

School of Natural Resources and Environment

University of Florida

A university-wide program in ecology, environmental sciences, and sustainability

Mini-Grant Programs Annual Report

2005-2006





School of Natural Resources and Environment

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A university-wide program in ecology, environmental sciences, and sustainability, hosted by IFAS in collaboration with the colleges of Agricultural and Life Sciences; Business Administration; Design, Construction, and Planning; Engineering; Health and Human Performance; Liberal Arts and Sciences; Journalism and Communications; Law; Medicine; Veterinary Medicine; and the Florida Museum of Natural History

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Florida, USA, taken from NASA Shuttle Mission STS-95 on 31st October 1998.

Table of Contents

Introduction.....	3
SNRE Mini-grant Programs Overview.....	3
Summary of SNRE Mini-Grant Programs FY 2005-2006	4
Three-year Comparison of the Mini-Grant Programs.....	9
FY 2005-2006 Seed Funding Grants Report	11
1. Alavalapati, Janaki Creating a Cooperative of Conserved Forest Ecosystems: Research and Outreach (CFEOR)	11
2. Barber, David Toxicity of Nanomaterials in Aquatic Organisms	15
3. Child, Brian Adaptive Performance Management and Peer Review for Developed, Democratic Incentive-Led Conservation in Southern Africa	19
4. Flocks, Joan Asset Mapping and Environmental Health Needs Assessment in Lake Apopka Communities	23
5. Rathinasabapathi, Bala Molecular Biology of Arsenic Reduction, Detoxification and Hyperaccumulation in <i>Pteris vittata</i>	28
6. Teplitski, Max Role of the Quorum Sensing Signal Mimics in Plant-Bacterial Symbiosis.....	31
FY 2005-2006 New Faculty Grants Reports	35
7. Angelo, Mary Jane The Conflicting Policies of the Endangered Species Act and U.S. Pesticide Law	35
8. Bradshaw, Joan Shoreline Stewardship Program: Florida Friendly Living on the Waterfront.....	38

9. Cohen, Matthew	
Development of Effective Sampling Methods for Wetland	
Ecological Assessment	42
10. Dodd, Alyssa	
Increasing Citizen Involvement in Everglades Restoration and	
Management.....	45
11. Petty, Denise	
Florida Aquatic Animal Health Program.....	48
12. Sheppard, Barbara	
Brevetoxin Detoxification Pathways and Biomarkers of Exposure	
in Florida Hard Clams, <i>Mercenaria mercenaria</i>	51
Appendix A: SNRE Mini-grant Programs FY 2005-2006 Funded and	
Pending Proposals.....	62

School of Natural Resources and Environment Mini-grant Programs Summary for FY 2005-2006

Introduction

The School of Natural Resources and Environment (SNRE) is the programmatic home of interdisciplinary undergraduate and graduate programs in ecology and environmental science that prepare students to understand and address complex scientific, political, managerial, social, and economic issues.

SNRE is hosted by the Institute of Food and Agricultural Sciences (IFAS) in collaboration with the colleges of Agricultural and Life Sciences; Business Administration; Design, Construction, and Planning; Engineering; Health and Human Performance; Liberal Arts and Sciences; Journalism and Communications; Law; Medicine; Veterinary Medicine, and the Florida Museum of Natural History.

Approximately 275 UF faculty members are affiliated with the school are housed within 11 academic colleges and units. These faculty members serve as advisors to SNRE graduate students and participate widely in research and outreach/Extension programs.

SNRE is the administrative home for three IFAS Extension partnership programs. *The Natural Areas Training Academy* is a training program for managers of natural areas jointly operated with The Nature Conservancy. *The Program for Resource Efficient Communities* is an interdisciplinary program aimed at promoting the adoption of best design, construction, and management practices in new residential community developments that measurably reduce energy use, water consumption, and environmental degradation. Faculty from several UF colleges participate in this program. *The Natural Resources Leadership Institute* helps rising leaders in state agencies, agriculture, elected office, academia, resource based industries, and NGOs develop skills in conflict management and collaborative leadership. The Department of Food and Resource Economics jointly operates this program with SNRE.

SNRE fosters interdisciplinary research through a variety of activities: awarding intramural grants, providing direct grant proposal support and administration, developing innovative cooperative agreements with external partners, delivering focused and timely information regarding funding opportunities, maintaining specific resource directories, managing our UF faculty expertise database, and creating faculty workgroups with diverse specializations to create collaborative interdisciplinary extramural proposals for funding. This report highlights the SNRE intramural mini-grant programs.

SNRE Mini-grant Programs Overview

The SNRE Mini-grant Programs established in FY 2003-04 advances interdisciplinary research and program development. SNRE offers two grant opportunities to UF faculty: Seed Funding Grants (SFG) and New Faculty Support (NFS).

The purpose of the Seed Funding Grant Program is to develop collaborative proposals in (1) new and emerging interdisciplinary activities or (2) cross-cutting perspectives on historically important issues. The New Faculty Support Program provides funding to assist new faculty in developing innovative and important programs in the area of natural resources and environment.

The SNRE Mini-grant Programs receive funding from the deans of the colleges of Agricultural and Life Sciences, Engineering, Liberal Arts and Sciences, and Veterinary Medicine; the IFAS Dean for Research; and the UF Vice President for Research.

Summary of SNRE Mini-Grants Programs FY 2005-2006

The success of the Mini-grant Programs can be measured this year in the diversity and variety of deliverables developed. Many of the projects incorporated external outside collaborators from organizations and agencies such as the World Wildlife Foundation, the Integrated Resource Development and Nature Conservation, Florida Fish and Wildlife Commission, US Forestry Service, and several Florida Water Management Districts. Partnerships were created with other countries and communities including Namibia, Kwandu, Mayuni, Mashi, and Waparo. Local community programs were developed in partnership with state extension agents in Sumter, Citrus, Hernando, Pasco, and Palm Beach Counties.

Participation and Awards

- 66 proposals were received from faculty from 15 departments/units across six colleges.
- Six Seed Funding Grants were awarded for a total of \$110,000.
- Six New Faculty Support grants were awarded for a total of \$30,000.
- The funded projects involved 20 PIs/CoPIs and 46 collaborators; 23 were internal to UF housed across 29 departments/research centers and six county extension offices, and 23 were external collaborators.

Deliverables Generated as of May 2007

- 32 extramural proposals/contracts were submitted, requesting \$13 million. Of these, 13 proposals were funded totaling \$979,436 and eight proposals, totaling \$6,078,320, are still pending.
- The 2005-2006 FY generated \$1,296,945 total funds as a direct result of the Mini-grant Program.
- In total 128 deliverables were reported including: 29 peer-reviewed publications, 46 presentations/workshops, creation of a new faculty position, an international fieldwork program, a memorandum of understanding, a risk assessment tool, several websites, educational materials, a monofilament recycle bin program, and aquatic weed placemats.

Post-doc and Student Support:

- The Mini-grant Programs also specifically supported research interests of three post-doctoral students, eight graduate students, one undergraduate student, and one intern.

The SNRE Mini-grant Program received \$140,000 total funding from IFAS, CLAS, COE, COVM, LAW, and UF sponsored research (Table 1). Table 1 provides a graphic presentation of funding contributed and allotted to participating colleges. Table 2 gives the demographics of grant participants through projects funded and faculty involvement across colleges.

Table 1. SNRE Mini-grant Programs FY 2005-06 - Total Funds Contributed by and Awarded to Participating Colleges

Unit	Amount Contributed to Grant Programs	Amount Awarded
IFAS/CALS/SNRE	\$55,000.00	\$50,000.00
CLAS	\$15,000.00	\$25,000.00
COE	\$10,000.00	\$0.00
COVM	\$10,000.00	\$35,000.00
LAW	\$0.00	\$30,000.00
UF Sponsored Research	\$50,000.00	\$0.00
Totals	\$140,000.00	\$140,000.00

Table 2. SNRE Mini-grant Program FY 2005-2006, College of Lead Principle Investigator and Break Down of Faculty Involved Across Colleges.

College of Lead or First Principal Investigator Listed	Projects Funded	Number of Faculty Involved
IFAS/CALS	7	23
CLAS	1	6
COE		1
COVM	2	5
CoHHP		1
CoLaw	2	3
Other		2
Units Outside UF		22
Total	12	63

2005-2006 FY Highlights

The projects funded for the 2005-2006 FY had many successes in terms of the creation of opportunities and the impact on the local and scientific community. Some highlights from this year include:

- Creation of the “Cooperative for Conserved Forest Ecosystems: Outreach and Research” (CFEOR). This cooperative joins together many conservation organizations such as the Florida Division of Forestry, Florida Fish and Wildlife Conservation Commission, Florida Wildlife Federation, The Nature Conservancy, and the Water Management Districts of Northwest Florida, Suwannee River, and St. Johns River. This partnership entered into a Memorandum of Understanding (MOU) that provided a unique framework for collaborative research and joint development of projects and technology. Members are required to pay dues at varying levels of commitment and participate in cooperative activities, ranging from sharing information, exchanging samples and data, and joint planning for projects.
- Development of participatory peer-based monitoring protocols in collaboration with southern African partners resulted in the development of monitoring/performance tracking systems for adaptive management. As a result of this project a program was developed that took faculty and graduate students to Caprivi/Nambia and Kasane/Botswana for 10 weeks of fieldwork.
- Creation of the Lake Panasoffkee Celebration event which involved local community youth and many local agencies such as the Sumter County Parks Department, the Sumter County Sheriff Department, Sumter Electric Company, as well as other state agencies. This project promoted shoreline stewardship for Lake Panasoffkee in order to sustain and enhance restoration efforts. A number of educational programs associated with the event occurred, including a youth poster competition.
- Development and implementation of biosecurity protocols for aquaculture farms to reduce pathogen introduction and protect Florida farmed and wild aquatic animals from exotic animal diseases. Workshops for aquaculture producers were held in conjunction with follow-up assessments indicate that the workshop practices and accompanying educational materials are being adopted.
- Significant advancement in understanding how nanomaterials interact with aquatic organisms, standard methodology for studies of this type were established, and subsequent development of appropriate environmental regulations for nanomaterials.

Summary Figures and Table

Activities generated by the SNRE Mini-grant Programs are shown in Figures 1 and 2. Figure 1 categorizes the funding received in terms of extramural dollars, leveraging, and in-kind support for the 2005-2006 funding cycle. Deliverables in the form of publications, submitted grant proposals, presentations, and reported resources resulting from the project funding are reported in Figure 2. A summation of the funds received and deliverables produced for the 2005-2006 FY are shown in Table 3, and Appendix A shows grants awarded and pending for each PI.

Figure 1. Deliverables received include proposals funded, presentations, workshops, and other deliverables.

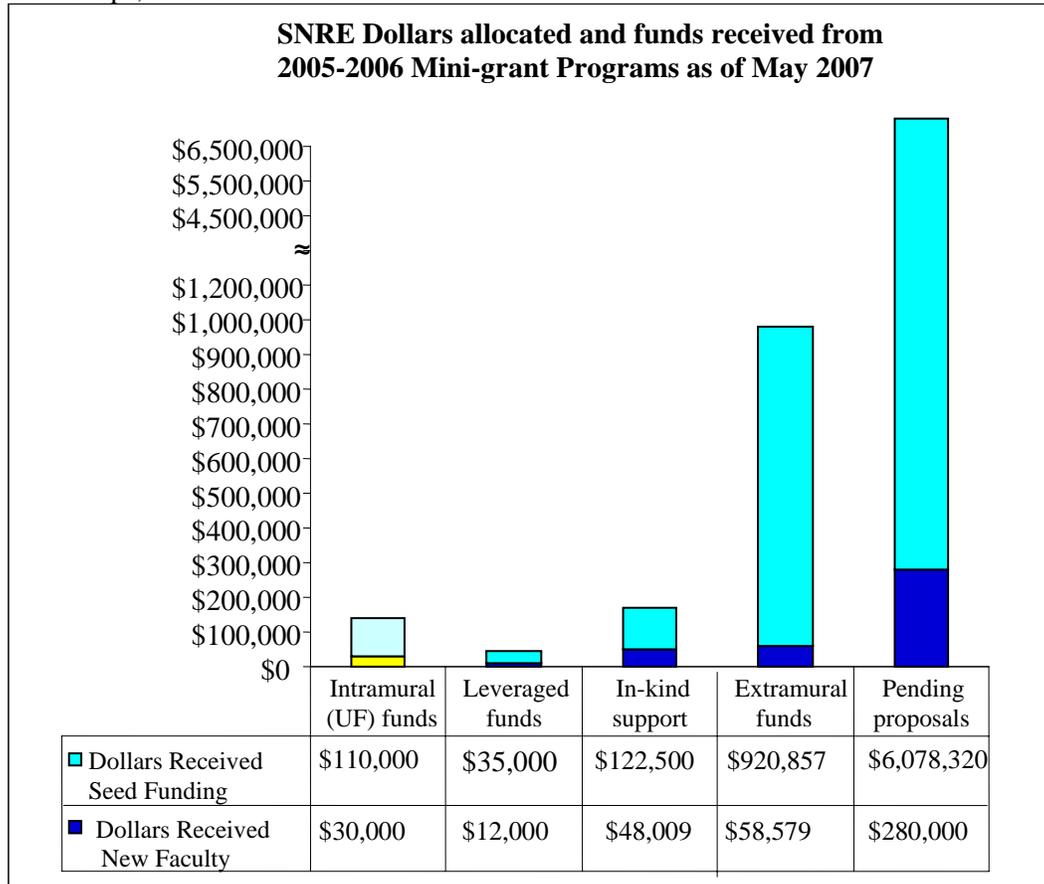


Figure 2. Data for Total SNRE Mini-grants Dollars Allocated and Funds Received for 2005-06 Mini-grant Programs as of May 2007

