASGC Director and Board of Directors, a request for proposals was distributed to invite proposals from MASGC consortium members to serve as the fiscal host of MASGC. Three proposals were received and after careful and deliberate review, The University of Southern Mississippi was selected in July 2001 to serve as the fiscal host for the next 6 years. Additionally, during the last 30 years there has not been any sort of agreement between the MASGC Board of Directors and USM. A Memorandum of Agreement (MOA) between the two parties was signed and submitted to the National Office. A revised MOA that reflects USM's role as fiscal host will be completed in early 2002.

The second, and likely the most profound, improvement in MASGC's program areas involves changes in how our Extension program operates. Historically, MASGC has funded a separate Extension program in each state. Consistently, during the Extension proposal review process, comments were made regarding the seemingly lack of coordination between each program. In appearance each program functioned independently and without integration of personnel or programs. As a result, the MASGC Associate Director was requested to complete an internal Extension evaluation by the MASGC Technical Review

Panel in the fall of 2000. During the evaluation process both Extension programs recognized the need for change and voluntarily began a transition process to improve both the programming and efficiency of extension. As a result, for the first time in MASGC's history, there was a single Extension proposal submitted for funding for program year 2002. This project involves the formal sharing of personnel across state lines and improvements in the overall Extension program planning process.

**Exemplary Impacts**

*International Conference on Jellyfish Blooms*

Dr. William "Monty" Graham convened the first-ever International Conference on Jellyfish Blooms in January 2000. This conference brought together scientists from around the world to discuss the science of jellyfish. Dr. Graham was also the lead editor of the proceedings resulting from this conference. Dr. Graham's scientific leadership in the area of jellyfishes served him well when the Gulf of Mexico had a massive bloom of Australian spotted jellyfish, *Phyllorhiza punctata,* beginning early summer of 2000. Dr. Graham recognized the significance of this invasive species event and was able to use $10,000 of Mississippi-Alabama Sea Grant Consortium rapid response funds to leverage an additional $300,000 to conduct broad-based research and outreach activities. One of Dr. Graham's strengths during this process was his ability to work with colleagues at multiple universities, state and federal agencies, and private citizens across neighboring Gulf States.

*Assessment of Sea Urchins as Fishery and Aquaculture Candidates in the Gulf of Mexico*

Dr. Stephen A. Watts and Dr. James B. McClintock at The University of Alabama at Birmingham and Dr. John M. Lawrence, at the University of South Florida assessed *Lytechinus variegates* as a fishery and aquaculture candidate. One primary impact of their research was the publication of *Edible Sea Urchins: Biology and Ecology.* J.M. Lawrence, (Editor). Elsevier Science Press, Amsterdam. 43 pp. (in press).

*Field Applications of Multiplex PCR to Monitor Microbial Contamination in Shellfish in the Gulf of Mexico*

Research results by Dr. Asim K. Bej, at The University of Alabama at Birmingham, support a previous study by the PI which tested the multiplex PCR approach on a large number of *V. parahaemolyticus* strains isolated from human patients, oyster-growing waters, and in oyster tissue homogenates to identify the occurrence and distribution of the targeted genes in these pathogens. The multiplex approach for the detection of pathogenic and total *V. parahaemolyticus* in shellfish has been approved by the FDA to be included in the *Bacteriological Analytical Methods,* and in the APHA *Compendium of Methods for the Microbiological Examination of Foods* as a recommended standard method alternative to the conventional culture-based assays.

*Nutritionally Complete, Low Cost Artificial Diets for the Culture of Fish and Crustacean Larvae*

Drs. Louis R. D'Abramo and Randal K. Buddington, Mississippi State University, developed a multi-state technique for the preparation of a microparticulate diet for *Macrobrachium rosenbergii.* Their research has lead to the application of a patent.

*Offshore Aquaculture Consortium*

Lack of planning and rigorous scientific evaluations of engineering, site specificity, environmental and ecological interactions, and the bioeconomic performances of candidate fish species under differing seasonal oceanographic regimes introduces significant risks to both the environment *and to industry* proposing offshore aquaculture with the available indigenous species in the Gulf of Mexico. In 1999, the Gulf of Mexico Offshore Aquaculture Consortium was formed to create a collaborative, Gulf-wide, university-based interdisciplinary research program that will address social, environmental and technological issues that are critical to developing economically viable offshore aquaculture endeavors in the Gulf of Mexico. Currently, there are 14 consortium members representing Sea Grant programs,

Universities, Federal agencies, and private sector industries. By developing university/industry partnerships and seeking broad public/commercial input, the Consortium's goal is to develop socially and environmentally acceptable offshore aquaculture models that are appropriate to all stakeholders in the Gulf of Mexico region.

*Sustainable Cobia Culture and Fisheries Summit*

Interest in the culture of cobia has grown substantially in the past five years as researchers have gained some familiarity with captive fish and begun to recognize this fish's rapid growth and adaptability to confinement. As a result, a summit on research, outreach, and policy was convened in Biloxi, MS in September 2000. The summit was hosted by MASGC and sponsored by the National Sea Grant Office, The University of Southern Mississippi's Gulf Coast Research Laboratory, Virginia Sea Grant, and the Mississippi-Alabama Sea Grant Consortium. Twenty-three representatives of academic institutions, private enterprise and the federal government identified and prioritized a series of issues that relate to enabling commercialization of cobia culture. The manuscript from this summit may be found at: http://www.virginia.edu/virginia-sea-grant/pdf/cobia.pdf.

## Interim Accomplishments and Impacts
## February 1, 2001 through October 31, 2001

- 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 who dropped out in the mid-1980's due to financial issues.
- Through funding from the National Sea Grant Office, the Mississippi-Alabama Sea Grant Consortium, and significant other sponsorships, the Open Ocean Aquaculture IV Symposium was held June 17-20, 2001 in St. Andrews, New Brunswick. 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, and the Illinois-Indiana Sea Grant Consortium.
- MASGC Programs Officer is coordinating the development of a database compiling 30 years of MASGC research and publications. This database is compatible with the National Sea Grant Office's goal of having an electronic database of Sea Grant projects.
- MASGC has revised its Web site (http://www.masgc.org).

# APPENDICES

# Appendix A

# Activities Supported From Program Development Funds

# Program Year 2000

| Project # | Amount Funded | Project Information |
|---|---|---|
| E/O-72-PD | $ 8,703 | Howard D. Walters - The University of Southern Mississippi<br>*Project Marine Discovery: Teachers' Minicamp for Natural Coastal Hazards—Pilot* |
| R/ER-49-PD | $ 9,876 | J. Stephen Brewer, Ph.D. - The University of Mississippi<br>*Anthropogenic Eutrophication of Salt Marsh Communities: Interactions Between Environmental Stress & Nutrient Addition* |
| R/ER-50-PD | $23,390 | Thomas P. Cathcart, Ph.D. - Mississippi State University<br>*Implementation of Landscape Management and Native Planting for the Man-Made Beach in Biloxi, MS* |
| R/ER-51-PD | $20,000 | Michael J. Sullivan, Ph.D. - Mississippi State University<br>*Use of $^{15}$Nitrogen Enrichment to Assess Organic Matter Production and Utilization in an Essential Fisheries Habitat* |
| R/LR-49-PD | $ 5,000 | Raymond P. Henry, Ph.D. - Auburn University<br>*Dean's Research Initiative: Carbonic Anhydrase Induction as a Model System for Environmentally Mediated Gene Expression* |
| R/MT-44-PD | $12,600 | J. Robert Woolsey, Jr., Ph.D. - The University of Mississippi<br>*Ballast Water Treatment and Management: Acoustic Screen Filtration for Control of Non-indigenous Species in Ballast Water* |
| R/MT-45-PD | $20,000 | Robin D. Rogers, Ph.D. - The University of Alabama<br>*Room Temperature Ionic Liquids as Benign Solvents for Extraction Of Astaxanthin and Solubilization of Chitin* |
| R/SP-5-PD | $20,871 | James H. Cowan, Jr., Ph.D. - University of South Alabama<br>*Fisheries Habitat of Juvenile Red Snapper in the Northern Gulf of Mexico* |

# Appendix B

# Collaborating Institutions

**Auburn University,** Auburn, Alabama
Land-grant university with the largest on-campus enrollment in the state of 21,860 students

**Dauphin Island Sea Lab,** Dauphin Island, Alabama
Alabama's marine education and research center with 22 member institutions

**Jackson State University,** Jackson, Mississippi
The Urban University of Mississippi, this HBCU has an enrollment of more than 6,200 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 over 16,000 students

**Mobile County Public School System,** Mobile, Alabama
Largest public school system in Alabama with an average enrollment exceeding 66,000 students

**Naval Oceanographic Office,** Stennis Space Center, Mississippi
Supports oceanographic requirements around the globe with a staff of approximately 1,000

**The University of Alabama,** Tuscaloosa, Alabama
The state's first university; enrollment currently 19,300 students

**The University of Alabama at Birmingham,** Birmingham, Alabama
One of the three institutions comprising the University of Alabama system; enrollment of 16,000

**The University of Mississippi,** Oxford, Mississippi
Oldest public institution of learning in the state; enrollment of 14,500 students

**The University of South Florida,** Tampa, Florida
Supports 35,000 students in various centers; second largest university in the southeast

**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 2000

| Funding Source | Amount |
|---|---|
| Mississippi State Appropriation | $175,000 |
| Mississippi-Alabama Sea Grant Consortium Subscriber Fees | $100,000 |
| Marine Science Scholars Fellowship Supporters | $ 10,000 |
| **TOTAL** | **$285,000** |

# Appendix D

# Publication List

**During the current reporting period MASGC sponsored research that lead to 30journal articles, 2 invited papers, 7 technical reports, 6 abstracts, and 7 presentations. Extension and Legal Program production included 25 outreach publications, 21 Web pages, and 18 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

*Molecular Cloning, Expression, and Tissue Distribution of Crustacean Molt-inhibiting Hormone.* R. D. Watson, K. J. Lee, S. Qiu, M. Luo, H. R. Umphrey, R.D. Roer, and E. Spaziani. (2001) *Amer. Zool.* (in press).

*Molt-inhibiting Hormone Immunoreactive Neurons in the Eyestalk Neuroendocrine System of the Blue Crab,* Callinectes sapidus. *Arthropod Struct. Devel.* (in press).

*Expression of Crustacean* (Callinectes sapidus) *Molt-inhibiting Hormone in Insect Cells Using Recombinant Baculovirus.* Submitted to *Molec. Cell. Endocrinol.*

*Production of Antipeptide Antibodies for Detection of Crustacean* (Callinectes sapidus) *Molt-inhibiting Hormone.* Submitted to *Peptides.*

Dissertations

*Neuroendocrine Regulation of Crustacean Molting: Studies of the Molt-Inhibiting Hormone of the Blue Crab,* Callinectes sapidus. Doctoral dissertation of Kara J. Lee (Ph.D., 2001).

Abstracts

*Presence and Potential Roles of G-Proteins in Y-Organs of the Blue Crab,* Callinectes sapidus. D.W. Han and R.D. Watson (2000) *J. Ala. Acad. Sci.* 71: 6.

*Presence and Potential Roles of G-Proteins in Y-Organs of the Blue Crab.* D.W. Han and R.D. Watson. *Amer. Zool.* (in press).

*Production of Antipeptide Antibodies for Detection of Crustacean Molt-inhibiting Hormone.* K.J. Lee and R.D. Watson. *Amer. Zool.* (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

*Conflict Between Somatic and Gonadal Growth in Sea Urchins.* M. Lawrence. 2000. Http://crdpm.cus.ca/oursin

*Stress and Deviant Reproduction in Echinoderms.* J.M. Lawrence and J. Herrera. *Zool. Stud.* 39: 151-171. 2000.

*Fertilization and Development of Eggs of the Sea Urchin* Lytechinus variegatus *Maintained on an Extruded Feed.* S.B. George, J.M. Lawrence, A.L. Lawrence, and J. Ford. *J. World Aquacul. Soc.* 31: 232-238. 2000.

*The Effect of Size and Diet on Gonad Production by the Chilean Sea Urchin* Loxechinus albus. S. Olave, E. Bustos, J.M. Lawrence, and P. Cárcamo. *J. World Aquacul. Soc.* (In press).

*The Role of Carotenoids on Egg Quality and Development in the Sea urchin* Lytechinus variegatus. S. George, J.M. Lawrence, A.L. Lawrence, J. Smiley, and L.R. Plank. *J. World Aquacul. Soc.* (In press).

*Edible Sea Urchins: Biology and Ecology.* J.M. Lawrence, (Editor). *Elsevier Science Press,* Amsterdam. 437 pp. (In press).

*Edible Sea Urchins.* J.M. Lawrence In: *Edible Sea Urchins: Biology and Ecology,* J.M. Lawrence (ed.). *Elsevier Press.* (In press).

*Digestion.* J.M. Lawrence and T.S. Klinger. In: *Edible Sea Urchins: Biology and Ecology,* J.M. Lawrence (ed.). *Elsevier Press.* (In press).

*Disease.* K. Tajima and J.M. Lawrence. In: *Edible Sea Urchins: Biology and Ecology,* J.M. Lawrence (ed.). *Elsevier Press.* (In press).

*The Ecology of* Tripneustes. J.M. Lawrence and Y. Agatsuma. In: *Edible Sea Urchins: Biology and Ecology,* J.M. Lawrence (ed.). *Elsevier Press.* (In press).

*The Ecology of* Lytechinus variegatus. S.A. Watts, J.B. McClintock, and J.M. Lawrence. In: *Edible Sea Urchins: Biology and Ecology.* J.M. Lawrence (ed.). *Elsevier Press.* (In press).

*Reproductive Endocrinology of Sea Urchins.* K. Wasson, and S.A. Watts. In: *Edible Sea Urchins: Biology and Ecology,* J.M. Lawrence (ed.). *Elsevier Press.* (In press).

*Energy Metabolism and Gonad Development.* A. Marsh and S.A. Watts. In: *Edible Sea Urchins: Biology and Ecology,* J.M. Lawrence (ed.). *Elsevier Press.* (In press).

Presentations

*Understanding Early Life History Strategies During Culture of the Sea Urchin,* Lytechinus variegatus. B.D. Wallace, A.W. Cunningham, M.S. Vickery, S.A. Watts, J.B. McClintock and J.M. Lawrence.J. Ala. Acad. Sci. 71, 2. 2000.

*The Effects of Dietary Protein on the Production and Proximate Composition of Gonads in the Sea Urchin* Lytechinus variegatus. H.S. Hammer, S.A. Watts, J.B. McClintock, J.M. Lawrence and A.L. Lawrence. J. Ala. Acad. Sci. 71, 3. 2000.

*The Effects of Dietary Protein on the Production and Proximate Composition of Gonads in the Edible Sea Urchin* Lytechinus variegatus. H.S. Hammer, S.A. Watts, J.M. Lawrence, A.L. Lawrence and J.B. McClintock. World Aquaculture Society, Orlando, Florida. 2001.

*The Effects of Dietary Protein on Growth of Juvenile Sea Urchins.* B.D. Wallace, H. Hammer, S.A. Watts, J.M. Lawrence and A.L. Lawrence. World Aquaculture Society, Orlando, Florida. 2001.

*Problems Associated with Settlement, Metamorphosis and Post-metamorphic Growth of* Lytechinus variegatus *in Culture.* S.A. Watts., M.S. Vickery, M. Becerro, B. Wallace and J.M. Lawrence. World Aquaculture Society, Orlando, Florida. 2001.

*The Effect of Dietary Protein Concentration on Gonad Composition and Gametic Condition in the Sea Urchin* Lytechinus variegatus. H.S. Hammer, S.A. Watts, J.M. Lawrence, A.L. Lawrence and J.B. McClintock. *Society for Integrative and Comparative Biology.* pg. 212. 2001.

*The Effect of Dietary Protein Concentration on the Growth of Juveniles of the Sea Urchin* Lytechinus variegatus. B.D. Wallace, H.S. Hammer, S.A. Watts, J.M. Lawrence and A.L. Lawrence. *Society for Integrative and Comparative Biology.* pg. 417. 2001.

**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.**

Manuscripts

*Cluster Analysis of AP-PCR Generated DNA Fingerprints of* Vibrio vulnificus *Isolates from Patients Fatally Infected After Consumption of Raw Oysters.* Michael C.L. Vickery, N. Harold, Asim K. Bej. *Letters in Applied Microbiology.* 30: 258-262. 2000.

*Identification of Plasmids and Hemolysin Genes in* Vibrio parahaemolyticus *Isolated from 1994 and 1997 U.S. Pacific Northwest Outbreaks.* Christina L. Pass, Greer Kaufman, Asim K. Bej and Charles A. Kaysner (In review).

*Occurrence and Distribution of* Vibrio vulnificus *in Gulf Coast Oysters Using Multiplex PCR Amplification of cth and viuB* Christina L. Pass, William Burkhardt, Kevin Calci, Angelo DePaola and Asim K. Bej (In preparation).

*Multiplex PCR Amplification for the Detection of Total and Pathogenic* Escherichia coli *from Gulf Coast Oysters.* Asim K. Bej, William Burkhardt, Kevin Calci and Angelo DePaola. (In preparation).

*Application of Multiplex PCR Amplification to Determine the Occurrence and Distribution of* Vibrio parahaemolyticus *in Shellfish Collected from the Gulf of Mexico.* Christina L. Pass, William Burkhardt, Kevin Calci and Angelo DePaola. (In preparation).

*Comparisons of Methods for Purification of Total Nucleic Acids from Microorganisms in Shellfish for PCR Amplification.* Greer Kaufman and Asim K. Bej. (In preparation).

*Application of Multiplex PCR Amplification to Determine the Occurrence and Distribution of Total and Pathogenic Salmonellae in Shellfish from the Gulf of Mexico.* Greg McKee, Jeff Caroll, Asim K. Bej. (In preparation).

**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.**

Publications are in preparation but must await the application for a patent before submission.

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

Manuscripts

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

Invited papers

*Effect of Octylphenol on Serum Vitellogenin, Reproductive Capacity and Offspring of Male Fish.* M. Brouwer and S. Gronen. NIEHS workshop on unique marine/freshwater models for environmental health research. 1998.

*Endocrine Disruption in the Japanese Medaka.* M. Brouwer. International Workshop on Standardization of Endocrine-Disrupters Testing in Medaka. Nagoya, Japan. 2001.

Technical Reports

*Reproductive Effects of Estrogenic and Antiestrogenic Chemicals of Sheepshead Minnow* (Cyprinodon variegatus). Final Technical Report. Marius Brouwer, The University of Southern Mississippi. MASGP-99-002.

Abstracts

*Reproductive and Biochemical Effects of 4-tert-octylphenol on Small Fish.* S. Gronen and M. Brouwer. *J. Miss. Acad. Sci.* 43: 20. 1998.

*Effect of Octylphenol on Serum Vitellogenin, Reproductive Capacity, and Offspring of Male Medaka Fish.* S. Gronen and M. Brouwer. *Soc. Env. Tox. Chem. Abstract Book: 187. 1998.*

*Reproductive Effects of Estrogenic Chemicals on Sheepshead Minnows.* A. Karels and M. Brouwer, *J. Miss. Acad. Sci.* 45: 20. 2000.

**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.**

Manuscripts

*Predicted Sex Ratios of Hatchling Kemp's Ridleys Produced in Egg Corrals During the 1998, 1999, and 2000 Nesting Seasons.* A. Geiss, T. Wibbels, R. Marquez-M, M. Garduno-D, P. Burchfield, and J. Peña-V. In: *Proceedings of the 21st International Sea Turtle Symposium.* February 2001. Philadelphia, PA.. NOAA, Technical Publications NMFS-SEFSC (in press).

*Sexing Juvenile Sea Turtles: Is There an Accurate and Practical Method?* T. Wibbels, D. Owens, and C. Limpus. *Chelonian Conservation and Biology.* 3: 756-760. 2000.

Technical Reports

*Incubation Temperature in Kemp's Ridley Nests During the 1999 Nesting Season.* T. Wibbels, R. Márquez-M., M. Garduño-D., P. Burchfield, and J. Peña-V. In: *Proceedings of the 20th International Sea Turtle Symposium.* March 2000, Orlando, FL. NOAA, Technical Publications NMFS-SEFSC (in press).

*Incubation Temperature in Kemp's Ridley Nests During the 1998 Nesting Season.* T. Wibbels, R. Márquez-M., M. Garduño-D., P. Burchfield, and J. Peña-V. In: *Proceedings of the 19th International Sea Turtle Symposium.* March 1999, Padre Island, Texas. NOAA, Technical Publications NMFS-SEFSC-443, pp. 133-134.

*Sand Temperatures of Green Turtle Nesting Beaches in the Hawaiian Archipelago.* T. Wibbels, G.H. Balazs, D.M. Parker, and J. Hanson. In: *Proceedings of the 19th International Sea Turtle Symposium.* March 1999. Padre Island, TX. NOAA, Technical Publications NMFS-SEFSC-443, pp. 131-133. 2000.

**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

*Laboratory Growth Responses of Juvenile* Mugil *sp. to Temperature and Salinity: Delineating Optimal Field Growth Conditions.* M.S. Peterson, C.F. Rakocinski, B.H. Comyns, and G.L. Fulling. *Proceedings of the Gulf and Caribbean Fisheries Institute* 51: 341-352. 2000.

*Relating Environmental Fluctuation and Early Growth of Estuarine Fishes: Ontogenetic Standardization.* C.F. Rakocinski, B.H. Comyns, and M.S. Peterson. *Transactions of the American Fisheries Society* 129: 210-221. 2000.

*Field Growth Responses of Juvenile White Trout* (Cynoscion arenarius) *to Continuous Variation in Physical Habitat Conditions.* C.F. Rakocinski, B.H. Comyns, M. S. Peterson, and G.A. Zapfe. *Proceedings of the Gulf and Caribbean Fisheries Institute.* (In press).

**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

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

*Chemokinesis and Chemotaxis in Marine Bacteria and Algae.* C.D. Amsler and K. B. Iken. In: *Marine Chemical Ecology*, J.B. McClintock and B.J. Baker (eds.). CRC Press, Boca Raton, FL. 2001. (In press.)

*Quantitative and Qualitative Studies of the Swimming Behavior of* Hincksia irregularis *(Phaeophyceae) Spores: Ecological Implications and Parameters for Quantitative Swimming Assays.* K.B. Iken, C.D. Amsler, S.P. Greer and J.B. McClintock. Submitted to *Phycologia.*

*Light Boundaries and the Coupled Effects of Surface Hydrophobicity and Light on Spore Settlement in the Brown Alga* Hincksia irregularis *(Phaeophyceae).* S.P. Greer and C.D. Amsler. Submitted to *Journal of Phycology.*

**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

*Oxidation of Sarcophine: Formation of Hydroxylated Cembranolides.* Isamu Katsuyama, Hesham Fahmy, Jordan K. Zjawiony, Sheiref I. Khalifa, and Raouf W. Kilada. *Tetrahedron.* (submitted) 2001.

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

Extension Publications

*Mississippi Coastal Recreational Boating Access: Assessment and Projected Needs.* D. Burrage, C. Hollomon and B.C. Posadas. Mississippi State University, Coastal Research and Extension Center, Biloxi, MS. (http://msstate.edu/dept/crec/marres.html) 2000.

*Mississippi Tide Tables.* D. Burrage. MCES Pub. 850. Mississippi State University, Mississippi State, Mississippi. Annual publication.

*Ansley Fishing Waters Guide.* D. Burrage. Revision and update of MCES publication 874. Mississippi State University, Mississippi State, Mississippi. 2000.

*Upper Pascagoula River Fishing Waters Guide.* D. Burrage. Revision and update of MCES publication 878. Mississippi State University, Mississippi State, Mississippi. 2000.

*Wolf River and East St. Louis Bay Fishing Waters Guide*. D. Burrage. Revision and update of MCES publication 876. Mississippi State University, Mississippi State, Mississippi. 2000.

*Jourdan River and West St. Louis Bay Fishing Waters Guide*. D. Burrage. Revision and update of MCES publication 875. Mississippi State University, Mississippi State, Mississippi. 2000.

*Tilapia Marketing in Mississippi*. B.C. Posadas. In Costa-Pierce, B. and J. Rakocy. Tilapia Aquaculture in the Americas. World Aquaculture Society, Baton Rouge, Louisiana, vol. II. 2000.

*Costs and Returns of Producing Catfish in the Mississippi Black Belt Area*. B.C. Posadas. Technical Bulletin 226. Mississippi Agricultural and Forestry Experiment Station, Mississippi State, Mississippi. 2000.

*Economic Impact of Seafood Harvesting, Processing and Distribution in Mississippi*. B.C. Posadas. Mississippi State University, Coastal Research and Extension Center, Biloxi, Mississippi. (http://msstate.edu/dept/crec/fwmr.html) 2000.

Newsletters

*Gulf Coast Fisherman*, newsletter for distribution to commercial and recreational fishermen, fishery managers, educators and seafood businesses. D. Burrage. (Total circulation is 600, primarily in the Gulf and South Atlantic region). Newsletter is also distributed by posting on the Internet and by e-mail. 2000.