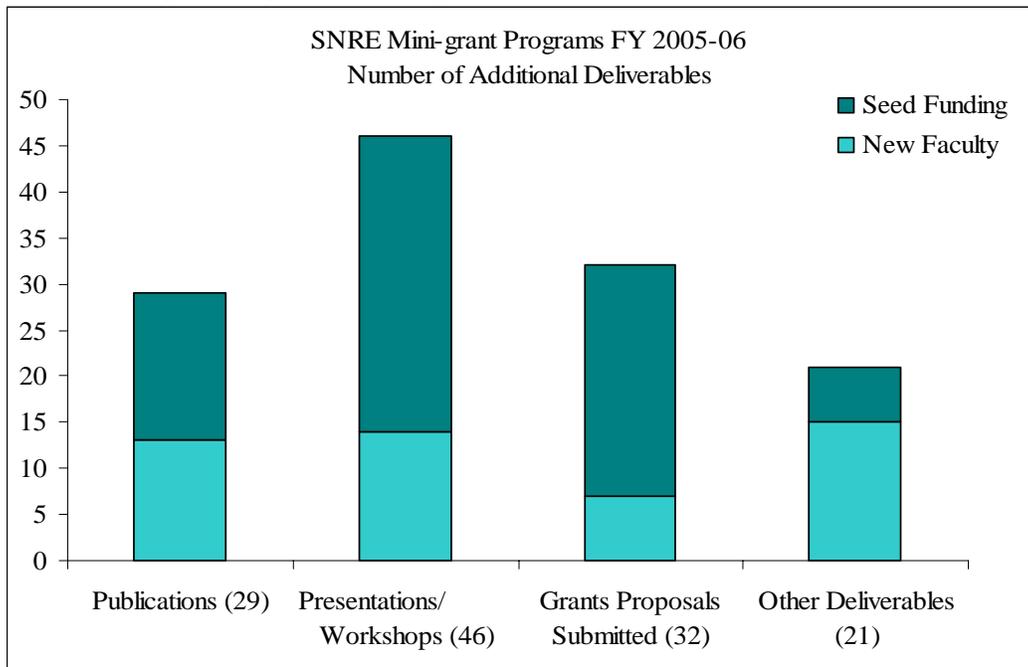


Table 3. SNRE Mini-Grant Program FY 2005-2006 Summary of Deliverables and Funds as of May 2007.

	New Faculty Totals	Seed Funding Totals	Grand Totals
# of Projects Funded	6	6	12
SNRE ALLOCATION	\$30,000	\$110,000	\$140,000
Total # OF DEPTS./UNITS/County Offices REP. (a)	14	15	29
PIs and CoPIs	9	11	20
COLLABORATORS (b)	20	26	46
-Internal	11	12	23
-External	9	14	23
GRANT/Contracts			
-proposals/contracts written	7	25	32
-total amount requested	\$493,579	\$12,858,238	\$13,351,817
-proposals funded	4	9	13
-proposals pending	1	7	8
-amount for proposals pending	\$280,000	\$5,798,320	\$6,078,320
-total amount funded	\$58,579	\$920,857	\$979,436
MOU (Cooperative contract with membership fee)	0	\$100,000	\$100,000
LEVERAGE (external)	\$12,000	\$35,000	\$47,000
IN-KIND SUPPORT	\$48,009	\$122,500	\$170,509
PUBLICATIONS	13	16	29
-book	1	0	1
-refereed	5	12	17
-non refereed	1	1	2
-EDIS/extension	4	0	4
-research paper	0	2	2
- report	2	1	3
PRESENTATIONS	5	25	30
-local/regional	2	15	17
-state	2	3	5
-national	0	1	1
-international	1	4	5
-invited speaker/ seminar	0	2	2
POSTER PRESENTATIONS	5	7	12
WORKSHOPS/ INSERVICE TRAININGS	4	0	4
OTHER DELIVERABLES			
-New Faculty Position	1		1
-New Programs Developed		3	3
-Regional Education Plan	1		1
-Risk Assessment Tool	1		1
-website	2	0	2
-brochures	1	1	2
-program manual	1	0	1
-forum	0	1	1
-Lake Panasoffkee Community Education (2 day event)	1	0	1
- Community youth poster contest	1	0	1
- (10) launching ramps with weed signage	1	0	1
- (6) monofilament recycling bins	1	0	1
- aquatic weed placemats	1	0	1
- educational notebooks	3	0	3
TOTAL DELIVERABLES (d)	49	79	128
TOTAL FUNDS FROM EXTERNAL SOURCES (c)	\$118,588	\$1,178,357	\$1,296,945

a. Departments are counted once and therefore the grand total will not equal the sum of the two grant programs.

b. Collaborators are counted once and therefore will not equal the sum of the two grant programs.

c. Total Funds from External Sources includes total grant proposals funded, leverage, and in-kind support and contracts

d. Total Deliverables includes all publications, presentations, grants submitted, workshops, and other deliverables.

Three-year Comparison of the SNRE Mini-grant Programs

With the SNRE Mini-grants Program completing its third year of reporting, a comparison of this fiscal year with the previous years show the program is reaching its goals of fostering interdisciplinary work, advancing research and programs, and securing extramural funds. Over the course of the intramural funding

- 45 projects have been funded involving 255 PIs, Co-PIs and collaborators.
- A total intramural allocation of \$435,515 has generated a return of \$11,906,037 from outside sources, a success by any measure.
- 96 publications have been produced, 97 national and international presentations were given; 89 grant proposals were submitted and 38 of those extramural proposals were funded; also a wide variety of spin-off projects have occurred, including the creation of faculty positions, research and Extension programs, memorandum of agreements, community development projects, student scholarships, curricula, and websites.
- In total, 340 deliverables were produced within this three year time frame.

Summary Figures

Figures 3 and 4 shows the success of the Mini-grants program over the past three years, with categorical analysis of the funding sources, and a summation of the total deliverables for each funding year, respectively. Also included for the 2005-2006 funding cycle are the estimated funds from grants with a pending status (Figure 3). Funding for the program has fluctuated for each funding cycle; with \$95,515 funded in 2003, \$200,000 funded in 2004, and \$140,000 funded in 2005. However, the number of deliverables including grants funded, presentations, publications, and other deliverables continues to grow with 109 deliverables in 2003, 103 in 2004, and 128 in 2005 (Figure 4). Table 4 goes through the college of the lead investigator and contains a break down of faculty involved over the 2004- 2006 FY.

Table 4. College of Lead Principle Investigator and Break Down of Faculty Involved Across Colleges.

College of Lead or First Principal Investigator Listed	Number of Faculty Involved 2003-2004	Number of Faculty Involved 2004-2005	Number of Faculty Involved 2005-2006
IFAS/CALS	37	34	23
CLAS	1	20	6
COE	1	11	1
COVM	0	1	5
COMed	0	2	0
CoED	0	1	0
CODesign	0	0	0
CoLaw	0	0	3
CoHHP	0	0	1
Other	4	0	2
Units Outside UF	9	21	22
Total	52	90	63

Figure 3. Historical Comparison of Mini-grant Funding Years 2003-2006. Total Funds Represent Total Value from Leveraging, In-Kind Support, and Extramural Funds.

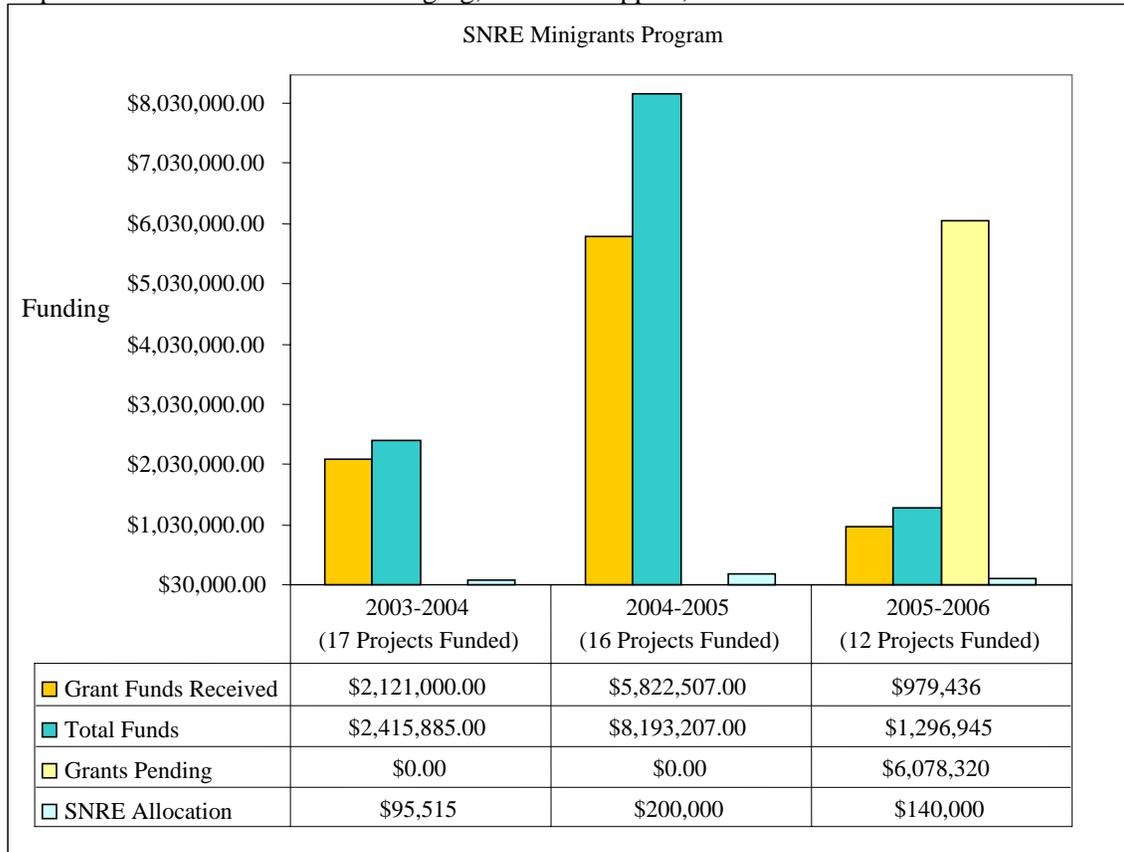
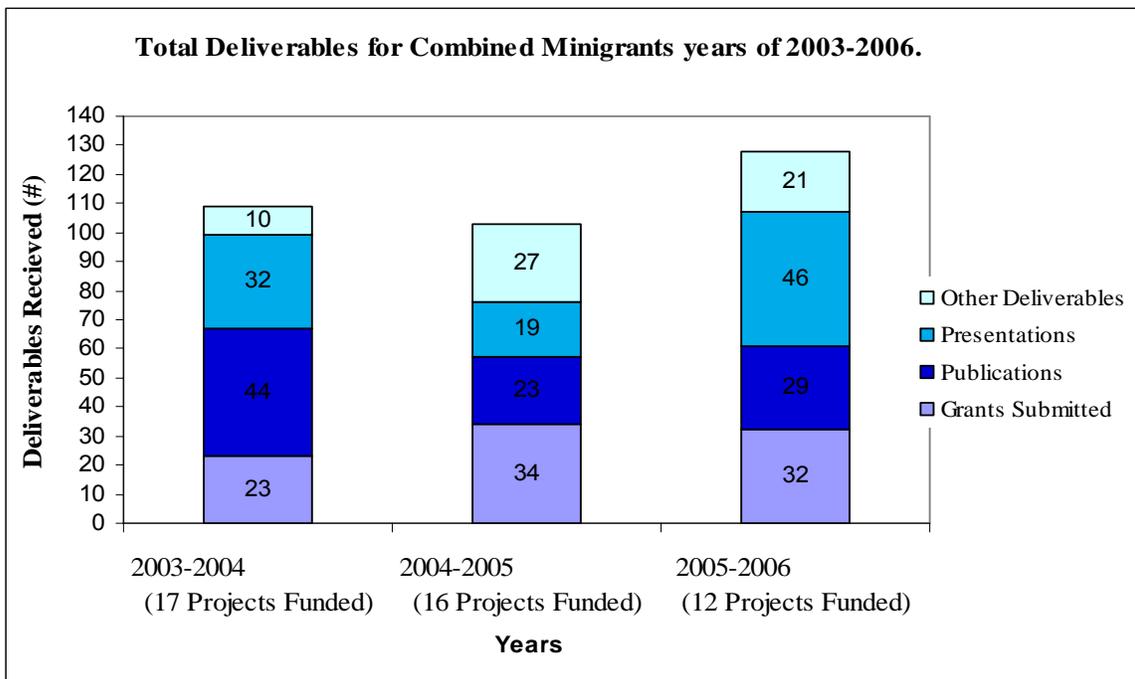


Figure 4. Deliverables in Publications, Presentations, and Other Miscellaneous Deliverables for Seed Funding and New Faculty FY 2005-2006 as of May 2007.



FY 2005-2006 SEED FUNDING GRANTS REPORTS

1. Creating a Cooperative of Conserved Forest Ecosystems: Research and Outreach (CFEOR)

Project Leader(s):

Dr. Janaki Alavalapati, School of Forest Resources and Conservation
Dr. Shibu Jose, School of Forest Resources and Conservation
Dr. Taylor Stein, School of Forest Resources and Conservation
Dr. George Tanner, Wildlife Ecology and Conservation

Collaborators:

Internal

Dr. Timothy L. White, School of Forest Resources and Conservation

External

Mr. Mike Long, Florida Division of Forestry

Executive Summary

The objective of this project is to develop a comprehensive plan and create a cooperative entitled Conserved Forest Ecosystems: Research and Outreach (CFEOR) to facilitate integrative research and outreach activities and promote sustainable conservation and management of Florida's forest ecosystems. Towards this objective, we have undertaken the following tasks:

1. Contacted several local, state, and federal governmental and non-governmental organizations and solicited their support
2. Conducted three meetings in Tallahassee (between July 2005 and June 2006) by inviting potential participants to deliberate on structure and administration of the proposed cooperative and to identify and prioritize research and outreach topics
3. Organized a forum on May 1, 2006 by inviting potential participants and experts from multiple disciplines of natural resources to explore identified research and outreach topics further at the Austin Cary Memorial Forest, Gainesville, Florida
4. Drawing on the input from participants, the following documents have been developed
 - Brochure explaining mission, governance, and benefits of CFEOR
 - Structure and administration of CFEOR
 - Memorandum of understanding between the UF and participating agencies

Formal initiation of CFEOR was done by Dr. Timothy L. White on October 30, 2006 during the first CFEOR Founding Members Meeting in Tallahassee. Currently CFEOR consists of 10 founding members: Florida Division of Forestry, Florida Fish and Wildlife Conservation Commission, Florida Park Service, Florida Wildlife Federation, National Forests in Florida, The Nature Conservancy, Northwest Florida Water Management District, Suwannee River

Water Management District, St. Johns River Water Management District, and UF School of Natural Resources and Environment and efforts for its expansion are on the rise.

Rationale for Cooperative

With over nine million acres of publicly owned forests and other natural areas in Florida, there is an immense need for scientifically derived management strategies to ensure sustained production of economic, social, and ecological services. Well managed natural areas reduce the concentration of green house gases in the atmosphere by sequestering carbon dioxide, enhance ground water recharge through canopy cover, further biodiversity by providing habitat for many wild flora and fauna including several threatened and endangered, revitalize people by offering aesthetics and other active recreation opportunities, and increase the stability of local communities by creating economic and employment opportunities. Furthermore, when these areas are situated strategically and managed sustainably, they limit urban sprawl and enhance the ecological integrity of a county, region, or overall state.

In Florida, the importance of public natural areas was long recognized and significant efforts were made to expand them. For example, since 1990 the state of Florida has spent billions of dollars to acquire environmentally sensitive private natural areas for conservation. In addition to the state efforts, individual counties (e.g., Alachua and Sarasota counties) have land acquisition programs to conserve strategic natural areas. While more natural areas are being brought into public domain, limited attention is being paid to their sustainable management. These unique resources, if not managed effectively, will not be able to offer ecological, economic, and social benefits at a socially desirable level. At the extreme, they could become public liabilities by increasing the risk of wildfires and invasion of pests/diseases and by offering limited economic and employment opportunities to local communities.

Dr. T. L. White (School of Forest Resources and Conservation, University of Florida) and Mr. M. Long (Florida Division of Forestry) envisioned that sustainability of forests and other natural areas can be ensured more effectively through a consorted effort among governmental (federal, state, and local), non-governmental, and academic agencies. The objective of this project is to make this vision a reality by developing a comprehensive plan and creating a cooperative that facilitates integrative research and outreach activities and promotes sustainable conservation and management of Florida's forest ecosystems.

Deliverables Supported Entirely or in Part by this Grant

Memorandum of Understanding

The purpose of this MOU is to begin a broad and multidisciplinary cooperative research, application development, and technology transfer/exchange program between the participants under the name "Cooperative for Conserved Forest Ecosystems: Outreach and Research", hereinafter called "CFEOR". This MOU provides a framework through which collaborative research and technology transfer/exchange projects of mutual interest to the participants may be coordinated. Participants in this effort, including land use planning and policy making agencies, institutions of higher education, various land management agencies at the federal,

state, and local levels, and private and NGO entities involved in or interested in land management will benefit substantially from this collaboration.

Forum

In order to further explore the identified natural resource research and outreach topics and cooperative ways of addressing them further, a forum was organized on May 1, 2006 at the Austin Cary Memorial Forest, Gainesville. Several experts from various disciplines across the US and Canada were invited to share their experiences of addressing natural resources issues through collaborative and cooperative approaches.

Documents

- Brochure explaining mission, governance, and benefits of CFEOR
- Structure and administration of CFEOR
- CFEOR Newsletter

A variety of federal, state, and local governmental and non-governmental organizations across the state and several academic and research units at the University of Florida (UF) were contacted, discussed the idea of cooperative, and sought their input and support. Based on these discussions and feedback, draft copies of a brochure, the structure and administration of the proposed cooperative were developed. In order to discuss these details and legitimize the process, a meeting was called for by inviting potential members across the state.

A meeting entitled “Conserved Forests Cooperative Meeting: A Beginning” was held on July 21, 2005 in Tallahassee, Florida. In addition to selected faculty members from the School of Forest Resources and Conservation, Department of Wildlife Ecology and Conservation, and Department of Fisheries and Aquatic Sciences, representatives from Florida Division of Forestry, Florida Fish and Wildlife Conservation Commission, Florida Park Service, USDA Forest Services, The Nature Conservancy, Suwannee River Water Management District, and St. Johns River Water Management District attended the meeting. Several constructive comments and criticism were received on the scope, membership and structure, and deliverables of the proposed cooperative. At the end, members suggested to revise the documents based on the feedback and call for another meeting. Additional meetings were held to discuss the revised brochure, structure and administration document, Memorandum of Understanding, and research and outreach topics. A tentative acronym CFEOR (Conserved Forest Ecosystems: Outreach and Research) was developed. The organizations identified “developmental pressures,” “restoration,” and “fire” as their top three most important issues. Other deliverables include the monthly newsletter to participants and members for the CFEOR as well as a website.

Extramural/Membership Funding Breakdown

Membership is broken down into different levels of financial and participatory commitment. Steering Committee Members are required to pay \$8,000 a year and support at least one research/outreach project per year. The next level of membership in the CFEOR required participants to pay \$4,000 a year with support of research/outreach projects being optional.

Supporting members will be required to pay \$1,000 per year with support of research/outreach projects being optional. Estimated commitment to membership support is around \$100,000 at this time.

Impacts/Outcomes

A formal initiation of CFEOR was done on October 30, 2006 by Dr. Timothy L. White during the First CFEOR Founding Members Meeting. Mr. Mike Long, Florida Division of Forestry was selected to serve as the chair of the Steering Committee for two years. Following are the founding members:

- Florida Division of Forestry
- Florida Fish and Wildlife Conservation Commission
- Florida Park Service
- Florida Wildlife Federation
- National Forests in Florida
- The Nature Conservancy
- Northwest Florida Water Management District
- Suwannee River Water Management District
- St. Johns River Water Management District
- School of Natural Resources and Environment, UF

All the members are actively advocating for CFEOR and working to recruit new members. An IFAS press release was written explaining the rationale, mission, scope, and benefits of CFEOR. With membership dues, CFEOR will soon hire a program assistant to develop a website and help coordinate research and outreach activities. We hope that CEFOR will expand and promote collaborative research and technology transfer/exchange projects of mutual interest to the participants. Participants in this effort, including land use planning and policy making agencies, institutions of higher education, various land management agencies at the federal, state, and local levels, and private and NGO entities involved in or interested in land management will benefit substantially from this collaboration.

2. Toxicity of Nanomaterials in Aquatic Organisms

Project Leader(s):

Dr. David Barber, Department of Physiological Sciences, College of Veterinary Medicine

Collaborators:

Internal

Dr. Nancy Denslow, Department of Physiological Sciences, College of Veterinary Medicine

Dr. Kevin Powers, Particle Engineering Research Center, College of Engineering

Dr. David Evans, Department of Zoology, CALS

Executive Summary

The goal of this project was to evaluate the toxicity of metallic nanoparticles in a model aquatic organism in an effort to determine the potential risk that these materials pose to aquatic species. Our main objective was to compare the effects produced by exposure to soluble and nanoparticulate forms of the same metal. To this end we have exposed zebrafish (*Danio rerio*) to 51nm (nominal diameter) aluminum nanoparticles, aluminum chloride, 50 nm (nominal diameter) copper nanoparticles, and copper sulfate. For each material we have determined the concentrations that produce lethality in 50% of zebrafish exposed for 48 hours (LC₅₀), though we have conducted exposures of up to 96 hours. We have also examined histological and biochemical changes in gill, liver, and kidneys of exposed animals and determined changes in gene expression that occur in gills as a result of exposure to aluminum chloride or aluminum nanoparticles. The success of this project has been driven by close collaboration of the interdisciplinary team of researchers. The major findings of the project are as follows:

Careful characterization of particles before use is required to fully understand the nature of the particles being studied. Nominal size information is often not accurate.

Addition of particles to water results in apparent agglomeration, though large numbers of small particles remain. The methodology for accurately characterizing particles in environmental samples needs to be further explored. We are currently examining field flow fractionation for obtaining more accurate data in “dirty” samples.

Dissolution of metallic particles must be considered. Comparable concentrations of aluminum, both total and soluble, are present in the water column after addition of aluminum chloride or 51nm aluminum particles. By contrast, virtually all 20 micron aluminum has sedimented by 24 hours. The low level of soluble aluminum is consistent with poor solubility of aluminum at neutral pH.

Exposure of zebrafish to nano-sized aluminum particles at concentrations up to 12.5 mg/L for up to 96 hours did not result in fish mortality. However, addition of 12.5 mg/L AlCl₃ killed 100% of fish within 24 hours. Exposure to 50nm copper nanoparticles produces acute

lethality. The calculated 48 hours LC_{50} for the copper particles is 1.5mg/L or ~2x greater than that of copper sulfate.

Exposure to aluminum decreases Na^+/K^+ -ATPase activity in gills. 72 hour exposure to 500 ppb aluminum as 51 nm particles results in significant changes in gill gene expression. Using the Agilent zebrafish microarray, there are 22 genes that are up-regulated more than 3-fold and 38 genes that are down-regulated more than 3 fold.

Rationale for Project

Nanomaterials are defined by the National Science Foundation as structures with one dimension between 1 and 100nm. By virtue of their small size, nanomaterials have very high surface areas and high percentages of their component atoms on the surface which leads them to have unusual reactivity. Because of these characteristics, nanomaterials have many potential uses including electronics, medicine, environmental remediation, catalysts, and consumer products. Many nanotechnology applications utilize metallic nanoparticles, including aluminum. Aluminum nanoparticles are being used in reflective paints and coatings. The Department of Defense is using nanoaluminum powders for energetic materials such as propellants, explosives, and rocket fuels. Researchers at UF are creating and evaluating very high aspect ratio aluminum and other metal powders for use as military obscurants in the infrared portion of the spectrum. These obscurant materials are introduced directly into the environment as dispersed powders both in training and during combat operations. These uses of aluminum nanomaterials will result in intentional and unintentional releases of nanomaterials into the environment which may cause harm to a wide variety of organisms.

While aluminum nanomaterials are entering the environment, their potential fate and toxicity is essentially unknown. Aluminum produces gill dysfunction and can be lethal to fish when present in a dissolved form at low pH. At neutral pH, aluminum presents much lower toxicity due to its low solubility. While most metallic nanoparticles are coated with thin metal oxide shells, they are likely to be much more reactive and bioavailable than larger metal oxide particles. However, there are no published studies examining the potential toxicity of metallic nanomaterials in animals present in the environment. The only published study that examines toxicity in non-mammalian species is a single small study in largemouth bass exposed to fullerenes (bucky balls) which demonstrated oxidative stress in the brains of exposed animals (Oberdorster 2004). There is a clear need for further investigation of toxicity caused by exposure to metallic nanomaterials in ecological species.

Intentional and accidental release of nanomaterials into the environment will occur in the future and sound scientific studies on the potential adverse effects of these materials on the environment are necessary to accurately determine the risk that nanomaterials pose. The proposed study evaluated the effect of exposure to aluminum nanoparticles on zebrafish and developed methods for the detection and characterization of nanomaterials in environmental samples. The proposed research is only possible because of the collaboration among toxicologists, zoologists, and particle engineers from 3 colleges.

Deliverables Supported Entirely or in Part by this Grant

Publications

Griffitt, R. J., Weil, R.N., Denslow, D., and D. S. Barber. Acute toxicity of copper nanoparticles in zebrafish. Anticipated submission in Sept. 2006

Griffitt, R. J., Weil, R., Hyndman, K., Reyer, N., Denslow, N. D., and D. S. Barber . Effects of aluminum nanoparticle exposure on zebrafish gill function and gene expression. Anticipated submission in Sept. 2006

Presentations

Barber, D.S. 2005. Effects of Aluminum Nanoparticle Exposure on Zebrafish. International Symposium on the Role of Adsorbed Films and Particulate Systems in Nano and Biotechnology, Gainesville, FL. August 24-26.