Web Pages

1. Updated MSU-Coastal Research and Extension Center website http://msstate.edu/dept/crec/crec.html
2. Updated MSU-CREC Aquaculture Economics and Marketing website
3. Updated MSU-CREC Non-Delta Catfish production website
4. Updated MSU-CREC Coastal Aquaculture Unit website
5. Updated MSU-CREC Aquatic Nuisance Species website
6. Updated MSU-CREC Freshwater Prawn Production and Marketing website
7. Updated MSU-CREC Tilapia Production and Marketing website
8. Created MSU-CREC Offshore Aquaculture Production and Marketing website
9. Created MSU-CREC Striped Mullet Production and Marketing website
10. Created MSU-CREC Flounder Production and Marketing website
11. Updated MSU-CREC Fisheries Economics and Marketing website
12. Updated MSU-CREC Economic Impact of Mississippi Seafood Industry website
13. Updated MSU-CREC Coastal Herring Complex website
14. Updated MSU-CREC Seafood Processing and Safety website
15. Updated MSU-CREC Constructed Wetlands website
16. Updated MSU-CREC Coastal Mississippi Public Access website
17. Updated MSU-CREC Environmental Valuation website
18. Updated MSU-CREC Nursery Production Marketing website
19. Updated MSU-CREC Crosby Arboretum website
20. Updated MSU-CREC E-Commerce website
21. Maintain a web page under the Mississippi State University Extension Service Curriculum; used primarily to post monthly newsletter *Gulf Coast Fisherman* in html format. Post monthly issues and maintain back issues for six months on this site.

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

Extension Fact Sheets

*The Jubilee Phenomenon.* Richard K. Wallace. Update. MASGP-99-005. 2000.

*Ballast Water Management: The Right Thing To Do.* Richard K. Wallace. MASGP-99-007. 2000

*Activities You Can Do Within Your Watershed.* Jody A. Scanlon. MASGP-99-008. 2000.

*Strategic Planning.* Jody A. Scanlon. MASGP-99-009. 2000.

*Watershed and Other Terminology.* Jody A. Scanlon. MASGP-99-010. 2000.

*Dog River Watershed.* Jody A. Scanlon. MASGP-99-011. 2000.

*Get to Know Your Watershed.* Jody A. Scanlon. MASGP-99-012. 2000.

*Three Mile Creek Watershed.* Jody A. Scanlon. MASGP-99-013. 2000.

Newsletters

*Sea Harvest News.* "Keeping TED Flaps Tight" Richard K. Wallace. July 2000

*Sea Harvest News.* "New Alabama Trip Ticket in Place" Richard K. Wallace. August 2000

**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

*Essential Fish Habitat: Does Calling It Essential Make It So?* Kristen M. Fletcher and Sharonne O'Shea. *30 Environmental Law Review 51* 2000.

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

*Sovereignty, Utility, and Fairness: Using U.S. Takings Law to Guide the Evolving Utilitatian Balancing Approach to Global Environmental Disputes in the WTO.* Richard J. McLaughlin. Scheduled to be published in *Oregon Law Review.* 2000.

*If You Can't Beat 'em, Eat 'em: Legal Methods to Control Aquatic Nuisance Species in the Gulf of Mexico.* Kristen M. Fletcher. *Ocean and Coastal Law Journal.* 2000.

*Property Rights and Taking Legislation in the Gulf States: Just the Beginning or Is the Revolution Over?* Monograph Publication (2000).

*Will U.S. Foreign Policy Migrate with the Whales? A Critique of U.S. Foreign Policy and the Rapidly Changing International Whaling Regime.* Kristen M. Fletcher. published in *Environmental Change and U.S. Foreign Policy* (in press).

Technical Reports

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

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

*Understanding Fisheries Management,* Second edition of *Fisheries Management for Fishermen.* Richard K. Wallace and Kristen M. Fletcher. 2000.

Newsletters

*Water Log*. "Supreme Court Rejects State's Maritime Laws." Kristen M. Fletcher, Editor. Volume 20:1. 2000.

*Water Log*. "Public Trust Doctrine Protects Beach Access." Kristen M. Fletcher, Editor. Volume 20:2. 2000.

*Water Log*. "Corps Must Prepare Environmental Impact Statements for Mississippi Casinos." Kristen M. Fletcher, Editor. Volume 20:3. 2000.

*Water Log*. "Clinton Creates Coral Reef Reserve." Kristen M. Fletcher, Editor. Volume 20:4. 2000.

# Appendix E

# Students Supported

Over the three-year period of these projects, a total of 2 post-docs, 13 Ph.D., 19 M.S., 17 J.D. and 32 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.**

Kara J. Lee, (Ph.D., 2001) Department of Biology, The University of Alabama at Birmingham.

Deug-Woo Han, Department of Biology, The University of Alabama at Birmingham. Current Ph.D. student.

Kevin J. Borders, Department of Biology, The University of Alabama at Birmingham. Undergraduate Honors Research student.

**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.**

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*

Brenda Wallace, Department of Biology, The University of Alabama at Birmingham, M.S. student working on larval biology.

Mickie Powell, Department of Biology, The University of Alabama at Birmingham, Ph.D. candidate who is helping with some of the physiological studies.

Jenni Wheeler, Department of Biology, The University of Alabama at Birmingham, B.S. student.

Audrey Richards, Department of Biology, The University of Alabama at Birmingham, B.S. student.

Scott Hofer, Department of Biology, The University of Alabama at Birmingham, B.S. Honors student who will enter the M.S. program in the spring to continue on the project.

Rebecca Worrell, Department of Biology, The University of Alabama at Birmingham, B.S. Honors student.

Katie Gibbs, Department of Biology, The University of Alabama at Birmingham, B.S. student

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.*

E. Eigenburg, Department of Biology, The University of South Florida, B.S. student.

M. Kastura, Department of Biology, The University of South Florida, B.S. student.

E. Amato, Department of Biology, The University of South Florida, B.S. student.

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.**

Ekaterina Kovalenko, Department of Wildlife and Fisheries, M.S. (Aquaculture Science), is in the process of writing her thesis, *Successful, Complete Substitution of Live Food with a Microparticulate Diet for the Larval Culture of* Macrobrachium rosenbergii. Expected date of graduation is May 2001.

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

Suzanne Nichole Gronen, Department of Marine Sciences, College of Marine Sciences, The University of Southern Mississippi. Masters degree May 2000. Thesis title: *Effects of Endocrine Disrupting Chemicals on Development of Reproductive Organs and Reproductive Function in the Teleost Fish,* Oryzias latipes.

Arthur Alan Karels, Department of Coastal Sciences, College of Marine Sciences, The University of Southern Mississippi. Masters degree 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.**

Alyssa Geis, Department of Biology, The University of Alabama at Birmingham. Masters Degree in Biology, anticipated graduation May 2001. Thesis: *Evaluation of Sex Ratios in the Kemp's Ridley Recovery Program.*

Angelia Myrick, David Rey, Lee Ellis, and Branden Sanderlin, senior undergraduate students conducted "Undergraduate Research BY 398" under Dr. Wibbels direct supervision in the Department of Biology, The University of Alabama at Birmingham during 2000. Title of their research project: *Evaluation of Incubation Temperatures in Kemp's Ridley Nests During the 1998-2000 Nesting Seasons.*

**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.**

Glen Zapfe - M.S. candidate - September - December 2000 (100%); January 2001 (50%).
Christa Woodley - M.S. candidate - 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.**

Stephen Greer, Department of Biology, The University of Alabama at Birmingham. Ph.D. candidate. Expected completion 2002. Thesis: *Behavioral Analysis of Bacterial, Algal, and Invertebrate Settlement and the Effects of Echinoderm Secondary Metabolites on Settlement.*

Dr. Katrin Iken, Department of Biology, The University of Alabama at Birmingham. Postdoctoral Research Associate.

Dr. Mikel Becerro, Department of Biology, The University of Alabama at Birmingham. 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.**

Ian Kennedy, current M.S. student in Chemistry.

Partial support given to one undergraduate student.

**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**

John Bowling, Department of Pharmacognosy, The University of Mississippi. Graduate student.

Jennifer Bullock, Department of Pharmacognosy, The University of Mississippi. Graduate student.

Vernon Rayford, School of Pharmacy, Honors College, The University of Mississippi. Undergraduate student.

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

At the close of the current project year (July 31, 2001) instructional support will have been extended to over eight hundred students. This number, combined with that of the first two years of the project, brings

the total to over twenty-two hundred. The following Mobile County High Schools have participated in the project: Baker, Blount, Bryant, Citronelle, LeFlore, Montgomery, Murphy, Rain, Shaw, Theodore, Williamson, and Vigor.

**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.**

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

Jonathan Huth, J.D., 2000.
Tim Peeples, J.D., 2000.
Ginger Weston, J.D., 2000.
Stacy Prewitt, J.D., 2001.
Jimmy Hall, J.D., 2001.
April Roberts, J.D., 2001.
David Harris, J.D., 2002.
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 $5,000 support to the following graduate students through "other source" funds:

Jody A. Bruton, University of South Alabama, Ph.D. candidate
Stephen A. Bullard, The University of Southern Mississippi, M.S. candidate
Melaura M. Cranford, University of South Alabama, M.S. candidate
Leslie J. Gallagher, University of South Alabama, M.S. candidate
Glenn M. Hendrix, The University of Southern Mississippi, M.S. candidate
Nirmal D. Pugh, The University of Mississippi, Ph.D. candidate
Dena G. Vincent, The University of Southern Mississippi, M.S. candidate
Jennifer M. Walker, The University of Alabama, Ph.D. candidate

**Sea Grant Federal Fellowship Program - Dean John A. Knauss Marine Policy Fellow**
(E/O-70 & 71).

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

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

# Appendix F

# Program Awards and Honors

**Marine Science Scholars Program**

The Mississippi-Alabama Sea Grant Consortium was the recipient of a $5,000 grant from the International Paper Company. The funds from this grant were used to support a Marine Science Scholars graduate fellowship award.

Chevron (Pascagoula, MS) in conjunction with The Nature Conservancy sponsored a $5,000 Marine Science Scholars' graduate fellowship for research to be conducted in the Grand Bay NERR.

**Sea Grant Federal Fellowship Program - Dean John A. Knauss Marine Policy Fellow**

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

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

# Appendix G

# 1998-2001 Omnibus

# Progress Reports

## *Research - Seafood Resource Management and Production*

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

The objective of this project is to develop a method that will permit specific manipulation of the blue crab *(Callinectes sapidus)* molt cycle and provide an abundant and controllable supply of soft-shelled crabs.

1. Production and testing of antibodies against recombinant MIH (rMIH). The investigators continue to pursue use of anti-MIH antibodies as a means of inducing molting. Two approaches have been used. First, recombinant MIH (rMIH) was generated in *E. coli* using a pET 15b expression vector. The recombinant protein was purified and used for the production of immune serum. Second, protein sequence analysis programs were used to select regions of the MIH peptide for generation of antipeptide antisera. Based on the sequence analyses, two 14-mer peptides were commercially synthesized and used for production of antipeptide antisera. Manuscripts describing the above results are in press (Watson et al., 2001) or have been submitted (Lee and Watson, submitted). The PIs are now testing whether injection of the anti-rMIH or the antipeptide antisera will block the molt-suppressing action of MIH and induce molting.

2. Production of recombinant molt-inhibiting hormone for crystallization. The rMIH expressed in *E. coli* did not possess MIH bioactivity (i.e., it was not properly folded). Thus, while the prokaryotically expressed rMIH was useful for production of immune serum, it was not suitable for crystallographic studies. Consequently, the PIs turned to a eukaryotic (baculovirus) expression system, and have successfully used the baculovirus system to express blue crab MIH in insect Sf9 cells. The recombinant peptide is MIH-immunoreactive (as determined by Western blot), is of the appropriate molecular size (as determined by mass spectrometry) and sequence (as determined by N-terminal amino acid sequencing), and possesses MIH bioactivity (as determined by its ability to dose-dependently suppress ecdysteroid production by Y-organs *in vitro*). Based on the above results, the recombinant peptide expressed using the baculovirus/insect cell system appears to be properly processed and folded. A manuscript describing the results has been submitted for publication (Lee and Watson, submitted). It is anticipated that the recombinant peptide can be used for crystallization, determination of the 3-D structure of MIH, and design of chemical inhibitors of MIH.

3. Immunocytochemical analysis of the MIH neuroendocrine axis of *C. sapidus*. Immunocytochemistry has been used to investigate the structure of the blue crab MIH neuroendocrine axis. Polyclonal antiserum raised against authentic MIH of the green crab, *Carcinus maenas*, was used as the primary antiserum, and goat anti-rabbit IgG FITC conjugate as the secondary antibody. Conventional

and confocal immunofluorescent microscopy revealed MIH immunoreactivity in a cluster of 15-20 X-organ neurosecretory cell bodies, their axons, and axon terminals in the sinus gland. This is the first report of the cellular architecture of the MIH neuroendocrine axis in blue crabs. The investigators anticipate the results will provide baseline data for future experimental manipulations of MIH synthesis and secretion in *C. sapidus*. A manuscript describing the results is in press (Watson et al., 2001).