Poster Presentations

Barber, D., Reyer, N., Denslow, N., Hyndman, K., Evans, D., and Freedman, J. 2005. Effects of Aluminum Nanoparticle Exposure in Zebrafish (*Danio rerio*). Proceedings of the annual Society of Environmental Toxicology and Chemistry meeting, Baltimore, MD.

Garcia-Reyer, N., Barber, D. S., Hyndman, K., Evans, D., Powers, K., Freedman, J. H., and N. D. Denslow. 2006. Gene Expression Pattern Alteration in Gill from Zebrafish Exposed to Nanoparticles. *The Toxicologist* 90 (S-1):1082.

Griffitt, R. J., Weil, R., Hyndman, K., Reyer, N., Denslow, N. D., and D. S. Barber. 2006. Effects of metallic nanomaterials on zebrafish. Abstract accepted for SETAC national meeting.

Extramural Grant Proposal(s) Submitted and Status

Program/Agency	Title	Period	Status
Nanotechnology Research Grants Investigating Environmental and Human Health Effects of Manufactured Nanomaterials: A Joint Research Solicitation-EPA, NSF, NIOSH, NIEHS	Biochemical Molecular and Cellular Responses of Zebrafish to Exposed Metallic Nanoparticles	January 2005**	Awarded: \$350,000
Same as above	Role of Protein Absorption in Nanoparticle Uptake, Distribution and Toxicity in Zebrafish	January 2006	Pending: \$398,320

**This grant was submitted as a direct result of our 2004 SNRE application which we revised in our SNRE proposal that was funded in 2005.

Leveraging/Cost Sharing

- Funds received from other sources: Funds from the NSF grant listed above were also utilized in this work (~\$15,000, primarily a salary for a post-doc who started in February 2006 on this project).
- Actual and/or In-kind FTEs of PIs, staff, and students including partners and collaborators. ~30% of a technicians time and 5% PI time (~\$25,000)
- Equipment, vehicles, lab use, etc. 10 custom zebrafish microarrays were donated by Dr. Jon Freedman of Duke University (~\$3,500)

Impacts/Outcomes

The work conducted with SNRE seed funding has produced significant advances in our understanding of how nanomaterials interact with aquatic organisms. Because the field is relatively new, the studies we performed will help establish the standard methodology for studies of this type. Our work is among the first to describe the effects of nanomaterials on aquatic organisms and should be instrumental in future efforts to develop appropriate environmental regulations for these materials. We are also among the first investigators in this field to perform studies as recommended by the International Life Science Institute (ILSI) including accurate characterization of materials as dosed. We have successfully collaborated with the particle engineers at UF to apply appropriate methods for this type of characterization with real world aquatic samples. This work has set the stage to describe fate and transport of nanomaterials in the environment. The work conducted in our studies has been communicated to other scientists by a number of presentations at national and international meetings and has resulted in one extramurally funded grant and submission of a second.

3. Adaptive Performance Management and Peer Review for Devolved, Democratic Incentive-Led Conservation in Southern Africa

Project Leader(s):

Dr. Brian Child, Associate Professor, Department of Geography, CALS

Collaborators:

Internal

Dr. Sandra Russo, Assistant Director for Program Development in the International Center, Center for Women's Studies and Gender Research, CALS

Dr. Jane Southworth, Associate Professor, Department of Geography, CALS

Dr. Mike Binford, Professor, Department of Geography, CALS

External

WWF (SARPO), WWF (LIFE) Namibia, IRDNC, Namibia, Kwandu, Mayuni, Mashi and Wuparo Conservancies
Namibia CBNRM Institutional Support Group

Executive Summary

This project worked at two levels. Recognizing the importance of relationship building and social legitimacy for conducting long-term field research, research the PI developed and the concept of peer-based monitoring and adaptive management collaboratively through several regional southern African forums such as IUCN-SASUSG and WWF.

The concept of peer-based monitoring and adaptive management was then field tested in northern Namibia for two months (in partnership with WWF) using highly participatory methods. In brief, the PI facilitated the community to design and conduct their own 'scientific' research into the governance and economics of wildlife management. There were three objectives:

1. To identify key variables that encapsulate the essence of community governance;
2. To develop data collection mechanisms that provide an accurate assessment of the complexity of governance and economic issues on natural resource management; and
3. To test whether visualized descriptive quantitative data accelerates social change and/or makes it more equitable.

This work was done in partnership with WWF (Namibia and regional programmes) and with the Namibian CBNRM Support NGO, Integrated Resource Development and Nature Conservation (IRDNC). It has laid the foundation for a significant number of grant applications, both to NSF and to donor organizations and foundations. It was also instrumental in providing the IGERT field trip with access to the Namibian CBNRM programme.

Rationale for Project

Aim: Development of methods for participatory peer-based monitoring protocols in collaboration with many southern African partners.

This is expected to develop into carefully designed monitoring/performance-tracking systems for adaptive management in southern Africa. It will also provide a research tool to study practical experiments in local democratic management of natural resources in southern Africa.

Deliverables Supported Entirely or in Part by this Grant

Publications

Child, B. 2006. Pilot study in East Caprivi to Develop Management Orientated Performance Tracking for Conservancy Governance, Formal Report to WWF LIFE.

Child, B., and Richard Diggle. 2007. Progress and challenges of CBNRM in East Capriv. (Publication in progress for journal submission)

Presentations

Child, B. Developing Adaptive Performance Monitoring for Governing CBNRM Institutions. (presented at several international forums and at UF)

Child, B. Presentation on research finding for Adaptive Performance Management and Peer Review for Devolved, Democratic Incentive-Led Conservation in Southern Africa. Namibia, IUCN Southern African Sustainable Use Specialist Group (presented at two International Forums).

Program Development

A program was developed in which 6 faculty and 10 graduate students will go to Caprivi/Nambia and Kasane/Botswana for 10 weeks of field work as a continuation of the grant project. There will be collaboration between 7 young African professionals plus two local facilitators/leaders. Possible field expenditure could reach \$300,000.

Extramural Proposal(s) Submitted and Status

This funding provided vital continuity for the PI in a transition from African development specialist to academia. It also enabled the PI to maintain key relationships in southern Africa, providing opportunities for cooperative proposals, and field sites for graduate students.

This will now likely lead to major funding source from Norway aimed at improving democracy and the environment through a collaborative arrangement that includes UF, a Norwegian University, the International Institute for Environment and Development in London, and African partners in academia and management. The PI has been invited to Norway to discuss such options with Norwegian Ministry of Foreign Affairs (who disburse bi- and multi-lateral funding). Similar person-to-person negotiations have been opened up with the Kellogg

Foundation in South Africa and the Randolph Foundation in New York for projects that link scholarship to implementation in conservation in Southern Africa. This funding also provided the impetus for an NSF HSD grant, and for further grants still to be submitted (e.g. Linked human and ecological systems due November 2006).

Program/Agency	Title	Period	Status
Danish Council for Development Research	Monitoring Matters: Comparative Analysis of Innovative Approaches	2005-2008	Awarded: DKK7.9m (DKK303,626 for UF = USD \$48,903)
NSF/HSD	Parks as Agents of Social and Environmental Change in Eastern and Southern Africa	2006-2008	Awarded: \$366,446
RGP Research Opportunity Incentive Seed Fund 2006	Developing Adaptive Management and Governance Criteria for CBNRM Programmes in Namibia and Southern Africa	2006-2007	Awarded: \$72,500
Kellogg Foundation	Inter-disciplinary Adaptive Management and Community Development in Southern Africa	2007	Pending: Negotiations are on-going
Randolf Foundation	Free-market Conservation and Democratization in Southern Africa	2007-2009	Pending: \$100-300,000, negotiations are on-going
Norwegian Ministry of Foreign Affairs	Governance and Resource Management in Southern Africa	2007-2012	Pending: \$4,000,000+ for collaborative project, negotiations are on-going (major project highly likely to succeed)
USAID	Adaptive Performance Management and Peer Review for Devolved, Democratic Incentive Led Conservation in Southern Africa	2005-2007	Not granted: \$650,000
USAID SANREM CRSP Planning Project	Developing Adaptive Management and Governance Criteria for CBNRM Programs in Namibia and Southern Africa	2005	Not granted: \$50,000
USAID SANREM CRSP Main Project	Developing Adaptive Management and Governance Criteria for CBNRM Programs in Namibia and Southern Africa	2006-2008	Not granted: \$1,200,000

Leveraging/Cost Sharing

- IRDNC/WWF estimated contribution – US \$30,000
- WWF Supported work with approximately US \$20,000
- IRDNC provided field support staff, as did communities
- IRDNC provided me with use of vehicle for two months
- IRDNC provided housing

Impacts/Outcomes

We tested if participatory identification and monitoring of governance-related variables works (it does) and if this affects social evolution (it seems to). This provides confidence in methodology, a platform for further work, and further access to funding including from donors.

4. Asset Mapping and Environmental Health Needs Assessment in Lake Apopka Communities

Project Leader(s):

Joan Flocks, Director, Social Policy Division, Center for Governmental Responsibility,
University of Florida Levin College of Law

Dr. Natalie Freeman, Associate Professor, Environmental Health, College of Public Health and
Health Professions and College of Veterinary Medicine

Collaborators:

Internal

Dr. Steve Roberts, Professor/Program Director, Center for Environmental and Human
Toxicology

Ms. Meghan Schuck, Master of Public Health student, University of Florida

Ms. Zoe Finch, Master of Public Health student, University of Florida

External

Ms. Eugenia Economos, Organizer, Farmworker Association of Florida

Executive Summary

The Asset Mapping and Environmental Health Needs Assessment in Lake Apopka Communities project was designed to respond to environmental health concerns in central Florida communities surrounding Lake Apopka, the state's most contaminated lake. After initial study, field visits, and meetings with some of the area's community leaders, two UF Masters of Public Health (MPH) students, their supervisor Dr. Natalie Freeman, and community organizer Jeannie Economos completed 172 Environmental Health Surveys between January and April 2006. The survey instrument was based on the Protocol for Assessing Community Excellence in Environmental Health (PACE-EH) and included questions related to demographic information, social services and infrastructure, social and environmental concerns, and health concerns. Surveys were administered at community centers, advocacy centers, health clinics, and recreation sites using convenience and snowball sampling methods. Respondents were socially and ethnically diverse. Survey results varied according to where respondent was from and where the interview took place. Despite the diversity within the sample, some concerns were consistent across groups. For example, respondents expressed the same concerns about traffic congestion, available affordable housing, and drug trafficking. In terms of health concerns, the group as a whole considered dental problems, diabetes, drug and alcohol abuse, and hypertension to be serious issues in their communities. Although the results of this survey are not generalizable because of sample size and diversity, they nevertheless can provide groundwork for future study examining the relationship between environmental factors and health status in the area.

Rationale for Project

Lake Apopka consists of approximately 30,000 acres in Orange and Lake Counties of Central Florida, about 10 miles north of Orlando. It is the headwaters of an ecologically significant chain of lakes and rivers and, due to past agricultural and industrial pollution, the most contaminated lake in Florida. In 1985, the Florida legislature passed the Lake Apopka Restoration Act, mandating that several state and local agencies develop feasible restoration programs for the lake. Subsequently, the Saint Johns River Water Management District (SJRWMD) purchased 13,000 acres of farmland bordering the lake.

The health of wildlife in Lake Apopka has been extensively studied and the adverse impacts of contaminants are well documented. Yet there have been no human health studies conducted in the communities near the lake. Many residents in the Lake Apopka area feel they have been exposed to the same contaminants that have polluted the lake and that they have suffered adverse health effects. Some community members consider this to be environmental injustice caused, in part, by the fact that they are poor, of color, and/or work and reside in areas dominated by agricultural and industrial interests. These community members include farm workers who worked on the farms bought out by the SJRWMD, family members of these workers, and other non-farm worker residents. Potential sources of human exposure to substances that have contaminated the lake include: direct exposure of farm workers to pesticides on farms, exposure of farm workers and residents through drift from aerial applications, exposure of farm workers and family members through contaminated objects brought home from farm fields, exposure of area residents through contaminated groundwater, and exposure through consumption of contaminated fish and wildlife. Residents have also identified other local sites of environmental health concern including two Superfund sites; landfills that are located in some residents' backyards; a medical incinerator; a number of current and former industries, including fertilizer manufacturers and a former General Electric plant; and hundreds of plant and tree nurseries.

Since the purchase of Lake Apopka farms there has been only inconsistent attention drawn to the communities' expressed environmental health concerns. State agencies have been unresponsive to community requests for human health studies. Media and political attention has occurred only sporadically. Local grassroots and nonprofit organizations have tried to address specific health concerns, but their efforts are overwhelmed and under funded. In addition, the area is in a state of transformation as developers build up subdivisions for metropolitan Orlando on former agricultural and lake area land.

The proposed project is an attempt to gauge current community environmental health concerns through activities such as assets mapping and an environmental health needs assessment. These activities will provide the groundwork necessary for future, extramurally funded studies examining relationships between environmental factors and health status in this area. Activities will occur in two stages.