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

This project involves 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.

Previously, a study was completed in which the effects of qualitatively different diets on gonad production were examined. Three diets that varied in protein content but were isocaloric were proffered to several groups of urchins. Feeding rates varied with protein content. Gonad production varied with protein content and was optimized at approximately 32 percent crude protein. Marketable gonads could be produced within 10 weeks. Most importantly, gonad quality varied directly with 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 PIs will be able to manipulate the organic content of the roe and, most importantly, manipulate taste. An evaluation of the cellular content of the gonads has been completed. Whereas the gonads are a combination of storage cells (nutritive phagocytes) and gametes (eggs or sperm), the PIs 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.

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.

As the use of artificial feed in roe production was done the previous year, this year focused on the somatic growth of juveniles. This is important as the time to marketable size needs to be as short as possible. The studies were performed at The University of Alabama at Birmingham. In a study that examined the effects of protein of juvenile growth, it was determined that at levels less than 23 percent protein, over 50 percent of the individuals died within 14 weeks. Those fed 32 percent and 50 percent 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 when 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. Data are currently being analysed.

New research directions being explored include:

(1) The possibility that sea urchins can be a component of polyculture in new offshore aquaculture pens.
(2) Since the incredibly high carbohydrate levels in the gonads are unique, the basic control of glycogen production, transfer and utilization should be considered. Preliminary work has begun with the Department of Nutrition Science (Dr. Barbara Gower).
(3) The fact that the investigators can now grow sea urchin larvae in a defined medium has received significant attention at national meetings. It may now be possible to develop cultures that can be used to address marine pollution and toxicology studies. Dr. Ann Rudloe of the Gulf Specimen Company has advised that sea urchins are in considerable demand for this purpose and that she would be interested in participating in future studies in this direction. This may represent a new commercial application for the aquaculture of urchins.
(4) The investigators would like to expand their studies to include *Tripneustes ventricosus*, which is found in south Florida and also occurs in the Bahamas. The roe from this urchin in already in high demand (high market acceptance) and the investigators believe some of their technology developments can be transferred to the culture of that species.
(5) Recent hormonal studies in the investigators' labs have indicated that steroids, and possibly phytosteroids, can influence gamete production and gonad growth. Additional experiments are warranted in this area of research because many foodstuffs used in formulated diets contain phytosteroids and other potential growth-promoting/inhibiting compounds.
(6) The PIs will be examining the role of temperature in promoting gonad growth. Since gonad growth can be the result of an increase in nutritive storage, or an increase in gametes, this and other factors will be examined. Nutritive storage is desirable for food culture; gamete production is desirable for production of animals for developmental biologists.
(7) The role of carotenoids is being considered very important in juvenile production. Additional studies are desirable in this field.

***Field Applications of Multiplex PCR to Monitor Microbial Contamination in Shellfish in the Gulf of Mexico*** **(R/MT-39).** Asim K. Bej, The University of Alabama at Birmingham. This project closed August 31, 2000.

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.

The following objectives were successfully completed:

1. Comparison of methods for the purification of microbial DNA from pre-enriched oyster tissue homogenates: Cell lysis method: Application of this approach yielded PCR-compatible DNA from targeted microorganisms that were seeded in oyster tissue homogenate. Although the "cell lysis" of DNA extraction is reliable, this approach requires the use of several purification steps. This approach may not be attractive to many laboratories due to (i) the use of phenol and chloroform which are hazardous to human health; and (ii) it may be a relatively time-consuming process if a large number of samples need to be evaluated.

In FDA seafood laboratories, conventionally, microorganisms in oyster homogenate samples are enriched for a few hours to overnight at permissible growth temperatures, prior to microbiological- or genetic-based detection. In order to coincide with their approach, the PI explored the effectiveness of a simple but efficient method of DNA purification from the pre-enriched broth cultures of oyster homogenate that can be used for PCR amplification of the targeted genes. This method of purification of template DNA can be referred as "direct boiling with Chelex®100".

2. Optimization of the multiplex PCR amplification: Multiplex PCR amplification of vibrios, *E. coli* and *Salmonella* have been optimized by changing various PCR reaction parameters.

3. Applications of the multiplex PCR on field oysters:

(I) ***V. vulnificus***: The current results indicate that the multiplex PCR amplification of *viuB* gene segment along with the *cth* gene may be used as an alternative approach to conventional culture-based microbiological assays, to monitor the presence of potentially virulent strains of *V. vulnificus* in oysters.

(II.) ***V. parahaemolyticus***: The current results support a previous study by the PI which tested the multiplex PCR approach on a large number of *V. parahaemolyticus* strains isolated from human patients, oyster-growing waters, and in oyster tissue homogenates to identify the occurrence and distribution of the targeted genes in these pathogens. The multiplex approach for the detection of pathogenic and total *V. parahaemolyticus* in shellfish has been approved by the FDA to be included in the *Bacteriological Analytical Methods,* and in the APHA *Compendium of Methods for the Microbiological Examination of Foods* as a recommended standard method alternative to the conventional culture-based assays.

(III.) ***V. cholerae***: Multiplex PCR amplification for the detection of toxigenic *V. cholerae* O1 and O139 strains was negative for all samples. This suggests that toxigenic *V. cholerae* was not prevalent in shellfish during the period of this study.

(IV.) ***E. coli***: Results suggest that most of the samples had *E. coli* including pathogenic strains, irrespective of the season or the location. Therefore, it seems from this result that *E. coli* may be more prevalent in the Gulf waters than other microbial pathogens tested in this study. It is possible that from the sewage outfall areas, the salt-water-tolerant *E. coli* has spread in the Gulf waters.

(V.) ***Salmonellae***: Although 20 percent of the samples exhibited positive PCR amplification of the *spvB* gene, suggesting the presence of the pathogenic strains of salmonella in these samples, none of the samples showed amplification of the *invX* gene.

Positive detection of the salmonella was confined primarily in the oyster samples collected from the sewage-contaminated locations. This result suggests that although some of the oyster samples had pathogenic salmonella, these strains were not invasive in nature.

4. Evaluation of colorimetric detection of the PCR amplified DNA: (a.) GeneComb hybridization methodology: For detection of the amplified DNA, a colorimetric gene probe hybridization using the GeneComb system was used. All positive PCR amplified DNA characterized by gel electrophoresis methodologies exhibited complete correlation with the GeneComb colorimetric hybridization method. The cost of this approach needs to be evaluated for its application as a routine monitoring for shellfish for the presence of microbial pathogens.

New Research Directions: The PI has investigated the plasmid profiles of *Vibrio parahaemolyticus* strains isolated from human patients during the 1994 and 1997 U.S. Pacific Northwest outbreaks in order to determine whether a single pathogenic strain is involved in these outbreaks.

Technology Transfer: Transfer of the technology has been made to the U.S. 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.*

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

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

A microparticulate diet that can be easily and reliably produced is preferred to live food for a number of reasons. Labor costs associated with the production of live food will be eliminated and the nutrient composition of the diet can be controlled, thereby avoiding the geographical and seasonal changes in nutrient composition that are characteristic of live food. Moreover, such a diet can serve as a convenient vector for the provision of certain hormones, attractants, and therapeutic or prophylactic agents to treat or prevent disease. With the ability to control the nutritional health of the larvae, production levels should increase and the cost of production per larvae will correspondingly decrease. Also, the ingredient composition of the diet can be modified to be used in the determination of qualitative and quantitative nutrient requirements and in achieving a better understanding of the physiology of larvae. The composition of the diet can also be modified to satisfy species-specific nutritional needs.

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* indicates 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 PIs plan to test whether the diet can serve as a substitute for *Artemia* nauplii in the larval culture of striped bass and haddock. With a nutrient composition similar to that of *Artemia* nauplii, a greater applicability is anticipated. As a corollary to the development of this diet, modification of the preparation procedure has led to the production of a paste that, when homogenized, produces nutritionally complete, water stable particles that range in size from 10 to 50 microns. These particles have the

potential of serving as substitutes for algae and rotifers in the larval culture of crustaceans and fish. An initial evaluation of the effectiveness with filter feeding *Artemia* nauplii is planned.

The process of applying for a patent relative to the preparation of the microparticulate diet has been initiated.

## *Research - Coastal Ecosystem Health and Management*

***Effects of Endocrine-Disrupting Chemicals on Reproductive Function of Fish (R/ER-38)***
Marius Brouwer, The University of Southern Mississippi. This project closed April 30, 2000.

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.

***Transfer of Sexing Technology to the Kemp's Ridley Sea Turtle International Recovery Program (R/LR-44).*** 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.

During the 2000 nesting season, a comprehensive international collaboration was continued with the Instituto Nacional de la Pesca at the Kemp's ridley nesting beach in Rancho Nuevo, Mexico. The purpose of this collaborative project is to facilitate the implementation of a variety of technologies for estimating sex ratios produced in the Kemp's Ridley Recovery Program. Optimal techniques for monitoring incubation temperatures within nests and for obtaining blood samples from hatchling Kemp's ridleys were developed. The data collected at Rancho Nuevo indicated that both males and females were produced during the 2000 nesting season, and that an overall female bias was produced. Additionally, the ongoing collaboration with the National Park Service and U.S. Geological Survey in the U.S. Virgin Islands in estimating hatchling hawksbill sea turtle sex ratios on Buck Island Reef National Monument were continued. A project was initiated with the National Marine Fisheries Service to examine the sex ratio of juvenile Kemp's ridley on the Gulf Coast of Florida. During 2000, a hormone sexing technique for predicting the sex ratio in the juvenile population of Hawksbill sea turtles inhabiting Buck Island Reef and a population of Kemp's ridleys at Ten Thousand Islands, FL was used. Those data indicate female biased sex ratios in the juvenile populations. Further, the PI is continuing his collaboration with the National Marine Fisheries Service, Honolulu Laboratory, in estimating hatchling Hawaiian green sea turtle sex ratios on the French Frigate Shaols in the Hawaiian archipelago. Data from that project suggests relatively cool incubation temperatures in the nests of green sea turtles on the French Frigate Shoals.

In addition, Dr. Wibbels began collecting gonad tissue from hatchlings which were found dead in nests after all of the live hatchlings emerged. Tissue is currently being examined histologically to provide an additional method of verifying the sex ratios produced in specific nests. During 2000, a collaborative project was begun with the Seychelles Wildlife Department to study the sex ratios of Hawksbill sea turtles produced from nesting beaches in the Republic of the Seychelles.

***Recruitment Dynamics and the Effects of Environmental Variation on Early Growth and Survival of Important Estuarine Fishes (R/ER-39).*** 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 has been 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 two weeks of prior variation in physical conditions. It was decided that 148 additional specimens (not including 269 already processed) representing eight 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. Processing of these otoliths is progressing well. Techniques for reading and interpreting otoliths have been established and otolith reading is well underway. In addition, initial inspection of otoliths from lab-reared spot indicates the presence of daily otolith growth increments. These daily increments were not distinctive in otoliths from lab-reared croaker.

In spring 2000, USM Department of Coastal Sciences graduate student, Glenn Zapfe, started an ancillary research project addressing the effects of meteorological forcing and marsh inundation on feeding success and growth of the main target species, spot. Between late February and mid-May 2000, a Datasonde IV unit was deployed at the Ocean Springs study area. During this study period, thirteen fish collections were taken for stomach samples and four collections were taken for otolith analysis from two predetermined sites. Monitored relative changes in water level measured by the Datasonde were directly related to the point at which the water level reached the shoreline. The stomach samples were paired to reflect periods when the marsh edge was flooded versus periods when the water was pushed off the marsh edge. Accompanying benthic prey samples were also taken both within the marsh edge and away from the edge. Stomach analysis methods using a computerized visual analysis system have been devised to quantify whether fish were consuming more food at times when the marsh edge was flooded. Using information on fluctuations in water level in conjunction with the baseline established for when water reached the shoreline, the degree of marsh access during the six hour period prior to the collection of fish stomachs will be estimated and related to volume of food consumed. In addition, the growth histories of spot will be related to marsh access over much longer periods. The analysis of stomach, prey, and otolith samples is well underway for this project, which will provide the data for Zapfe's MS thesis.

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

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

The objectives of this project are 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. The investigators are at various stages in the process of purifying natural antifouling compounds 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 efforts have been concentrated on extracts of *Astropectin articulatus* and *Luidia clathrata*. Bioassay-guided purification of the *Astrocyclus caecilia* extracts has also begun. As expected, these assays have proved to be effective with very small quantities of extract and so have made true bioassay-guided purification possible. 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. Crude extracts of the crinoid *Comactinia* sp. and the asteroids *Narcissus tridonius, Asterias vulgaris,* and *Linckia* sp. have been prepared but have not yet been purified.

The investigators have been unable to obtain the asteroid *Goniaster tesselatus*, 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 and will be used in the coming year in order to collect data that will allow publication of the basic assay. A new postdoctoral student, Dr. Midel Beccero 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. As of February 2001, Dr. Beccero has been replaced with a laboratory technician who is experienced with invertebrate larvae and is anticipated to continue 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.

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

The purpose of this project is 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 has been spent on the evaluation of biological treatment of PAHs (polycyclic aromatic hydrocarbons) within a sediment sample received from New York Harbor. Results indicate that few PAH active organisms appear within the sediment. The PI has initiated development of seeding protocols for exotic organisms obtained from Dr. Lewis Brown of the Biological Sciences Department at Mississippi State University. Oxidation experiments continue with evidence indicating that the catalase reservoirs within the New York sediment is far greater than those encountered with up-land sediments. Estimation of hydrogen peroxide degradation has been completed. The extent of PAH oxidation is being analyzed. A second PAH contaminated sediment with hopefully more promising bacterial activity is being received from Wayne State University.

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

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

The objective of this project is to develop, based on structure-activity relationship data collected from the first and the second years of the project, the most active derivatives of puupehenone and sarcophine into pharmaceutical and agrichemical agents; based on *in* vitro bioassays to select the best candidates for *in vivo* and field studies, and to determine their pharmacokinetic properties to provide the best drug candidates and useful agrichemical agents.

In the third year of this project, the semi-synthetic modifications were focused on the confirmation of stereochemistry of 13-hydroxysarcophine (the main product obtained in the second year of the project by hydroxylation of sarcophine) and conjugate addition of sulfur nucleophiles to puupehenone in order to obtain biologically active compounds with reduced toxicity. The manuscript describing the PIs work on oxidation of sarcophine was sent to *Tetrahedron* for publication; however, a dispute with one of the reviewers of the manuscript prompted the PIs to do more work to provide additional arguments to confirm the stereochemistry of 13-hydroxysarcophine. All the additional testing indicated that the major product obtained at room temperature was identified beyond any doubt as 13S(β)-hydroxysarcophine.

Sarcophine derivatives obtained in selenium dioxide oxidation reactions were tested for activity as potential calcium channel blockers at Viatech Laboratories, Ivoryton, CT, a division of Cognetix Inc., Salt Lake City, UT. A manuscript publication is in preparation. 13S(β)-Hydroxysarcophine and its 4-chlorobenazoate derivative were sent to chemopreventive assays in Dr. Pezutto's laboratories at the University of Illinois in Chicago, as well as for activity against HIV-1, AIDS-OI, and other infectious diseases and cancer.

Puupehenone sulfide derivatives were tested for their cytotoxicity at the Natural 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 were shown to have a 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.

Temporary problems with the supply of marine organisms for chemical studies were encountered. These problems were related to the lack of sufficient funds for collection trips, but were solved by broadening the collaboration with scientists from Egypt and by collaboration within the Department of Pharmacognosy.

## *Education, Training, and Human Resources*

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

The objectives of this project are 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, twelve teachers representing ten of Mobile County's fifteen 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 the fall semester. The project has been extended through the spring semester, during which more than four hundred additional students are scheduled for participation. This will bring the total student count during the three project years to over twenty-two hundred.

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 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.

The development and maintenance of instructional resources to support project implementation was continued throughout the 2000 project year. Study stations were identified and interpretive materials developed to assist students and teachers in gathering data while engaged in field study activities. Project funds were applied to the maintenance of the following wildlife exhibits and natural areas used in the field trip activity plan: wetland aviary, deer run, raptor aviary, raccoon habitat, saltwater aquarium, bottomland nature trail, carnivorous plant bog and freshwater lake. (Over twenty-five species of birds and mammals and an abundance of marine fishes and invertebrates are housed and displayed in the live exhibits, while plants abound in the natural areas associated with the trails, bog and lake.)

During the training workshop held in August, each participating teacher was provided a resource materials kit to utilize in carrying out the classroom and field study objective outlined in the project's activity plan. The following items were included: abstract of proposal, curriculum unit plan, project administrative and logistics guidelines, relief map of Dog River watershed, copy of the Internet web site on the Dog River watershed, site maps of Environmental Studies Center (ESC), Key to Selected Trees of the ESC, Water Quality Factors for Fresh Water, Water Quality Indicators Guide, and assorted pamphlets and posters on wetlands and water quality. Refills for water quality test kits and soil testing supplies were also purchased and distributed to all project teachers for pre-field trip preparation of students, on-site sampling and post-trip analysis on return to the local school laboratory.

Because of a system-wide change in the high school scheduling format since submission of the original grant proposal, it was necessary to extend the project through July 31, 2001 to accommodate all students identified for inclusion in the project. The net result has been an increase in the number of field trip days to approximately twice the original estimate. Adjustments in the budget were requested and approved to successfully handle these changes.

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

This project is 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 will allow 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.

***Mississippi Sea Grant Extension Service** (A/O-9-MS).* C. David Veal, Mississippi State University.

The Coastal Research and Extension Center (CREC) is structured to provide education and outreach for Mississippi coastal residents regarding almost every aspect of the coastal environment—fisheries, seafood processing, aquaculture, wetland management, marine industry, recreation, economics and law. The aquaculture extension project provides economic, marketing and technical information on the major commercial aquaculture species which have potential in the Mississippi Gulf Coast. Economic analysis 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. http://msstate.edu/dept/crec/awmr.html

The public access to coastal Mississippi project 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 shrimp processing wastes disposal project provides 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.

Coastal Adopt-A-Stream Program - Beginning in August 1999, efforts to select and adopt several stream sites across coastal Mississippi was initiated 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 South Mississippi Environmental and Agricultural Coordination Organization (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 the Mississippi Sea Grant Extension Service 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 the development of 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 will be available for use in 2001. Both kits include the addition of test for nitrate and phosphate, as well as materials to test for fecal coliform bacteria. The tidal kit also includes a refractometer to measure salinity. Kits and materials will be 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. Gear research and technology transfer activities were continued 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. Staff developed gear testing protocols, participated in research cruises aboard industry vessels, conducted statistical analyses, and developed written reports regarding gear performance.

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

The objectives of this project are 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.

Direct assistance in response to individual seafood processors' needs for information and assistance was rendered on dozens of occasions during 2000. The depth of the requests responded to ranged from providing professional contacts or copies of scientific literature to delivering on-site scientific and technical services.

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. Continued assistant was provided to Blue Crab processors in relation to package labeling issues. On six occasions, the seafood technologist participated in monthly meetings of the Mobile Area Chamber of Commerce Seafood Task Force. Seafood processors were provided continued assistance in responding to the FDA's "untitled letters." A total of 102 industry and regulatory agency personnel received AFDO/Seafood HACCP Alliance Basic HACCP certificates.

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. Continuing support was provided to the Dog River Revival citizens group by assisting with meetings, contribution 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.

Additional activities included continuation of a Legacy sponsored project which provided a Mobile Bay field trip experience for 150 Mobile county school students and several other groups on board the Extension Program's 33 foot vessel. Grass Roots Inc. was assisted by arranging for 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.

The following accomplishments are representative of the overall Alabama Sea Grant Extension Program.

- 52 newspaper columns (estimated circulation 130,000)
- 2 Sea Harvest News (700 circulation)
- Cooperation and coordination with 20 organizations and agencies
- Personal contacts including telephone calls and mailings of materials with over 85,000 constituents
- Contact with approximately 2,000 citizens through presentations or meetings
- Distribution of numerous information pamphlets, information sheets or specially prepared materials

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

The project investigators continue to develop special capabilities to analyze the law and propose solutions to problems confronting managers and users in the Sea Grant constituency as well as state, regional, and national policy-makers. Expanding capabilities have led to an ever-increasing capacity to respond to the growing number of advisory, education and training requests related to coastal and marine resource issues from academic, governmental and other Sea Grant affiliated agencies and institutions.

Fletcher is developing the Fisheries Management portion of the Legal Program's Web site. The Fisheries Management page will serve as a one-stop location for members of the fisheries management community to access the following: updates on federal fisheries management policy and law including recent case law, regulations, and legislation; an Adobe Acrobat version of *Understanding Fisheries Management;* analysis of current fisheries statutes; and answers to "frequently asked questions" about U.S. fisheries management. The page is currently under construction and should be completed by May 2001.

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 reviews the United States' use of trade restrictions as a fundamental instrument of international fisheries and marine conservation policy. McLaughlin analyzes the most recent decisions of the WTO and suggests 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 is being 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 generates concern because it affects marine reserves and Essential Fish Habitat (EFH). Fletcher and Harris are using 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. From February of 2000 through January of 2001, the Legal Program provided research for 44 requests. The requests tend to be from the Gulf region but included 15 requests from outside of the five Gulf of Mexico states.

***Mississippi-Alabama Sea Grant Communications Program (M/PC-1).*** 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 have been 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.

The MASGC Web site has gone through several design changes during this period. Although the amount of information offered on the site has definitely grown, the user-friendliness of the design has not improved. Efforts are continuing to improve the design and functionality of this Web site.

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 to be 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.

## *Program Management*

Administrative projects develop the programmatic elements of the Mississippi-Alabama Sea Grant Consortium. These projects are entitled: ***Program Administration and Program Development.***

The MASGC Marine Science Scholars Program provided eight $5,000 awards to graduate students enrolled at member institutions. Funding for these awards came from sources other than federal funds.

The following projects were supported through Program Development funds:

***International Conference on Jellyfish Blooms: A Scientific and Societal Agenda*** *(A/O-28-PD).* William M. Graham, Dauphin Island Sea Lab. (07/01/99 - 06/30/00)

In response to growing concerns of jellyfish blooms as possible indicators of declining coastal ecosystem health, this international symposium brought together a variety of perspectives including those of scientists, federal, state, and local agency representatives, medical and clinical specialists, fisheries biologists and economists. In addition to presentations that stimulated cross-fertilization of ideas and conversations among these groups, an edited volume of peer-reviewed articles on the subject of jellyfish blooms will be produced. The meeting was held January 5-7, 2000 at Gulf Shores, Alabama on the Gulf of Mexico.

A delay in printing has been experienced with the publisher of the conference volume (Kluwer Academic in the Netherlands).

***New Initiatives in Resource Economics and Environmental Issues for the Alabama Sea Grant Extension Program*** *(A/O-29-PD)* Richard K. Wallace, Auburn University. (11/01/99 - 10/31/00)

Coastal communities in South Alabama are experiencing explosive growth, much of which is based on the attractions of a healthy marine ecosystem and the values derived from the system. An important factor in maintaining a productive marine ecosystem is good water quality. Good water quality can be maintained by controlling nonpoint source pollution through watershed management.

This project was initiated to assist in the hiring of two new positions—one in Resource Economics and one in Water Quality. The Water Quality position was filled with the hiring of Ms. Evaden Brantley; however, the PI was unable to fill the Resource Economics position.

Brantley assumed the role of facilitator for the Coastal Alabama Clean Water Partnership almost immediately upon being hired. The Coastal Alabama Clean Water Partnership focuses on identifying projects that will improve water quality in local streams, especially those streams listed as impaired (the 303(d) list) by the Alabama Department of Environmental Management (ADEM). Because there are 45 sub-watersheds located in the Escatawpa, Mobile, and Perdido watersheds, the Steering Committee selected a few sub-watersheds on which to focus.

The Steering Committee considered available information compiled by Brantley from the Soil and Water Conservation District's Conservation Needs Assessment, the ADEM 303(d) list, and best professional judgment to select 'focus sub-watersheds.' The three Escatawpa focus sub-watersheds are Upper Big Creek, Lower Big Creek, and the Upper Escatawpa. Six focus sub-watersheds were selected from the Mobile watershed: Chickasaw, Three Mile Creek, Halls Mill Creek, Fish River, Magnolia River, and Bon Secour. The three focus sub-watersheds chosen from the Perdido watershed are Wolf Creek/Miflin, Blackwater, and Soldier Creek.

Brantley is working with many established watershed groups, assisting fledgling groups, meeting with local municipalities, and meeting with local landowners to help in the identification of projects. Once projects have been identified and submitted to the Steering Committee, they will be prioritized and funding will be sought to implement the projects.

Examples of presentations given include: Alabama Water Watch Basic Training workshops, 'Nonpoint Source Pollution Tips' to the Tri-County Master Gardeners Annual Meeting, 'Polluted Runoff and Your Role' to the National Association of Retired Federal Employees, 'Polluted Runoff' to the Fairhope Optimist Club, 'Extension's Role in Watershed Planning' to the Southern Water Quality Extension Specialists, 'Coastal Alabama Clean Water Partnership' to the Coastal Extension Agents Workshop, 'Watershed Protection' to the Alabama Rivers Alliance Annual Conference, and 'Protecting Waters from Sediment' to the Alabama Code Officials Annual Conference.