Stage 1 (Fall 2005):

1. *Collect and organize existing data on Lake Apopka communities.* Data include, but are not limited to, US Census tracking changes across time in demographic and economic characteristics of the community, Florida Department of Health and the Florida Department of Environmental Protection information about human and environmental health status of the area, and information collected by various community-based organizations about community concerns during the past decade.
2. *Introduce UF MPH students working on the project to the area and its residents.* The students will learn about the environmental, cultural, and occupational history of the area, and about community members' perspectives on historical pollutants in the area, perceived associations between pollutants and health effects, and the impact of the closing of the muck farms, the contamination of Lake Apopka, and the suburbanization of the area on their livelihoods and quality of life.
3. *Write a community description.* This description will include information about the geography, demographics and history of Lake Apopka communities as well as an overview of important community environmental health issues, information from meetings with community members and other information that will guide researchers during Stage 2.

Stage 2 (Spring 2006):

1. *Conduct community asset mapping.* Community asset mapping involves making an inventory of individuals, physical structures, natural resources, institutions, businesses, and informal organizations in the community in order to identify kindred interests, special skills, and available resources. This activity will provide the foundation for conducting a community-based environmental health needs assessment.
2. *Conduct a community-based environmental health needs assessment.* This assessment will address the concerns of residents near Lake Apopka about perceived health effects of living near Lake Apopka, working at former Lake Apopka farms, consuming local fish or wildlife, and other perceived means of exposure to the area's contamination. There has been no previous systematic collection and evaluation of information from community members in the area. In order to collect unbiased information, a formal assessment instrument will be developed that covers a range of environmental exposure conditions and perceived health conditions. These data will provide the basis for future outreach activity and research within the community. The needs assessment will include public health issues such as access to health care and availability of health information to individuals within the community and an environmental hazard assessment.

Deliverables Supported Entirely or in Part by this Grant

Publications

Finch, Zoe. 2006. Determining Community Needs through an Environmental Health Opinion Survey. MPH Special Project research paper.

Schuck, Meghan. 2006. Evaluation of a Convenience Sample from an Environmental Health Study of Lake Apopka Communities. MPH Special Project research paper.

Presentations

- Finch, Z. 2006. Determining Community Needs through an Environmental Health Opinion Survey. College of Public Health and Health Professions, Public Health Day.
- Flocks, J., Roberts, S., Schuck, M., Finch, Z., and E. Economos. 2006. Presentation of Environmental Health Needs Assessment survey at Zellwood Redland's Christian Migrant Association
- Flocks, J., 2006. Roberts, S., Schuck, M., Finch, Z., and E. Economos. Presentation of Environmental Health Needs Assessment survey to ACORN meeting participants.
- Flocks, J. 2006. Environmental Justice and Proactive Actions. Center for Environmental Health and Justice, Florida State Conference on Environmental Health, Justice, and Economic Prosperity, Orlando, FL.
- Flocks, J., Roberts, S., Schuck, M., Finch, Z., and E. Economos. 2006. Presentation on survey at Redlands Christian Migrant Association meeting in Mascotte, FL
- Flocks, J., Roberts, S., Schuck, M., Finch, Z., and E. Economos. 2006. Presentation on survey and discussion with community members at a community health and resource fair, John Bridges Center, Apopka.
- Freeman, N. 2006. Assessment of Residents' Environmental Health Perceptions Living near a Contaminated Lake. International Conference on Environmental Epidemiology and Exposure.
- Schuck, M., 2006. Evaluation of a Convenience Sample from an Environmental Health Study of Lake Apopka Communities. College of Public Health and Health Professions, Public Health Day.

Extramural Grant Proposal(s) Submitted and Status

In April 2005, a proposal for a Lake Apopka Outreach Core was submitted to the National Institute of Environmental Health Sciences (NIEHS) as part of the University of Florida Superfund Basic Research Project (SBRP). As originally stated in the proposal for the SNRE seed funding grant, activities outlined above were designed to support the Outreach Core. However, the UF SBRP was not refunded in the year 2005-2006, although the outreach core proposal received the best score out of all proposed projects and cores. There are plans to resubmit a UF SBRP proposal in 2007. The Outreach Core will again be a part of the SBRP proposal and the activities from the SNRE seed funding project will strengthen the core proposal. Funding for the Outreach Core is approximately \$100,000/yr for five years.

Program/Agency	Title	Period	Status
National Institute of Environmental Health Sciences (NIEHS)	Disease Investigation through Specialized Clinically-Oriented Ventures in Environmental Research (DISCOVER) [P50]	2007	Not granted: Up to 1.5 million center/year;
UF SBRP	Support the Outreach Core Program	2007	Pending: \$100,000/ 5 years.

Leveraging/Cost Sharing

- The University of Florida Superfund Basic Research Program contributed \$5000 to this project.
- Two Master of Public Health students logged approximately 300.5 hours (approximately \$2,000/per student) from October, 2005 – April, 2006 in preparing for and conducting the Environmental Health Needs Assessment survey.

Impacts/Outcomes

Results of the fieldwork and environmental health assessment survey show that Lake Apopka communities have similar social and health concerns as other low to mid-income communities. Concerns about a lack of access to dental care, drug trafficking, and health issues such as diabetes and hypertension are common concerns in economically similar communities across the nation. The Lake Apopka area is unique not only in that it has experienced a number of incidents resulting in environmental contamination, but that it is experiencing rapid development as a result of being close to metropolitan Orlando. Concerns about traffic congestion and lack of available affordable housing are likely a reflection of this growth. Yet, just because respondents did not consistently bring up environmental health concerns does not mean there are no issues there. It could mean, for example, that there is a general lack of awareness about the environmental health of the area, or that basic health care needs are more pressing on these populations. The fact that the expressed concerns reflected basic structural inequities is also not unrelated to the fact that these are communities that also host environmental contamination. Current efforts by other community organizations are focusing more on specific environmental health concerns. A chapter of the Association of Community Organizations for Reform Now (ACORN) is focusing on several landfills and industries located in low-income neighborhoods. The Farmworker Association of Florida (FWAF) has just presented results from a study on the adverse health effects of pesticide exposure among former Lake Apopka farm workers. The results of the current project can build on the momentum brought to the community through these other efforts, as well as bring in a wider range of surrounding community members who are concerned about particular health issues. Efforts of all community-based organizations in the area will benefit from support of a wider, more diverse population.

5. Molecular Biology of Arsenic Reduction, Detoxification and Hyperaccumulation in *Pteris vittata*.

Project Leader(s):

Dr. Bala Rathinasabapathi, Horticultural Sciences Department
Dr. Lena Ma, Soil and Water Science Department

Executive Summary

Arsenic is of great environmental concern due to its extensive contamination and carcinogenic toxicity. *Pteris vittata*, the first known arsenic hyperaccumulator, was discovered by Co-PI's research team and reported in Nature. This discovery led to the idea that phytoextraction, a plant-based green technology, may become a reality as a cost-effective and environment-friendly method to clean up arsenic-contaminated sites. However, before *P. vittata* can be successfully used, it is paramount to first understand the underlying mechanisms of its arsenic hyperaccumulation. The goal of the two-year SNRE grant was to develop molecular biology tools to understand arsenic hyperaccumulating fern *Pteris vittata* L. Utilizing funding from SNRE we have developed an expression cDNA library from fronds of *P. vittata* plants exposed to arsenic. A novel method was developed to identify cDNAs implicated in arsenic resistance by expressing them in a microbial model. Biochemical research on specific fern proteins has unraveled some aspects of the arsenic resistance mechanism of this extraordinary fern.

Rationale for Project

Prior to our research little molecular biology research has been done on understanding arsenic hyperaccumulation in *Pteris vittata* L. SNRE research funding enabled us to develop key research tools and apply them to advance the knowledge base in this area of research. We have achieved the two objectives set forth in the original proposal and more. Our research identified for the first time (a) a role for fern triosephosphate isomerase in arsenate reduction and (b) a novel glutaredoxin with a role in regulating cellular arsenic levels. These results will be used as preliminary data in proposals submitted to federal grant agencies.

Deliverables Supported Entirely or in Part by this Grant

Publications

Kertulis-Tartar, G.M., Rathinasabapathi, B., and L.Q. Ma. 2007. Effects of arsenic on glutathione reductase and catalase activities in the fronds of *Pteris vittata* L., an arsenic-hyperaccumulating fern and *P. ensiformis*, an arsenic-sensitive fern. Environmental and Experimental Botany (under review).

Rathinasabapathi, B., Wu, S., Sundaram, S., Rivoal, J., Srivastava, M., and L.Q. Ma 2006. Arsenic resistance in *Pteris vittata* L: Identification of cytosolic triosephosphate isomerase based on cDNA expression cloning in *Escherichia coli*. Plant Molecular Biology (in press).

Rathinasabapathi, B., Raman, S.B., Kertulis, G., and L.Q. Ma. 2006. Arsenic-resistant proteobacterium from the phyllosphere of arsenic-hyperaccumulating fern *Pteris vittata* reduces arsenate to arsenite. *Canadian Journal of Microbiology* 52:695-700.

Rathinasabapathi, B. 2006. Ferns represent an untapped biodiversity for improving crops for environmental stress tolerance. *New Phytologist* (in press).

Rathinasabapathi, B., Ma. L.Q., and M. Srivastava . 2006. Arsenic hyperaccumulating ferns and their application to phytoremediation of arsenic contaminated sites. In: "Floricultural Advances" Edited by Jaime A. Teixeira da Silva, Global Science Books, Ikenobe, Japan pp.304-311.

Sundaram, S., Rathinasabapathi, B., and L.Q. Ma. 2006. A novel arsenate-activated glutaredoxin of arsenic hyperaccumulator fern *Pteris vittata* L.: Potential role in regulating intracellular arsenite levels. *Plant Physiology* (in preparation).

Poster Presentations

Sundaram, S., Rathinasabapathi, B., Wu, S., Ma, L.Q., and B. Rosen. 2006. Functional genomics of the arsenic hyperaccumulator fern *Pteris vittata* L.: cDNA cloning and heterologous expression of a multifunctional arsenate reductase. Poster presentation, *Plant Biology* American Society of Plant Biologists, Aug 5-9, Boston, MA, USA.

Visitor Invitation, Seminar & Collaboration

Dr. Barry Rosen (Wayne State University) presented a special seminar at the Horticultural Sciences Department and held discussions for research collaboration.

Rosen, B., Mechanisms of arsenic transport and detoxification in prokaryotes and eukaryotes. Seminar by Dec 10, 2005.

Extramural Proposal(s) Submitted and Status

Two proposals to the National Science Foundation were submitted during 2005 and 2006. Both times it was not funded. However, the comments from the reviewers suggested much enthusiasm for the proposed ideas and showed promise for future submissions. The PI and Co-PI plan to submit proposals to both the National Science Foundation and the United States Department of Agriculture NRICGP program this year.

Program/Agency	Title	Period	Status
USDA-NRICGP.	Biotransformation of Arsenic and Phosphate in Rhizosphere of <i>Pteris vittata</i> : Roles of Microbes and Root Exudates.	2007	Pending: \$250,000
National Science Foundation	Evolution of Arsenic Hyperaccumulation in Ferns: Generation and Comparative Analyses of Fern Expressed Sequence Tags.	2007	Pending: \$350,000
National Science Foundation	Functional Genomics of the Arsenic Hyperaccumulating Fern <i>Pteris vittata</i> L.	2005	Not granted: \$467,629
National Science Foundation	Functional Genomics of the Arsenic Hyperaccumulating Fern <i>Pteris vittata</i> L.	2006	Not granted: \$373,489

Program Development

Rathinasabapathi B, Ma LQ. (2006 to 2011). HOS-04255. Arsenic resistance and hyperaccumulation in *Pteris vittata* L. Joint CRIS project.

Leveraging/Cost Sharing

- Our research productivity is reflected in the generation of five peer-reviewed articles and one review article published directly from research supported by this grant.
- The project served for professional training of one graduate student (Gina Kertulis) and two post-doctoral associates (Mrittunjai Srivastava and Sabarinath Sundaram).
- In kind support for two post-doctoral students is estimated at \$ 60,000 USD, and one graduate student at \$15,000 USD.

Impacts/Outcomes

Our research has generated a high quality cDNA library of *P. vittata* and uncovered important new details about how the arsenic hyperaccumulating fern tolerates high levels of arsenic. Some of the cDNAs isolated will be instrumental for future research to develop technologies for remediating arsenic-contaminated water and soil. We expect that our joint publications will have a high impact in the scientific community and in our success in winning research grants.

6. Role of the Quorum Sensing Signal Mimics in Plant-Bacterial Symbiosis

Project Leader(s):

Dr. Max Teplitski, Assistant Professor, Department of Soil and Water Science, University of Florida-IFAS

Collaborators:

Internal

Dr. Nicole Horenstein, Associate Professor, Chemistry Department, University of Florida

Dr. Mengsheng Gao, Post-Doctoral Scientist, Dept of Soil and Water Science, UF-IFAS

External

Dr. Richard T. Sayre, Professor, Dept of Plant Cellular and Molecular Biology, OSU

Dr. Wolfgang D. Bauer, Professor, Dept of Agronomy, University of California, Davis

Executive Summary

This proposal was based on our recent discovery that many plants produce signal “mimics”, the compounds which specifically interfere with bacterial quorum sensing. Quorum sensing (QS) is the mechanism of bacterial cell-to-cell communication and gene regulation. It is central to structuring and survival of bacterial communities, and for bacterial infection or colonization of plant and animal hosts. Because of the role for QS in biological control and Nitrogen-fixing symbiosis, plant mimics may have important applications in environmental sciences to promote sustainable beneficial plant-bacterial communities within natural and anthropogenic ecosystems. The goal of this SNRE proposal was to prepare a solid NSF proposal, which explores the roles of QS in the interactions of a model legume *Medicago truncatula* with its nitrogen-fixing bacterial symbiont, *Sinorhizobium meliloti*.