***Project Marine Discovery: Teachers' Minicamp for Natural Coastal Hazards—Pilot*** *(E/O-72-PD).* Howard D. Walters, The University of Southern Mississippi. (09/01/00 - 08/31/01)

This project was initiated in order to develop and pilot a two-day hands-on workshop for inservice teachers to increase their content knowledge for natural coastal hazards; to incorporate pedagogical skills and activities to increase the potential that these participants will incorporate these content areas into their classroom instruction; to incorporate previously developed online resources from the Sea Grant HazNet program; and to develop a "template" for an additional series of workshops on this topic for which the investigator is seeking separate funding.

These objectives were realized by planning and implementing a two-day teacher minicamp at the J.L. Scott Marine Education center and Aquarium at the University of Southern Mississippi's College of Marine Sciences. Eighteen teachers from elementary and middle schools in Mississippi and Alabama received instruction and enhanced technological capabilities in the content area of natural coastal hazards, as this topic was delineated in the National Sea Grant College Program's strategic plan. This pilot effort extended the activities of a previously funded Sea Grant effort, Sea Grant HazNet.

***Dean's Research Initiative: Comparison of Organochlorine Contaminant Levels in Yellow Blotched Map Turtle Adults and Eggs From Polluted and Non-polluted Sites in the Lower Pascagoula River Drainage*** ***(R/ER-48-PD).*** Mary T. Mendonca, Auburn University. (08/01/99 - 07/31/00)

In order to promote research in the College of Sciences and Mathematics (COSAM) at Auburn University, the Office of the Dean has initiated a program to provide research support to COSAM faculty members. For those proposals in marine science, MASGC is also supporting this initiative by matching the Auburn funds on a 1:1 basis.

This project was funded by Auburn for $3,500 with an additional $3,500 being provided by MASGC. Support is requested for contaminant analyses on adults and eggs of yellow blotched map turtles from polluted and non-polluted sites in the Lower Pascagoula River Drainage area. These analyses will provide supporting evidence for previously collected data on sexual dimorphism in contaminant effects and hormonal changes in adult turtles.

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

Working in conjunction with a Georgia Sea Grant project by Dr. Steven C. Pennings, Dr. Brewer will attempt to evaluate whether the responses to nutrient addition are general between areas of different salinity, between geographic regions, and between estuaries that differ in their degree of urbanization. Preliminary results suggest that such generalization is only partially possible; however, preliminary experiments did not standardize for differences in salinity or nutrient status of different sites. 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. 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 and Phillip (Pete) O. Melby, Mississippi State University. (07/01/00 - 06/30/01)

This study is an effort to see whether an alternative exists to the intensive mechanized maintenance of the 42 km man-made beach. The end result of the proposed work, if conducted as anticipated, will be a completed upper and mid-beach planted site. This project is supported by the Biloxi Bay Chamber of Commerce and the Harrison County Board of Supervisors.

One area of the beach was initially worked on in 1995. At that time, a storm drain was replaced with a more natural appearing drainage system; a salt marsh was created at the edge of the beach using

emergent vegetation, and native plants were planted on the upper and mid-beach. By 1997, the site had become strikingly attractive; however, after Hurricane Georges in 1998, although the root mass in much of the planted area appeared to be largely intact, ironically, the site was seriously damaged by the clean-up which followed the hurricane. Heavy equipment used to clean the beach scraped a large portion of the site nearly clear.

A drip irrigation system has been installed and the site has been planted with 2000 sea oats. Three stands of Salt Marsh Hay, *Spartina patens*, native to beach fronts in the Gulf south were noted. Two of these stands were not planted by this team and it is suspected that the plants were washed to this area during Hurricane Georges and were not raked up during the hurricane clean-up operation. Seeds collected from these stands have been given to the team horticulturist to see if plants can be grown from the seed. A marsh pool has been constructed and sculpted. Members of the Loggerhead Club from the J.L. Scott Marine Education Center and Aquarium planted Bitter Panic Grass along the pool edge. A site technician (part-time) will oversee site maintenance and nurturing.

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

The objective of this project is to determine the effect of nutrient enrichment on the structure and function of essential seagrass habitat and to develop a $^{15}$N-labeling protocol for assessing the impacts of eutrophication on seagrass habitats. The proposed field study will be conducted in the seagrass beds of the north side of Horn Island, MS. The study consists of enriching seagrass beds at 3 nutrient levels and using 3 enrichment targets. The enrichment levels included addition of 12 lb. (high enrichment level), 3 lb. (low enrichment), and 0 lb. (no enrichment = control) to natural and artificial seagrass beds (27 total beds). The fertilizer to be used in the low enrichment treatment contains a known stable isotope ratio of nitrogen and will serve as a tracer for nitrogen in the food web. In natural beds, the fertilizer will be added to the seagrass community. Samples will be collected from the beds after three and five weeks of exposure to nutrient enrichment.

***Analysis of Habitat Use by Intercontinental Bird Migrants Along the Northern Coast of the Gulf of Mexico: A Scale Dependent Approach (R/LR-47-PD).*** Frank R. Moore, The University of Southern Mississippi. (09/01/99 - 08/31/00)

The long-distance movements and biology of migratory birds during stopover has generated considerable interest in recent years, in no small part because of threats to their populations. Although reports of drastic declines for the group as a whole are exaggerated, some migrant land birds are showing long-term population declines. Decline in populations has been attributed to events on the wintering grounds, fragmentation of breeding habitat, and to changes in the suitability of enroute (stopover) habitat. Few migratory birds engage in nonstop flights between points of origin and destination, rather they stopover periodically for a few hours or a few days before resuming migratory flight. Consequently, factors associated with the stopover ecology of migrants must figure in any analysis of population change and in the development of a comprehensive conservation "strategy" for land bird migrants.

This project centered on two important themes: (1) Development of effective conservation strategies for migratory birds depends on understanding the use and distribution of habitats available to migrants during passage. This issue is particularly critical in coastal areas where migrants must negotiate geographical barriers to continue their migratory movements and where human activity is causing the rapid loss of suitable stopover habitat. (2) A full understanding of the relationship between migrants and

stopover habitat is only possible through research designed to reflect the hierarchy of spatial scales across which migrant-habitat interactions occur.

The initiation of logistical set-up for Gulf coast research in Louisiana, Mississippi, and Alabama has been accomplished. The development and submission of three complementary research proposals has resulted from this seed project. This project allowed two doctoral students to explore the feasibility of conducting research across a range of spatial scales.

Jeff Buler is a new doctoral student recruited under this grant. His proposed dissertation research seeks to understand the behavior of individual migrants in relation to habitat availability and suitability across the landscape. Buler has been awarded a Mississippi Space Commerce Initiative (MSCI) Fellowship to support his research.

Sarah Mabey is in the last year of her doctorate under Dr. Moore's mentorship and has proposed postdoctoral research addressing conservation planning based on the spatial and temporal distribution patterns of migrants on a regional scale. Mabey has been awarded a Smith Postdoctoral Research Fellowship from The Nature Conservancy and will conduct her research under the mentorship of Dr. Theodore R. Simons, U.S. Geological Survey, Cooperative Fish and Wildlife Research Unit, North Carolina State University and Dr. Sidney A. Gauthreaux, Jr., Department of Biological Sciences, Clemson University.

A third research proposal designed to identify the geographic and temporal pattern of songbird stopover along the Gulf coast of Mississippi during spring and fall migration has been submitted through the Coastal Assistance Impact Program (CIAP). The geographic scope of the project extends across the three coastal counties of Mississippi from the Pascagoula River basin on the east to the Pearl River basin on the west. This region includes important ecological features (e.g., high concentrations of migratory birds, bottomland hardwood forests) and dramatic changes in the landscape as a result of development.

***Movement and Habitat Use of Gulf Sturgeon* (Acipenser oxyrinchus desotoi) *in Mississippi Coastal Waters* (R/LR-48-PD).** Stephen T. Ross, The University of Southern Mississippi. (10/01/99 - 09/30/00)

The goal of this project was to initiate studies of the marine component of Gulf sturgeon biology. The work had two major objectives. First, to determine movement and habitat use of 14 sonic-tagged Gulf sturgeon in coastal waters of Mississippi and adjoining regions. Prior to the initiation of this project, these Gulf sturgeon were tagged with sonic transmitters. The second objective was to attach an additional 15 sonic tags to Gulf sturgeon captured during the spring and summer of 2000. These fish will move into coastal waters in fall and winter of 2000-2001.

Of the 14 original tagged Gulf sturgeon, three remained in the Bouie River into January/February of 2000 and were thus not available for tracking in coastal waters in 1999. To date (October 2000), 15 relocations for nine of these tagged fish have been recorded. Several fish were located on repeated occasions and showed rather extensive movements. The substratum in these locations was primarily coarse sand with shell fragments.

Fifteen ultrasonic transmitters were purchased and attached to Gulf sturgeon during the period from March to May 2000. At present, all of these fish are still in fresh water. Tracking in coastal waters will resume as soon as these fish move from the summer holding area in the Pascagoula River out into salt water.

***Dean's Research Initiative: Carbonic Anhydrase Induction as a Model System for Environmentally Mediated Gene Expression*** ***(R/LR-49-PD).*** Raymond P. Henry, Auburn University. (04/01/00 - 03/31/01)

Environmentally mediated carbonic anhydrase (CA) induction, the increase in CA activity in ion transporting epithelial tissues in response to an externally applied salt stress, will be used to study the fundamental mechanisms of how organisms and cells interpret environmental signals and transduce them into selective gene expression. The primary experimental goal of this initiative will be to purify and obtain the primary sequence of two CA isoforms, cytoplasmic CA, which is the inducible fraction, and membrane-associated CA, which is constitutively expressed. Primary sequence data will be used to design gene-specific primers for RT-PCR in order to study the expression of the CA message (mRNA). This will answer a fundamental question on the regulation of CA induction: whether the increase in CA activity is controlled at the transcriptional or translational level.

***Ballast Water Treatment and Management: Acoustic Screen Filtration for Control of Non-indigenous Species in Ballast Water*** ***(R/MT-44-PD).*** J. Robert Woolsey, The University of Mississippi. (05/01/00 - 04/30/01)

To date, no methods or technologies have been found which provide viable, cost-effective solutions to the problem of the introduction of nonindigenous species to coastal waters, estuaries, rivers and lakes through the expulsion of ballast water. This project offers a potential solution based on techniques under development for high volume, micron screening of waste water, charged with suspended organic particles and microorganisms. The current research project is a cooperative endeavor under the direction of the Center for Marine Resources and Environmental Technology (CMRET), The University of Mississippi (The University of Mississippi), and involving the Moscow State Mining University (MSMU) of Moscow, Russia, and an industry partner providing financial support, Stewart Water Solutions, Inc. (SWS) of Woodstock, Georgia. Treatment concepts for the waste water project have somewhat similar constraints to those of the ballast water studies; i.e., requiring efficient screening and effective biocides with no significant residual effects which might further impact recycling or return to the environment.

A second cooperative partnership has recently been established with the Physical Electronics Research Institute (PERI) at Old Dominion University, Norfolk, Virginia. Under this agreement, the CMRET team would set up a prototype filter system, suitable for scale-up, at a ballast water test facility in Norfolk, operated in cooperation with the Center for Advanced Ship Repair and Maintenance (CASRM) at Old Dominion. The plan is to filter a typical batch of ballast water to about 20 microns which will then be subjected to various electrical pulsed plasma techniques developed and administered by the PERI. It is the general intent of this cooperative effort to provide the experience and expertise of the CMRET and PERI teams in the pursuit of an effective solution to the ballast water problem. The specific objective of this proposal is to provide a prototype filter for ballast water tests.

Modifications were made to the basic Acoustic Screen Filter (ASF) prototype test unit which included the installation of a 20-micron screen. In late July 2000, the ASF was transported to Old Dominion University (ODU) and seawater tests were commenced on August 1. Two tests were conducted in which 500 gallons (per test) were passed through the ASF. Water was introduced to the ASF at an approximate rate of 50 gallons per minute. In each test, water samples were taken at 50-gallon intervals both at the clean water and screen concentrate outlets. Test results proved very promising. Several tests, including 5-day BOD and microscopic analyses indicated that the ASF had successfully removed greater than 95percent of all organic matter including living organisms. This was accomplished with no fouling of the ASF screen. Plans are for the ODU team to continue with various tests.

***Room Temperature Ionic Liquids as Benign Solvents for Extraction of Astaxanthin and Solubilization of Chitin*** *(R/MT-45-PD).* Robin D. Rogers, The University of Alabama. (03/01/00 - 02/28/01)

The objectives of this project are to develop an extraction method for astaxanthin from shellfish shells using room temperature ionic liquids (RTIL), dissolving the chitin in RTIL, and derivatizing chitin to form chitosan and other useful derivatives using the chitin in the RTIL and after contact with the RTIL. Currently chitin is the world's second most abundant biopolymer, behind cellulose; yet the chemistry of this compound is poorly explored due to its insolubility in conventional solvents. The current methods for the dissolution and modification of chitin use compounds that are corrosive and are not environmentally friendly. The purpose of this project was to find a low cost, environmentally friendly alternative to the current technologies.

Currently, astaxanthin is used as a food additive to give foods a reddish color. By removing the astaxanthin and other compounds from the chitin, a one step procedure can be made to replace the currently used three step process. During the course of this project, several ionic liquids were demonstrated to extract astaxanthin from the processed shrimp shells leaving behind a clean white chitin.

In a different experiment, the chitin showed a high degree of swelling when placed in contact with the ionic liquid. This swelling can allow the astaxanthin and other proteins that are held in the polymer matrix of chitin to be released into the ionic liquid. The dissolution of chitin would make handling the polymer easier and molding it into different forms feasible. It would also allow for more complete reactions to occur between the chitin and reagents. Several ionic liquids tested will swell the chitin, and ionic liquids will slightly dissolve chitin.

The PI has demonstrated that ionic liquids can be used in the shellfish industry to replace the harmful and corrosive techniques used to date. By changing the ionic liquid, various chemistry can be performed on the chitin, from extraction of proteins and swelling of the polymer matrix to the derivatization of chitin to chitosan. Ionic liquids can provide a unique environment for reaction that previously was thought to be impossible or inefficient while providing an environmentally friendly setting. This project thus brings to bear the promise of new 'green' solvents to the utilization of shellfish waste. Successful development of RTIL specifically designed for extraction and processing of chitin would lead to value-added products from what are currently resource-draining wastes.

PG Research Foundation, Inc., Darien, IL is providing support in preparation of patents regarding the swelling, decolorization and derivatization of chitin using room temperature ionic liquids.

***Mississippi-Alabama Sea Grant Legal Program - Program Development Project*** *(R/SL-12-PD).* Kristen M. Fletcher, Tammy Shaw, Richard J. McLaughlin, and William Hooper, Jr., The University of Mississippi. (09/01/99 - 08/31/00)

This program development project allowed the Legal Program to focus additional resources on outreach activities across Mississippi and Alabama and to contribute valuable research in the emerging marine habitat policy field.

In 1999, the Mississippi Department of Marine Resources (DMR) requested the assistance of the Legal Program in various aspects of the development of the Comprehensive Resource Management Plan (CRMP), an effort by DMR, NOAA, developers, researchers, and environmentalists to address the environmental needs arising from the growth and development occurring on the Mississippi Gulf Coast. The Legal Program assisted the CRMP Team in the development of a storm water management program for the coast, including the creation of storm water management districts in coastal counties. Fletcher

contributed a legal analysis of the EPA requirements under the Clean Water Act and the National Pollutant Discharge Elimination System Phase II municipal storm water permit program and state statutes regarding water management districts which may be able to address these requirements. The Legal Program also assisted Jay Charland of the DMR in writing the proposed Storm Water Management District Charter which can now be used by counties or municipalities to create such a management district.

The General Manager of the Grand Bay National Estuarine Research Reserve (NERR) requested that the Sea Grant Legal Program conduct research into the possibility, procedures and implication of seeking listing on the National Register of Historic Places for shell middens and associated cultural resources located within the Grand Bay NERR. The research conducted by Fletcher and Shaw indicates that the Mississippi Department of Archives and History offers a Review and Compliance Assessment of each individual site proposal which would specify what kinds of research and work would be allowed within the estuary should it be listed on the National Register. The Legal Program has forwarded this information to the NERR Manager who plans to present this information to his management team for future consideration.

The Legal Program assisted the Center for Water and Wetland Resources at The University of Mississippi in the planning and execution of the Sustainability of Wetlands and Water Resources Conference, an international conference held in May of 2000. The conference used a cross-disciplinary format for educators, scientists, and general researchers to focus on recent work in wetlands research and a view toward understanding wetland processes in a watershed context. The Legal Program was responsible for creating and executing a legal panel entitled *A Legal Primer: An Introduction to Wetlands Law and Regulation and its Practical Impacts.* Fletcher also submitted two papers to the Conference Proceedings Volume. Participation in the conference and preparation of the proceedings led to an offer by Island Press to publish a book covering the myriad topics addressed at the conference. Fletcher is preparing a chapter for this book providing a detailed overview of U.S. wetlands law. The book is scheduled for publication in late 2001 or early 2002.

In response to the increasing number of questions surrounding the Essential Fish Habitat mandate under the 1996 Sustainable Fisheries Act, the Legal Program undertook a research effort that resulted in the publication of *Essential Fish Habitat: Does Calling it Essential Make it So?*, published in March 2000 in the *Environmental Law Review.* The Legal Program has distributed over 100 copies of the article to interested members of coastal management communities both nationally and internationally and has yielded significant dialogue between the Legal Program and a wide variety of stakeholders. In addition, Fletcher has made presentations of EFH at five conferences during 2000, including chairing the EFH Panel at The Coastal Society conference. The Legal Program will continue this work as EFH is implemented and more attention is given to marine habitat on a national level.

In 1994, Richard K. Wallace, William Hosking, and Stephen T. Szedlmayer of the Alabama Sea Grant Extension Program published *Fisheries Management for Fishermen: A Manual for Helping Fishermen Understand the Federal Management Process.* The publication, produced with the assistance of Sea Grant support, was a highly successful means of informing individuals in the fishing community of the regulatory process that plays a significant role in their lives and livelihoods. In 1999, discussions were held between Sea Grant Legal Program investigators and Dr. Wallace, in conjunction with requests from the public for new information indicating the desire and demand for revising the book in light of the significant re-shaping of the federal fishery management process since 1994. Legal Program researchers took the lead in conducting substantial research and review to revise the book, consulting with Dr. Wallace on key issues. The revised book, *Understanding Fisheries Management* was published in March 2001

# *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 include increasing 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. This project began December 1, 2000.

During the first half of year one, the PI will visit high schools and middle schools to deliver seminars, distribute marine science brochures and present videos to the students in order to stimulate their interests in ocean sciences.

## *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

The objective of this proposal is 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.

A total of 7,200 hatchery produced oyster seed (3,600 set on shell and 3,00 set on micro-cultch), divided into three size groups (≤5-14mm, 15-24mm and >25mm), were planted at two sites in replicated plots during September 2000. Temperature, salinity, and oxygen were monitored continuously at both sites. Low dissolved oxygen events were absent and both sites had similar temperature and oxygen levels. After six weeks, almost all oysters, regardless of size or location, were dead. Predation controls held in protective bags suffered 20-70percent mortality. Oyster drills were prevalent on the plots and the protective bags.

Oyster seed set on whole shell and on micro-cultch were exposed to oyster drills under laboratory conditions (temperature: 20.3 - 21.6 °C, salinity: 23.3 - 25.2 ppt and dissolved oxygen: 6.9 - 7.9 ppm). Oyster drills ate more large (> 25mm) seed set on micro-cultch than the other two size classes (≤ 15 mm and 16-25 mm) and than seed set on whole shell. When seed set only on whole shell was exposed to oyster drills, drills ate more of the largest size class. A similar study using blue crabs resulted in more medium and small oysters being consumed than the largest size class and more oysters set on micro-cultch were consumed than those set on whole shell. Temperature, salinity, and dissolved oxygen during the experiments were 21.8-22.9 °C, 26.3 - 26.9 ppt and 6.41 - 6.97 ppm, respectively. Survivorship of the three size classes when exposed to hypoxic conditions in a series of laboratory tests (temperature: 26.7 – 31.1 °C, salinity: 14.7-15.6 ppt and dissolved oxygen 0.01- 0.23 ppm) ranged from 100percent after 72 hrs to 0percent after 144 hrs. The mean estimated LT-50's for the three size classes ranged from 93 hours to 100 hours with no apparent relation between size and survival.

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 week 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, (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.

The major objectives of this project are to perform sensory evaluation of irradiated and raw oysters using triangle test, as well as evaluate consumer acceptance and attitudes towards irradiated oysters. 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. Dr. Veal became Principal Investigator on the project until such time as a new Fisheries Food Scientist could be hired. Dr. Veal requested and was granted a one-year no-cost extension on the project. The new closing date for this project is September 30, 2001.

***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).* Custodio Fernandes, Mississippi State University.

The overall goal of the project is transferring and adapting existing technology to the harvesting of Gulf oysters with hydraulic dredging equipment. Operational parameters will be optimized, including vessel operational parameters. 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. A one-year no-cost extension was requested and granted. The new closing date for this project is September 30, 2001.

Dr. John Supan, Louisiana State University, conducted a site visit with the industry cooperator, Mr. Jordan Bradford. After seeing the status of the equipment to be used and reviewing the Fernandez proposal, Dr. Supan felt confident he could take over the project and finish it as proposed. Mr. Bradford agreed to provide the in-kind support at the previously budgeted amount.

***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. The design will be a step-by-step collection of information from scientific journals, official methods/procedures, technical bulletins. These sources will be accessed through library collections and accessing databases including Science Citation Index, Agricola, Medline, Biological Abstracts, and others. This project began October 1, 1999 with a

closing date of September 30, 2000; however, the PI requested and was granted a nine-month no-cost extension. The new closing date for the project is June 30, 2001. Approximately 200 refereed journal articles have been collected and are in the process of being summarized.

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

The overall goal of this project is to investigate the development of markets based on consumer characteristics and preferences that affect the consumption and marketing of oysters. The specific objectives are to investigate the characteristics that influence regional variations in the consumption of oysters; to evaluate the effects of source of supply of oysters upon consumption; to evaluate the effects of the HACCP-based seafood inspection system on oyster consumption; and to use the results obtained to develop the criteria for potential market segments. This two year project began October 1, 1999.

The first year of the project included survey design, send-out, and data collection. The survey, which involved the use of focus groups in separate geographical regions of the U.S. (one each in Orangeburg, SC, Starkville, MS, and Manhattan, KS) has been completed. These focus groups were critical in developing a survey instrument focusing on both consumer and non-consumer aspects of oyster consumption. Focus group results and a review of the literature were incorporated into a completed survey having a nation-wide focus. The draft survey was pre-tested and revisions made to ensure the "2000 Survey of American Seafood Consumption" would be comprehensible and achieve its intended objectives.

A delay was experienced when a graduate student working on the project decided to change his major. This left a void which cost loss of time in survey development. Another delay was caused when it was determined that the Mississippi State University telephone survey service would not be able to conduct the survey until January 2001, causing the PI to redirect efforts toward a mail-out survey. A company specializing in nationwide addresses was found and a set of 4,500 random U.S. addresses was purchased. Survey databases have been set up to facilitate data entry.

# Appendix H

# 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.

Oyster tissues of gill and gonads were collected and RNA was isolated. Two gene libraries have been made. These cDNA gene libraries have been made and represent a whole collection of all expressed genes in the gill and in the gonad. In addition to the planned objectives, sequencing analysis to identify the genes and characterize gene sequence domains has been started. Such sequencing analysis may also produce single nucleotide polymorphisms that are useful for gene mapping of oysters. The PIs will continue the sequencing of expressed sequence tags (ESTs). After ESTs are sequenced, microarray technology to identify differentially expressed genes will be used. The gene library construction was successful with the two important indicators: the insert size and the number of primary recombinant clones. Both of the libraries are of high quality and that is, by far, most important to obtaining great sequencing results.

**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 (approximately 1g) has been isolated from *Hyrtios* sponges collected earlier in Hawaii. This amount of natural product will allow the PIs to work on chemical modification of puupehenone for about one year. After that, another collection will be necessary. To prepare the proper conditions for combinatorial synthesis of sulfur adducts, the reaction of puupehenone with ethanthiol as the model reaction was studied. It was found that the addition product is not stable without protection of catechol function, and it has to be converted to corresponding diacetate. Also studied was the oxidation of the obtained ethanthiol adduct to corresponding quinine-methide using various oxidation agents

including air, benzoquinone and DDQ. In all studied cases, the PIs observed the oxidation of catechol function to quinine-methide moiety, accompanied with co-oxidation on sulfur with subsequent elimination of substituent from the carbon C-15. This unwanted phenomenon prompted the researchers to change the condition of oxidation to avoid the sulfur oxidation. Considering a possibility that puupehenone may act as a radical scavenger, the PIs are currently examining the radical reagents such as DPPH for the purpose for this reaction. One the conditions for re-oxidation of catechol to quinine-methide moiety in puupehenone sulfur adducts is established, the combinatorial synthesis of its analogs will be pursued according to the project schedule.