Rationale for Project

The goal of this SNRE proposal was to prepare a solid NSF proposal, which explores the roles of QS in the interactions of a model legume *Medicago truncatula* with its nitrogen-fixing bacterial symbiont, *Sinorhizobium meliloti*. The full NSF proposal has three objectives:

1. Use reverse in-vivo expression technology (RIVET) and microarrays to identify symbiotic behaviors in *S. meliloti*, which are controlled by QS during bacterial interactions with its plant host.
2. Characterize the role of QS mimic compounds in structuring of host-associated bacterial communities by altering both the plant’s ability to produce mimics and the bacterium’s ability to sense/respond to the QS signals and/or plant mimics.
3. Purify and chemically characterize one or more of the QS signal-mimic compounds from *M. truncatula*. Test interactions of the purified (or synthetic) mimics with bacterial signal receptors.

Funds were requested to supplement (50%) salary of a dedicated post-doctoral scientist for a year, and also partially cover costs of data analyses, genetic library construction and screening. The full year of funding is requested to help us prepare and submit the NSF proposal, and to sustain rigorous, continuous research efforts while the NSF proposal is in review. An amount of \$30,400 was requested, and \$10,000 was actually allocated to the project.

Deliverables Supported Entirely or in Part by this Grant

Publications

Gao, M., Chen, H., Eberhard, A., Gronquist, M. R., Robinson, J. B., Connolly, M., Teplitski, M., Rolfe, B. G., and W. D. Bauer. 2007. Effects of AiiA-Mediated Quorum Quenching in *Sinorhizobium meliloti* on Quorum-Sensing Signals, Proteome Patterns, and Symbiotic Interactions- *Molecular Plant-Microbe Interactions Journal*; accepted on 15 February 2007.

Teplitski, M. Identification of lumichrome as a eukaryotic quorum sensing signal-mimic (in progress)

Teplitski, M. Identification of the in vitro QS regulon of *Sinorhizobium meliloti* (in progress)

Presentations

Joglekar, Kiran. Regulation of Quorum Sensing by AHL-mimics in prokaryotes. 2006. Florida Branch American Society for Microbiology Annual Meeting. Cocoa Beach, FL. **Awarded the “Best Oral Presentation”**

Teplitski, M. 2005. Eukaryotic signal-mimics disrupt quorum sensing-dependent gene regulation in bacteria. The Annual SEB Meeting, American Society for Microbiology, St. Petersburg, FL.

Teplitski, M. 2005. Quorum sensing in symbioses: root zone and beyond. Mote Marine Laboratory, Sarasota, FL.

Teplitski, M. 2005. Quorum sensing in symbioses: root zone and beyond. Whitney Marine Research Lab, St. Augustine, FL.

Teplitski, M. 2005. Underground Communication: Who listens when microbes talk? Oxford College, GA.

Teplitski, M. 2005. Underground Communication: Who listens when microbes talk? Jacksonville University, AL .

Teplitski, M. 2006. Presentation of current research for contract negotiation. XL Tech Group, Melbourne FL

Seminar for PLP6905 (Plant Pathology and Friends, at CREC)

Poster Presentations

Gao, M., Bauer, W., and M. Teplitski. 2006. Characterization of the *in vitro* quorum sensing regulon of *Sinorhizobium meliloti*. 106th American Society for Microbiology General Meeting. Orlando, FL.

Rajamani, M. Teplitski, M., Bauer, W. D., and R.T. Sayre. 2005. Algae secrete compounds that mimic bacterial quorum sensing signals. American Society of Plant Biologists Annual Meeting. Seattle, Washington.

Teplitski, M. and G. Compton. 2006. Aquatic Microbial Biofilms: A learning tool for high school biology. 106th American Society for Microbiology General Meeting. Orlando, FL.

Collaborative Projects

As a result of this research, we have initiated a collaborative project with Dr. K. Ritchie (Mote Marine Research Lab) to study the role of quorum sensing in coral-associated bacterial communities. We have submitted two exploratory grant proposals (to Lindberg Foundation and to National Geographic Foundation); total funding requested through these proposals: ~\$44,000. Both proposals are currently in review. A graduate student, Cory Krediet, has joined my lab to work on this project through the SNRE program.

Extramural Proposal(s) Submitted and Status

Program/Agency	Title	Period	Status
NSF*	<i>Sinorhizobial</i> quorum sensing <i>in vivo</i> and its symbiotic manipulation by QS signal-mimic compounds from the host.	2005	Not granted: \$638,887 .
NSF, IOB-Behavioral Systems Cluster	CAREER: The <i>in vivo</i> role for Quorum Sensing and Quorum Sensing signal-mimics in <i>Sinorhizobium-Medicago</i> symbiosis.	2006	Not granted: \$731,242
NSF-MCB	Linking forest litter chemical diversity, microbial functional diversity and phosphorus bioavailability.	2006	Not granted: \$354,053
XL TECH Group, Ltd	Initial characterization of controlled sensor blockers.	2007	Contract for \$11,295
Dean of IFAS Research	Initial characterization of controlled sensor blockers.	2007	Funded: \$41,793
Lindberg Foundation	Bacterial Bioshields: Beneficial bacteria protect corals from pathogens by disrupting cell-to-cell communication.	2007	Funded: \$9,900
National Geographic Foundation	Master Manipulators: Corals recruit beneficial microbes and promote bacterial information wars.	2007	Funded: \$20,000

*The proposal was ranked as “High Priority”, but was not funded. The panel summary pointed out that the “panel was excited by the science in the proposal. The panel was also enthusiastic about the potential of RIVET technology to detect quorum sensing modulation and commented that the experiments are largely very well thought out and the writing is clear”. Some of the technical issues of the proposed experiments were pointed out as potential weaknesses.

Leveraging/Cost Sharing

- The collaborative project with Dr. Ritchie allowed me to recruit an outstanding graduate student, Mr. Cory Krediet, who has joined our research group this Fall, through the SNRE program. Mr. Krediet is supported by the start-up funding allocated to me by the Soil and Water Science Department estimated \$15,000 USD.

Impacts/Outcomes

With this funding (\$10,000) we were able to obtain much of the needed preliminary data for the NSF proposal. The funding was also central to our ability to work on development of three manuscripts, each of which focuses on the role of QS in plant-bacterial interactions. The support from SNRE mini-grant helped us develop a highly visible program, which lead to the development of three new collaborations with Dr. K. Ritchie at Mote, Dr. A. Wright at UF, and with XL TECH Group.

FY 2005-2006 NEW FACULTY GRANTS REPORTS

7. The Conflicting Polices of the Endangered Species Act and U.S. Pesticide Law

Project Leader(s):

Dr. Mary Jane Angelo, Assistant Professor of Law, Frederic G. Levin College of Law

Collaborators:

Ms. Christina Storz (SNRE MS Candidate and joint Law student)

Mr. Kevin Shuler (Law student)

Executive Summary:

For more than 30 years a significant conflict has existed between two major federal environmental laws -- the 1973 Endangered Species Act (ESA) and the 1972 Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). Section 7 of the ESA imposes special duties on federal agencies including the duty to use their existing authorities to conserve threatened and endangered (T & E) species, and the duty to insure that their actions are not likely to jeopardize the continued existence of a T & E species. As a federal agency, the U.S. Environmental Protection Agency (EPA) is governed by the mandates. At the same time, however, EPA is charged with carrying out the mandates of FIFRA, which require that EPA register pesticides if the applicant for registration can demonstrate that the pesticide will not cause unreasonable adverse effects on the environment. This standard has been interpreted to require a balancing of the economic and other benefits to be derived from the pesticide against the environmental and health risks posed by the pesticide. Accordingly, if EPA determines that the benefits of the pesticide outweigh the risk, EPA must register the pesticide despite the fact that it may pose significant environmental risks, including risks to T & E species. In fact, because pesticides by their very nature (and by statutory definition) are intended to kill, injure or disrupt living organisms in the environment, many pesticides pose serious risks to species in the wild, including T & E species. The most widely used pesticides in the U.S., are highly toxic to mammals, birds and other wildlife species. Consequently, the use of EPA-approved pesticides may pose significant risks to T & E species. In fact, a 2004 study by the Center for Biological Diversity concludes that EPA has approved pesticide registrations that put more than 375 T & E species at risk.

The two conflicting statutory mandates have created a serious dilemma for EPA. Despite federal court decisions dating back to 1989 that have held that EPA can be liable for a take under the ESA by registering pesticides that result in the take of an ESA-listed species, EPA has consistently failed to fully comply with the ESA. Recently, a number of cases have been filed in federal courts asserting that EPA is in violation of the ESA. EPA has responded to this increased scrutiny by issuing new regulations, which, in essence, exempt EPA from certain provisions of the ESA. Preliminary research indicates that no significant scholarly research has been done to date on these issues.

The specific research needs for this project are described below. This project analyzes all of the biological opinions (BiOps) issued by the US Fish and Wildlife Service (FWS) since the mid-1980s and follows-up on the actions that EPA has taken in response to the recommendations made by FWS. The research results indicate that EPA has consistently failed to comply with the ESA when it makes decisions on the registration of pesticides. EPA has failed to consult the appropriate agency on most pesticide decisions. In the instances where EPA has consulted, EPA has consistently failed to follow the recommendations of the FWS. For example, major BiOps issued by the FWS in 1989 and 1993 identified over 400 circumstances in which EPA's registration of a particular specified pesticide jeopardizes the continued existence of a T & E species. As of mid-2006, EPA has failed to implement the recommendations contained in the biological opinions to reduce the risk to these species. The research indicates that EPA has consistently failed to take action to protect T&E species from pesticides, except in the limited circumstances where EPA has been sued under the ESA and a court has expressed ordered such action. Through this research, it is anticipated that a proposal to revise existing law will be developed identifying how to best accomplish the competing purposes of these two major federal environmental statutes.

Rational for Project

To fully research the above-described issues, funding is necessary to do the following: 1) develop three extensive Freedom of Information Act (FOIA) requests to be filed with the EPA and with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service (together, "the Services") to obtain biological opinions (BiOps) for EPA pesticide registration or cancellation decisions and to obtain EPA's pesticide registration documents; 2) pay for the costs of copying and postage for the large number of documents anticipated to result from the FOIA request 3) hire two graduate student research assistants (one law student and one SNRE graduate student) to analyze the documents obtained from a scientific and legal perspective to determine whether EPA has implemented the reasonable and prudent alternatives suggested in the BiOps (Research Assistants also will assist the P.I. in: conducting an analysis of the competing requirements and competing goals of the ESA and FIFRA; researching EPA's historic approach to dealing with these conflicting mandates and how courts have addressed the issue; and analyzing the 2004 regulation exempting EPA from certain ESA requirements); 4) to finance one trip to Washington, D.C. to meet with and obtain additional information from officials of EPA, the Services, and certain NGOs, such as the Defenders of Wildlife, which has been actively involved in these matters. Prior to the trip, specific officials at each agency will be identified and contacted to set up appointments and a series of questions will be developed before each trip to ensure that the interviews run efficiently and that as much pertinent information as possible is obtained.

Deliverables Supported Entirely or in Part by this Grant

Publications

Completion of legal academic research paper to be published in national legal journal. Publication will be mailed to significant environmental law faculty, environmental agencies and environmental organizations. (Draft form)

Research findings will be used for book that is currently under a tentative contract from Ashgate Publishers.

Presentations

Angelo, M.J., The killing fields: conflicting policies of the Endangered Species Act and U.S. Pesticide Law. SNRE Seminar Series. October 17, 2006.

Angelo, M.J. Environment & Agriculture. CGR 8th Annual Conference on Legal & Policy Issues in the Americas. April 11-12. Gainesville, FL

Leveraging/Cost Sharing

- This project did not involve other faculty members as collaborators. However, two graduate students assisted with the research. One current graduate student, Christina Storz, is a joint law student and SNRE graduate student. The other student, Kevin Shuler, was a law student who graduated in May 2006.
- Estimated \$30,000 USD in kind support for graduate students working on the research.

Impacts/Outcomes

The results of this research project will be provided to federal regulators, and environmental advocacy organizations to increase their awareness of this problem. Recommendations will be provided on ways that the conflict can be resolved.

As a result of this research, Professors Richard O. Brooks, Vermont Law School and Ross Virginia, Dartmouth, have recommended to Ashgate Publishers that they contract with Mary Jane Angelo to write a book on “Pesticide Law and Ecology” as part of their “Law & Ecology” series.

8. Shoreline Stewardship Program: Florida Friendly Living on the Waterfront

Project Leader(s):

Dr. Joan Bradshaw, Specialized Regional Extension Programs Natural Resources Citrus, Hernando, Pasco, and Sumter Counties

Collaborators:

Internal

Susan A. Kelly, County Extension Director, UF/IFAS Sumter County
Horticulture and FYN faculty in Citrus, Sumter, Hernando and Pasco County Extension

External

Citrus County Public Utilities
Hernando County Public Utilities
Southwest Florida Water Management District
City of St Petersburg

Executive Summary

Lake Panasoffkee in Sumter County has been designated as an Outstanding Florida Water by the Florida Department of Environmental Protection and is the third largest lake of the 1,800 lakes in west central Florida. Lake Panasoffkee is currently undergoing a \$25 million dredging project to revitalize the 920 acre lake. A major restoration project goal is the removal of 8.3 cubic yards of sediment from the lake bottom, as well as removal of unwanted aquatic weeds and emergent vegetation. A public awareness and Extension educational programs were initiated showcasing lake restoration efforts and prompting community call-to-action to maintain the renewal efforts via shoreline stewardship practices. A goal of the project was to persuade the community to become a "Lake PanPal" with the objective of creating a lake stewardship mind set. This program promoted shoreline stewardship actions to sustain and enhance the restoration efforts on Lake Panasoffkee and neighboring waterways.

Rational for Project

Lake Panasoffkee has a national reputation for its red-ear sunfish fishery making the lake an import contributor to the local and regional economy. Although fishing remains popular at Panasoffkee, the lake's future as an important recreation resource was threatened as a result of the loss of fishing spawning areas and open waters. A Lake Panasoffkee Restoration Council was formulated to administer a restoration plan consisting of dredging approximately 8,208,735 cubic yards of accumulated sediment and undesirable vegetation from the lake and residential canals.

To address educational needs associated with the restoration of the lake, the Shoreline Stewardship Program was initiated to address Florida-friendly shoreline planting, boating and fishing topics to focusing on habitat restoration.

Deliverables Supported Entirely or in Part by this Grant

Presentations, Exhibits and Awards Presentation

Program

Lake Panasoffkee Celebration was a family-oriented event designed to kick off activities associated with Lake Panasoffkee Restoration. The one-day event was hosted by the Sumter County Extension in conjunction with Sumter County Parks Department, SWFWMD, Sheriff Department, Fire and Rescue, University of Florida LakeWatch, Sumter Electric Company (SECO) and Florida Fish and Wildlife Conservation Commission. A goal of the program was to engage participants via a variety of demonstrations, presentations and exhibits on the following topics: Lake Pan - Now and Beyond, The Making of a Quality Lake, EZ Shoreline Landscaping the Florida- Friendly Way, Watershed Awareness, Water Conservation, Pollution Prevention, and Septic System Management.

Poster Contest

More than 500 residents attended the event and 165 residents took the pledge to Keep Lake Panasoffkee beautiful. A youth poster contest was held to encourage students to use their artistic talents to creatively share ideas on how Lake Panasoffkee residents can preserve the waters of the lake. One hundred and eight students submitted posters at this event.

Extension Publications

- Florida Friendly Living on the Waterfront- 50 Ways to Love your Lake
- But it's just a piece of Fishing Line...How harmful can it be?
- Aquatic Weeds: What you need to know
- Do-it-Yourself Sprinkler System Check up

Educational Materials

- Launching ramp aquatic weed signage- 10 launching ramp reminding boaters to prevent the spread of aquatic weeds.
- Monofilament Fishing Line Recycling Bins- Six bins will be established in conjunction with the launching aquatic weed signage.
- Information stations. Water resistant information stations will be established at with the 10 launching ramp signs where information brochures will be made available with information on aquatic weeds and fishing line recycling.

- Aquatic Weeds placemats for lake side restaurants 10,000 placements are being printed with information on aquatic weed and will be placed in following restaurants: Catfish Johnny's, Moes, Harbor Lights, Weda Hecamit, and Tracey Point

Extramural Grant Proposal(s) Submitted and Status

Program/Agency	Title	Period	Status
UF IFAS/IPM Florida Grants	Lake Panasoffkee Lake Restoration Outreach	2005	Funded: \$9000
Southwest Florida Water Management District Community Education grant	Water Wise Irrigation	2005	Funded: \$5000

Leveraging/Cost Sharing

- Susan Kelly, Sumter County Director received additional Community Education funds (\$5,000) and Tourism dollars (\$3,000) to support the Lake Panasoffkee celebration.

In-kind Support (FTEs of PIs, staff, and students including partners and collaborators)

In addition to funding provided by the SNRE grant, SWFWMD grant and an IPM grant, Sumter County provided additional funding to support the program. Parks Department donated the use of the site and 10 tents for the Lake Panasoffkee Celebration. A number of local businesses and county operations provided prize donations: PanaVista Fishing Lodge, Bass Water Fishing, Citrus County Parks Department, Citrus County Fire and Rescue. Additionally 30 volunteers assisted in doing presentations, registration, parking, event photography, and kids' activities.

Breakdown of costs for the program shared through leveraging.

<i>Item</i>	<i>#</i>	<i>Rate</i>	<i>Total</i>
Tents (10' X 20')	10	\$100/day	\$1,000
Prizes- Fishing Poles	10	\$15.00	\$150.00
Prizes Bait Buckets & accessories	10	\$10	\$100.00
Poster Contest Prizes	4	\$25	\$100.00
Live Bait- Fishing Derby	3 cases	\$10.00	\$30.00
Refreshments for 50 kids	50	\$1.00/child	\$50.00
Bobbers/hooks sunscreen	50	\$1.00/child	\$50.00
Volunteers	30 for 8 hours	\$18.04*	\$4,329.60
GRAND TOTAL			\$5,809.60

* Website for monetary value in the US- Most current figure (announced in 2006 for 2005): \$18.04/hour
http://www.independentsector.org/programs/research/volunteer_time.html

Impacts/Outcomes

As a result of the event and publications disseminated at a number of other events, there was a heightened awareness of water quality issue specific to Lake Panasoffkee. In addition to the knowledge gained as a result of the one-day event, residents became aware of the new location of the UF/IFAS Sumter County Extension, making it possible to know where to obtain additional shoreline stewardship information.

9. Development of Effective Sampling Methods for Wetland Ecological Assessment

Project Leader(s):

Dr. Matt Cohen, Assistant Research Scientist, Wetland Ecology and Environmental Informatics, Soil and Water Science, IFAS-SFRC

Dr. Ed Dunne, Assistant Research Scientist, Soil and Water Sciences, IFAS-SWSD

Collaborator(s):

External

Dr. Greg Bruland, University of Hawaii

Executive Summary

As mandated by the US EPA, numeric nutrient criteria (NNC) are being defined to protect a water body's designated use. These NNC specify fixed thresholds of water or soil quality which, when exceeded, invoke Federal protective measures like designation of Total Maximum Daily Loads. Single observations of water or soil chemistry, when compared to NNCs for the particular ecoregion, are expected to provide meaningful information about ecosystem condition, and ultimately be used for determining regulatory compliance with the Clean Water Act.

While this approach to ecosystem assessment is simple, it is almost certainly overly simplistic, and consequently misleading, when applied to wetland ecosystems, which are profoundly variable even within ecoregion due to landscape position, geology, hydrology, vegetation types, and microbial communities.

Using single numbers such as numeric nutrient criteria may also present illusory inference; single observations, in space or time, of soil or water nutrient concentrations are insufficient to reliably estimate ecosystem condition. We focus in this work on spatial variability, and how that might confound inference; while, we narrow our focus to one wetland type (cypress domes), the protocols that we've developed are both highly portable and simple to implement.

Our findings suggest that spatial variability and pattern can profoundly affect inference of wetland ecosystem condition when using small sample sizes. To reliably estimate system-level numeric nutrient levels (in this case soil total phosphorus, which is among the primary candidates for defining wetland NNCs) in the soil to within 10% of the true level, collection of between 8 and 21 samples is required. Sample numbers for minimally impacted wetlands was towards the higher end of this range due to substantially greater spatial autocorrelation. This latter finding, where we observed almost complete loss of spatial structural patterns with increasing anthropogenic influence, holds significant promise as a systems-level indicator of human-modified self-organizational processes.

Project Rationale

Develop understanding of spatial structure (autocovariance) at the ecosystem scale.
Make use of spectroscopy as a means to increase sampling power and spatial density.
Determine sampling intensity requirements for system-level characterization.

Extramural Grant Proposal(s) Submitted and Status

This work is currently being compiled for publication in a national-level peer-reviewed journal (some of the figures are included in this report) and the preliminary results obtained are being used for proposal development to NSF's ecosystems panel. Proposal submission is anticipated by June 20.

Program/Agency	Title	Period	Status
NSF/DEB – Ecosystems panel	Quantifying Ecosystem Spatial Self-Organization along a Gradient of Anthropogenic Impairment	2007	Pending: \$140,000/ per year for two years (\$280,000 total)

Deliverables Supported Entirely or in Part by this Grant

Publications

Cohen, M., Dunne, E., and Greg Bruland. 2007. Spatial structure of Isolated Forested wetland soils and implications for sampling design and condition assessment. *Wetlands*. (In final review).

Educational Opportunities

Supported exposure of graduate students to new instrumentation (VNIR spectrometer) and field methods.

Leveraging/Cost Sharing

- Drs. Cohen and Dunne both contributed approximately 5% of their time over the year to development, implementation, analysis and reporting (estimated \$6,500 total contribution).
- Laboratory manager time at the Wetland Biogeochemistry Laboratory, Soil and Water Science (estimated \$500 contribution), and graduate student assistance was provided to this project at a cost (estimated \$500 contribution).
- Supported undergraduate research on data analysis and wetlands (Evan Ratner – summer 2006) – estimated \$2,000 total.
- Field Equipment: Vehicle, samplers, basic laboratory equipment were provided at no cost; laboratory analyses were provided at reduced cost (\$200 contribution).

Impacts/Outcomes

Overall project impacts include the improved understanding of sampling requirements for wetland assessment as well as compelling preliminary evidence regarding the effects of anthropogenic disturbance on the development and persistence of self-organizing spatial structure. This research also led to several explicit conclusions:

Conclusions

1. Wetlands are profoundly heterogeneous, and efforts to characterize a given wetland using a small number of observations will be fraught with interpretative uncertainty.
2. Wetland spatial pattern may further complicate sampling, because a reliable system-level characterization requires sampling from points that are independent (i.e., not spatially autocorrelated). This is particularly problematic in minimally impacted systems, where autocorrelation appears more pronounced.
3. Spatial patterns are changed by increasing impact intensity. Sites in minimally impacted landscapes exhibit the expected radial spatial trends driven by autogenic processes, while those trends are missing from impacted sites, and are replaced by linear, gradient-based trends that may arise from allogenic factors.
4. The influence of spatial heterogeneity on sampling requirements results is significant; our analysis suggests that nearly 20 samples would be required to adequately characterize these isolated wetlands, though the sample requirements varied by impact intensity.
5. Spectral reflectance data obtained from each soil may provide a useful surrogate for conventional laboratory methods for the purpose of determining the strength and character of spatial patterns.

10. Increasing Citizen Involvement in Everglades Restoration and Management

Project Leader(s):

Alyssa Dodd, Agriculture and Natural Resources Regional Extension Faculty, specializing in public policy education, UF/IFAS Palm Beach County

Dr. Mark A. Brennan, Assistant Professor, Community Development, Family, Youth, and Community Sciences, UF/IFAS;

Dr. Glenn Israel, Professor, Extension Program Development, Agricultural Education and Communication, UF/IFAS

Collaborator(s):

Internal

Dr. Frank Mazzotti, Associate Professor, Wildlife Ecology and Conservation, UF/IFAS

Executive Summary

The University of Florida, Institute of Food and Agricultural Sciences (UF/IFAS) Extension conducted research to better understand citizen awareness of Everglades' issues and opportunities to participate in Everglades public decision making processes and management decisions. A mixed methods research framework, consisting of key informant interviews (n=15) followed by a citizen mail survey (sample n=1200) was used to meet project objectives. The ultimate goal is to provide recommendations for developing and delivering timely, relevant, and high quality educational programs to increase citizen understanding and involvement in Everglades' restoration and management.

Rational for Project

A need exists for Extension and other interests to better understand the important role of citizen involvement in local natural resource management. This is particularly relevant in the southeastern counties of Florida that surround the Everglades. Newspapers, academic research, and extension activities continue to document the local issues facing communities in this part of the state. All point to difficult and controversial public decisions that directly affect Everglades restoration and management. UF/IFAS has a tremendous opportunity to develop and deliver a timely, relevant, and high quality educational program to increase citizen understanding and involvement in Everglades restoration and management. However, before an effective educational program can be developed, there is a need to better understand citizen awareness and knowledge of Everglades issues, understanding of public decision-making processes, and desire to participate.

Deliverables Supported Entirely or in Part by this Grant

Publications

Brennan, M. A. and Dodd, A. R.,2007. Exploring Citizen Involvement in the Restoration of the Florida Everglades. Journal of Society and Natural Resources.

Dodd, A.R. 2006. Agricultural and Natural Resources Regional Specialized Agent Extension Education Plan. UF/IFAS Palm Beach County Extension. West Palm Beach, FL.

Dodd, A. R. and M.A. Brennan. 2006. Get Involved: Everglades Restoration. EDIS Document. UF/IFAS Extension. Gainesville, FL.

Dodd, A. R., Brennan, M. A. and G.D. Israel. 2006. Increasing Citizen Involvement in Everglades Restoration and Management: Final Project Report. UF/IFAS Palm Beach County Extension. West Palm Beach, FL.

Dodd, A. R., Brennan, M. A. and G.D. Israel. 2007. Extension's Role in Increasing Citizen Involvement in Everglades Restoration. Journal of Extension.