## *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 one-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 rapid real-time PCR amplification detection of pathogenic *V. parahaemolyticus* O3:K6 and *V. vulnificus* using ORF8 and *cth* as the templates, respectively, has been developed. The real time PCR amplification was optimized in a Cepheid Smart Cycler™ using SYBR™ green fluorescent dye in the PCR reaction. Further, the detection of these pathogens was optimized on Gulf water by processing the samples with commercially available kits such as Bio101™ and MoBio™. These kits are developed for DNA purification from soil and sediment that seem appropriate for the Gulf water samples. Alternatively, the samples were processed simply by boiling with Chelex™ 100 after concentrating by centrifugation, and an aliquot was subjected to PCR amplification for real time detection of these pathogens. Among these three procedures, boilng with Chelex™ 100 approach provided the highest sensitivity of detection of $10^2$ cells of each of these pathogens per 100 ml of Gulf water. At this time, two manuscripts are being prepared for publication of this data in peer-reviewed journals.

A multiplex PCR-based detection of total (genus) and clinical (pathogenic) *V. vulnificus* has been developed. Oligonucleotide primers from a segment of the *viuβ* was selected and tested to ensure the specificity of the primers and their target gene for the detection of a majority of the clinical isolates. Then a multiplex PCR amplification reaction was optimized for the detection of total (genus) and clinical (pathogenic) strains of this pathogen using oligonucleotide primers specific for the *cth* and the *viuβ* respectively. This multiplex PCR approach is being tested on Gulf waters and oyster tissue homogenate for a simultaneous detection of total (genus) and clinical (pathogenic) *V. vulnificus*. A manuscript is being prepared for publication of this data in a peer-reviewed journal.

**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. The initial activities of the project included obtaining supplies, hiring a graduate student to conduct the research, sourcing broodstock from the wild and rearing juveniles for the research.

For the maturation component of the project, broodstock have been collected from the wild, acclimated to controlled spawning conditions, and are currently being conditioned with the first set of test diets. To determine nutritional requirements of juvenile red snapper, a semi-closed recirculation system has been built to conduct nutrition research with juveniles. The first series of diets have been formulated and two growth trials have been initiated.

**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. Currently, there are a few farms within the United States that produce shrimp in low salinity inland water. Information from these farms is largely anecdotal, but they indicate that good growth rates and acceptable production can be obtained. Several different inland saltwater sources have been identified in Alabama, and marine shrimp have been successfully cultured in several areas in Alabama. However, variable results indicate there is a need to evaluate the influence of water sources and evaluate nursery techniques. Consequently, this research is geared to cover a wide variety of problems centering around acclimation and nursery systems and their influence on production.

A variety of well water sources have been tested using 48 hour bio-assays with results ranging from 100% mortality to near 100% survival. These results confirm the influence of water sources on survival. In addition to these studies, the influence of various nursery parameters (e.g. nursery length and stocking density) are being evaluated to determine their effects on pond production. Pond production trials are currently under way and scheduled for harvest in late October.

**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.

Extensive sampling for juvenile spotted seatrout was conducted throughout September. This was determined to be the optimal month for sampling of juveniles after examining historical records of spotted seatrout catches in beach seine and hand-pulled Beam trawl collections. Past records have shown that spotted seatrout juveniles are relatively difficult to collect, but so far the researchers have had some great success collecting juveniles in many watersheds. To date, juveniles have been collected from Grand Bay, the mouth of the Pascagoula River, Biloxi Bay, Horn Island, St. Louis Bay, Cat Island, the Louisiana marshes south of St. Louis Bay, and the mouth of the Pearl River. Juveniles still need to be collected from Chandeleur Sound. All fish have been frozen and preparation of otoliths is about to begin. Two visits have been made to the facilities at Louisiana State University to learn techniques from colleagues who are currently conducting otolith microchemistry studies of red snapper.

## *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 (RFWF) assay.

Combining EDC-exposed fish for breeding experiments may result in a smaller measured effect on reproductive endpoints compared to experiments with individual fish because in the group "good performers" may compensate for the deficiency of "bad performers". The use of reproductive data collected on individual fish may thus lead to an overestimation of the predicted effects on reproductive impairment of fish exposed to EDCs in the field. To answer this question, the PI has exposed male medaka fish to the estrogenic chemical, octylphenol for three weeks and examined egg production, fertilization rate, percent hatching and percent larval survival of breeding groups composed of 1, 2, 3, 5, and 10 exposed males and control females in a 1:1 ratio. The data are in the process of being analyzed.

Attempts to establish a liver cell line from the sheepshead minnow *C. variegatus* were initiated in September.

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. Fish have been transferred to grow-out to examine percent sex reversal once the fish are sexually matured.

**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.

The timing of movement of Gulf sturgeon out of the Pascagoula River into the Mississippi Sound generally begins in October and extends into January. Most Gulf sturgeon migrate out of the summer holding area between September and November when water temperatures drop below 23 to 25 C and there are accompanying pulses in river discharge. Both water temperature and river discharge may be important cues for sturgeon to migrate out of the Pascagoula River.

Once Gulf sturgeon leave the Pascagoula estuary, they tend to locate in or near the barrier island passes. Fish move both east and west, with telemetry recoveries for fish tagged in the Pascagoula River as far east as Dauphin Island and as far west as Cat Island and eastern Lake Ponchartrain. Habitats used by Gulf sturgeon in the vicinity of the barrier islands generally consisted of a clean san substratum and averaged 4.2 m deep. Bottom samples routinely contained numerous lancelets (*Branchiostoma*). Inshore relocations in the Mississippi Sound all had a mud substratum and averaged 2 m deep. Gulf sturgeon leave barrier island habitats in the spring to either return ro fresh water or move elsewhere in salt water as not all sturgeon return to freshwater each year. Efforts to locate Gulf sturgeon in the Gulf of Mexico during the summer have thus far been unsuccessful.

Studies on Gulf sturgeon in Mississippi show that they ascend the Pascagoula River in the spring, with some fish moving up to the Bouie River spawning grounds and others moving only to the Pascagoula River in the vicinity of Big Black Creek (the summer holding area). In addition, several fish have moved upstream into the Chickasawhay River. Gulf sturgeon generally move out of freshwater from November to December, coincident with water temperatures falling below 23 C and pulses of higher stream discharge. Important marine habitats include the barrier island passes. These findings demonstrate the importance of free flowing rivers for Gulf sturgeon and the association of suitable, adjacent marine habitat.

## *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.

This project involves both teachers and students in inquiry-based, investigative, hands-on learning about wetland environments and their importance in the natural environment of coastal Alabama. The project will be conducted over a three-year period, with over 100 teachers and some 2,000 students in grades K-3. For the 2001 project year, 37 teachers were recruited from 18 elementary schools to serve as the first year's participants. Planning was conducted during the summer of 2001 for the teacher training workshop scheduled for the beginning of the 2001-2002 school year. Development and assembly of

project resource materials, supplies and equipment were also initiated during the summer to support the teacher training and student field study scheduled to begin in the fall.

On September 18, the workshop was conducted at the Environmental Studies Center (ESC) for the 37 teachers identified earlier as project participants for 2001. Training and scheduling was completed for each teacher to bring his or her class to the ESC for a field trip focusing on wetlands. Teaching materials were distributed to each participant for use in pre- and post-field trip instruction. The first of 19 student field trips is scheduled for October 18, with the last trip coming on April 26.

## *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 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.

Sea Grant Extension Program personnel continue their work 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 consists of one-on-one dockside visits and demonstrations in small "town hall" type meetings. Details are also provided through office visits by commercial fishermen and news releases. Information regarding TED and BRD regulations, design and availability is also distributed through a network of regional marine suppliers. Program specialists go dockside to visit with shrimpers and to demonstrate how to choose, install, and correctly fish with TEDs and BRDs in order to minimize shrimp loss.

A one-day continuing education course for Realtors that focuses on explaining wetland issues was arranged and conducted. Arrangements have been made for expansion of this program to include a course on septic systems and environmental landscaping (i.e., the use of native plants). These courses are designed to address the issues and concerns of Realtors about each topic area and have two overall goals: 1) providing factual information about each issue that eliminates myths and misinformation about these oftentimes controversial topics, and 2) providing Realtors with instruction on what can and cannot be done and the processes they must follow to accomplish thrir jobs. Courses are coordinated with and taught using other extension specialists and personnel from appropriate state agencies. These courses are conducted through the West Gulf Coast Association of Realtors, with approval for credit from the Mississippi real Estate Commission. Three of these courses have been taught during the time period of February-October 2001.

Extension specialists have taken the lead role in forming the South Mississippi Enviromental and Agricultural Coordination Organization (SMEACO). SMEACO is a loose-knit organization of personnel from locak, state, and federal agencies and representatives from the private sector whose mandate is the consideration of environmental and agricultural topics. The purpose of this organization is the exchange of information on these issues in order to foster better communication and coordination of efforts. This organization meets on a quarterly basis to share information about members' programs and activities. Several educational programs have benefited directly from the existence of this organization, largely in terms of providing a pool of experts in several areas that can be called upon for advice or used in more formal circumstances. Three meetings have been held during the February-October 2001 time period.

Staff members regularly appear on local television programs, news programs, and before civic groups to discuss topics ranging from recreational soft-shell crabbing to fishery regulations and to promote the Sea Grant concept of research, education, and extension. Over 600 households receive the monthly newsletter, *Gulf Coast Fisherman.* The major thrust of this newsletter is directed towards the commercial fishing industry. Extension personnel also write and produce numerous educational publications on a wide variety of topics ranging from environmental landscaping to local fishing waters guides for use by the general public and educators. Many hours are devoted to responding to inquiries via telephone and mail and in providing printed matter to the public.

## *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.

Work began on Volume 21 of the *Water Log* Legal Reporter; research on the Tri-State Water Compact between Alabama, Georgia, and Florida; research, publications, and presentations on future Legal Program projects, and providing advisory services to Sea Grant constituents. Three issues of *Water Log* were prepared (Issue 3 to be mailed in October) and included articles on changes in U.S. wetlands laws, state court challenges to the Big Sunflower River Project, federal interpretation of the Oil Pollution Act, Mississippi and Alabama Legislative updates, and the latest U.S. Supreme Court takings case. Twenty-nine Advisory Services requests were filled including research to state and federal agencies, regional, national, and international researchers and universities.

The main research project during this time period is "Water Wars" (i.e. tri-state water compact). In furtherance of this project, Tammy Shaw presented on the topic to a law class, began preparing a web-based slide show, published a Water Log article, and attended an EPA conference on the issue.

Research and presentations toward future projects included a published article in the Environmental Law Reporter regarding Economic Conflicts in Fisheries Management (a 2003 project), attendance at a nonpoint source water pollution meeting (in furtherance of a 2002 project), and a presentation at the Coastal Zone Conference on Maritime Salvage (a 2003 project). Finally, researchers supervised the work of six law student research associates during this period and taught Ocean and Coastal Law, Natural Resources Law, Property Law, and International Law at the University of Mississippi Law School.

**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 convervation of Essential Fish Habitat; to analyze the use of Conservation Easements in coastal Alabma 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 wiritng and research on marine habitat-related issues.

Research was begun on the book to be published on Marine Reserves in the Gulf of Mexico. Fletcher made a presentation on the topic at the Coastal Zone Conference in Cleveland, OH and published a *Water Log* article on the topic.

## *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 two-page format focuses on delivering news highlights concerning MASGC research and outreach projects. Work also began on redesigning the MASGC Web site to provide Consortium information in a more timely, efficient, and user friendly format. Special emphasis was put on providing site visitors with links to MASGC's outreach components—the Mississippi and Alabama Extension Programs, the Office of Alabama Programs, the Mississippi-Alabama Sea Grant Legal Program, and the Education Program.

During Sea Grant's biennial national conference, *Sea Grant Week*, Reid organized and led the Southeast and Gulf Communicators Meeting, participated as a panelist in the communicators professional development session, and coordinated the set up of all Sea Grant Program exhibits at the conference.

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, NOAA/Jackson State University's Expanding Opportunities in Oceanic and Atmospheric Sciences Conference, and the Atlantic Aquaculture Exposition.

**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:

Jody A. Bruton, University of South Alabama, Ph.D. candidate
Stephen A. Bullard, The University of Southern Mississippi, M.S. candidate
Melaura M. Cranford, University of South Alabama, M.S. candidate
Leslie J. Gallagher, University of South Alabama, M.S. candidate
Glenn M. Hendrix, The University of Southern Mississippi, M.S. candidate
Nirmal D. Pugh, The University of Mississippi, Ph.D. candidate
Dena G. Vincent, The University of Southern Mississippi, M.S. candidate
Jennifer M. Walker, The University of Alabama, Ph.D. candidate

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

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

R/AT-3-PD - *Hybridization in Soft Corals - Combinatorial Genetics and Drug Discovery* (advanced technology). Marc Slattery, The University of Mississippi ($15,233).

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

R/SP-5-PD - *Fisheries Habitat of Juvenile Red Snapper in the Northern Gulf of Mexico* (seafood production). James H. Cowan, Jr., University of South Alabama ($20,871).