Dodd, A. R. & Brennan, M. A. 2006. 2007. Increasing Citizen Involvement in Everglades Restoration and Management. UF/IFAS Palm Beach County Extension. West Palm Beach, FL. <http://www.pbcgov.com/coopext/natres/index.htm>

Web Site (in progress) Palm Beach County Extension lost our web development support and are training staff at this time)

Poster Presentations

Dodd, A. R., Brennan, M. A., Israel, G. D. and F. J. Mazzotti. 2005. Increasing Citizen Participation in Everglades Restoration. 13th National Nonpoint Source Monitoring Workshop. Raleigh, NC.
http://www.bae.ncsu.edu/programs/extension/wqg/nmp_conf/detailed_agenda.pdf

Dodd, A. R., Brennan, M. A., Israel, G. D. and F. J. Mazzotti. 2006. Citizen Participation Opportunities in Everglades Restoration. Proc. of the 3rd Loxahatchee River Watershed Science Symposium. Jupiter, FL.

Dodd, A. R., Brennan, M. A., Israel, G. D. and F. J. Mazzotti. 2006. Exploring Citizen Participation Opportunities in Everglades Restoration Efforts. Proc. of the Greater Everglades Ecosystem Restoration Conference: Planning, Policy, and Science. Lake Buena Vista, FL. <http://sofia.er.usgs.gov/geer/2006/GEER-2006-Abstracts.pdf>

Dodd, A. R. 2007. Building a Natural Resource Issues and Public Policy Extension Program in South Florida. Proc. Of the USDA-CSREES National Water Quality Conference, Research, Extension and Education for Water Quality and Quantity. Savannah, GA. <http://www.usawaterquality.org/conferences/2007>

Dodd, A. R. 2007. Building a Natural Resource Issues and Public Policy Extension Program in South Florida. Joint Council of Extension Professionals, Annual Public Issues Leadership Development Conference. Crystal City, VA.

Extramural Proposal(s) Submitted and Status

Program/Agency	Title	Period	Status
Department of Interior	Increasing Citizen Involvement in Everglades Restoration and Management	2006	Not granted: \$5000

Leveraging/Cost Sharing

- Additional funds to expand this project were provided by Dr. Mark Brennan. These funds facilitated the expansion of the mail survey (nearly doubling its size) and the hiring of one student to help process the mailings/survey (an estimated \$4,000 contribution).
- UF Extension and the Department of Family, Youth, and Community Sciences also contributed resources. Included was the contribution of funding for an Extension research intern and a FYCS research practicum student. Both contributed to the processing, tracking, and data entry of the mail survey (estimated \$2,500 contribution).

Impact/Outcomes

Sea Grant is expected to fund an expansion of the survey to two additional southwest Florida counties this year. The survey instrument will be extended to include additional questions specific to coastal issues. Project leaders are currently:

1. Considering development of a grant proposal to fund an environmental stewardship and engagement program focused on Everglades restoration (possible funding source: The Laura Jane Musser Fund: Initiative to Promote Collaborative Process in Environmental Decision Making).
2. Planning to attend the USDA-CSREES Water Quality Conference in early 2007 to explore the Development of a broader USDA-CSREES research proposal.

11. Florida Aquatic Animal Health Program

Project Leader(s):

Dr. Denise Petty, Assistant Professor, University of Florida
Dr. Kathleen Hartman, Courtesy Faculty, University of Florida/Aquaculture Epidemiologist,
United States Department of Agriculture, Animal and Plant Health Inspection Services,
Veterinary Services (USDA-APHIS, VS)

Collaborators:

Internal

Dr. Roy Yanong, Associate Professor, University of Florida
Dr. Ruth Francis-Floyd, Professor, University of Florida

External

Mr. Greg Vermeer, Biological Scientist IV-Fish Health, Florida Fish and Wildlife
Conservation Commission
Dr. Thomas Holt, State Veterinarian, Florida

Executive Summary

Aquaculture is a significant agricultural industry in Florida. Florida aquaculture is diverse, with crop groups ranging from ornamental fish to recreational sport fish to fish, clams and shrimp produced for human consumption. Florida leads the U.S. in production of ornamental fish (\$49.4 million gate value in 2003); in addition, 15% of the ornamental fishes imported into the U.S. arrive at Florida designated ports of entry. USDA-APHIS, VS, Federal Fish and Wildlife Service (FWS) and National Oceanographic and Atmospheric Administration (NOAA) are collaboratively developing a National Aquatic Animal Health Plan (NAAHP). Some of the goals of NAAHP are to improve the health and productivity of cultured aquatic animals, facilitate safe interstate and international commerce, and protect cultured and wild aquatic animals from foreign diseases. This ongoing project was developed to assist Florida aquaculture producers via implementation of biosecurity protocols that will improve farmed aquatic animal health by reducing the risk of pathogen introduction, protect Florida farmed and wild aquatic animals from exotic aquatic animal diseases (e.g. Spring Viremia of Carp, White Spot Disease of Shrimp), and enable them to meet the standards of the National Aquatic Animal Health Program. Additional objectives were to promote awareness of disease threats through educational programs, improve marketability of farmed aquatic animals and increase profit margin by reduction of aquatic animal mortality, and promote the safe use of chemotherapeutants. To this end, three levels, Bronze, Silver, and Gold, were developed in the Florida Aquatic Animal Health Plan. The Bronze level is an entry level but includes biosecurity practices that are critical for pathogen reduction/exclusion. The Silver and Gold levels include the criteria of the Bronze level, but also require additional biosecurity steps and more recordkeeping.

Rationale for Project

On site facility visits by extension veterinarians will identify intervention points for pathogen exclusion/reduction. Educational programs highlighting the importance of biosecurity protocols will enhance the health of both farmed and wild fishes. Veterinarians and other fish health professionals will be targeted for specialized continuing education programs in aquaculture biosecurity and aquatic medicine.

Extramural Grant Proposal(s) Submitted and Status

Program/Agency	Title	Period	Status
USDA-CSREES	Tropical Aquaculture Florida	2006	Awarded: \$42,579

*Assisted Florida koi producers in attaining Spring Viremia of Carp Virus free status

Deliverables Supported Entirely or in Part by this Grant

Publications

An announcement of the Program with an invitation for participation was published in *Florida Fish Farmer*, the Florida Tropical Fish Farms Association Newsletter in January 2006.

Presentations

Petty, B.D. 2005. The Florida aquatic animal program. Meeting of the Board of Directors of Florida Tropical Fish Farms Association, Tampa, FL.

Petty, B.D. 2006. Biosecurity for aquaculture facilities. Diseases of Warm water Fish. Ruskin, FL.

Workshops

Workshop to update farmers on viral diseases of koi and goldfish were held in three regions of the state:

Koi and Gold Fish Disease update Workshop

- Ruskin (Central Florida), October 5, 2006
- Gainesville (North Florida), October 12, 2006
- Homestead (South Florida), October 19, 2006

Educational Material

- Notebooks containing fish disease diagnostic information were distributed to veterinarians who participated in Diseases of Warm water Fish in June 2006.

- A web site describing the Program and its benefits is currently in development and close to completion.
- A brochure describing the Program and an application was mailed to members of the Florida Tropical Fish Farms Association in March 2006.
- A Program manual is in development, and once completed, will be available on the web site.

Outreach materials

- A Material Safety Data Sheet notebook with instructions for preparation was provided to program participants.
- A recordkeeping notebook was developed for program participants and includes the following forms:
 1. Sick animal examination log
 2. Water quality log
 3. New fish purchase log
 4. Feed purchase log

Assessment Tool

A risk assessment tool was developed to aid extension veterinarians when assessing participating facilities. This tool provides a logical list of intervention points for an aquaculture facility and helps to identify areas of risk.

Impacts/Outcomes

We are actively working with seven facilities to meet Program standards. Extension veterinarians have visited each facility, and used the risk assessment tool to identify areas where management protocols can be improved for pathogen reduction/exclusion. After each visit, letters are sent to the facility and describe in detail the steps that must be taken to enter the Program. Notebooks for MSDS maintenance and recordkeeping were given to each facility. In addition, each facility was given a one month supply of a disinfectant to use in foot baths and equipment disinfection.

12. Brevetoxin Detoxification Pathways and Biomarkers of Exposure in Florida Hard Clams, *Mercenaria mercenaria*

Project Leader(s):

Dr. Barbara J. Sheppard, DVM, PhD, Diplomate American College of Veterinary Pathologists,
Clinical Associate Professor, Department of Infectious Diseases and Pathology

Collaborators:

External

Dr. Stanley Stevens, PhD, Director of the ICBR Proteomics core
Marjorie Chow, Manager of the ICBR Biomarkers Laboratory

Executive Summary

This study began laying the foundations for identification of toxin-associated protein expression patterns that may indicate responses to stress and could help identify detoxification pathways in the Florida hard clam (*Mercenaria mercenaria*). Florida hard clams at seed and adult life stages were exposed to pure commercial brevetoxin type 2 (PbTx-2) and alterations in temperature and salinity. Changes in protein expression profiles were examined by two-dimensional fluorescence difference gel electrophoresis (2-D DIGE) with Liquid Chromatography/Mass Spectrometry (LC/MS) characterization of a subset of protein spots. Analysis of multiple gel patterns revealed a consistent contingent of protein spots many of which were identified allowing creation of the first reference catalogue of 2D gel proteins for this species. A subset of proteins which were increased or decreased following treatments were identified that represented house keeping and stress-associated proteins including enzymes. In addition, whole body seed clam proteins were separated by 2D Liquid Chromatography (2D LC) and 10 fractions were analyzed with tandem Mass Spectrometry analysis (MS/MS) resulting in the identification of a large number of peaks. The 2D LC MS/MS further clarified the protein composition of this species and correlated well with 2D DIGE findings providing a solid foundation for additional investigations into the modulation of baseline protein expression. This species holds promise as a bioindicator of environmental health. It is hoped that the continuation of this work will help to elucidate genetic changes and tissue-specific mechanisms which facilitate the development of toxin resistance and will help to define the role of toxin-resistant species in stabilizing a fragile ecosystem.

Rationale for Project

Harmful algal blooms (HABs) are a global phenomenon well known to cause significant morbidity and mortality in fish, waterfowl and marine mammals. The aquatic toxins associated with these blooms are accumulated by many species and cause ‘outbreaks’ of several different human illnesses including ciguatoxic, neurotoxic, paralytic and diarrhetic shellfish poisoning. In particular, the binding of brevetoxins, large lipophilic polyether molecules with 10- or 11-rings, to sodium receptors results in an excessive influx of sodium ions leading to cellular and tissue dysfunction.

Bivalve mollusks such as *Mercenaria mercenaria*, also referred to as the Florida hard clam or northern quahog, accumulate the toxins by feeding on toxin-producing alga such as *Karenia brevis* during red tides. However, they appear to experience minimal morbidity and mortality in comparison to the significant increases in both of these phenomena in other species within the same ecosystem. In an experimental recreation of brown tides caused by *Aureococcus anophagefferens*, Cerrato et al, 2004 showed that the presence of the northern quahog *Mercenaria mercenaria* prevented the buildup of phytoplankton biomass and the net population overgrowth of the toxic alga. This apparent ability of *Mercenaria mercenaria* to cleanse itself and the environment may contribute significantly to the environmental dynamics of a red tide event. These species may play a vital role in the clearance of toxin-producing organisms from the environment thereby emphasizing their vital role in healthy oceans.

The intriguing ability of *Mercenaria mercenaria* to survive massive toxin exposures probably evolved as a survival tool allowing them to occupy a unique niche within their environment. Exposure studies have demonstrated a variably negative impact on the energy budget of different bivalves and a tendency to avoid consuming toxic alga. These findings collectively suggest that bivalves accumulating toxins do experience some toxic effects but, in general, have a high resistance to the dinoflagellate toxins. The physiologic or metabolic mechanisms which limit the pathologic consequences of toxin exposure in clams have not been studied in depth. It has been hypothesized that variable evolution of sodium channels in aquatic organisms may have been driven by a need to survive exposure to algal toxins; however, mollusks are often used in ion channel research because their receptor responses are similar to, rather than different from, other species.

Investigators have demonstrated in several bivalve species including *Mercenaria mercenaria* that toxin accumulation is greatest in the visceral mass, particularly the digestive gland, and that it is reduced with time. This pattern of accumulation followed by elimination is well known to the shellfish industry which must suspend harvests until the toxin content of their clams has returned to safe levels. Recent studies have identified specific brevetoxin profiles during the exposure and elimination phases in natural and experimental intoxications using liquid chromatography and mass spectrometry in several bivalves but have not looked at the Florida Hard Clam. Recent work in *Mercenaria mercenaria* and other edible bivalves has identified enzymes that may be useful biomarkers of the depuration process including glutathione-S-transferases and carbamoylases from the digestive gland.

Extramural Grant Proposal(s) Submitted and Status

Program/Agency	Title	Period	Status
National Institutes of Environmental Health Sciences	Tropical Aquaculture Florida	2006	Not granted: \$150,000
College of Veterinary Medicine Resident Research Grant Competition	Using PbTx-3 in resident research project.	2006	Awarded: \$2,000

Deliverables Supported Entirely or in Part by this Grant

Publications

Pending the availability in October 2006 of a currently unpublished proprietary Aplysia database which will facilitate the identification of additional invertebrate proteins, the findings will be submitted in at least two papers coauthored by Drs. Sheppard and Stevens.

Presentation

Sheppard, B. 2006. Mollusk and Toxin Interrelationships. Department of Infectious Diseases and Pathology, College of Veterinary Medicine.

Workshops

Dr. Sheppard will include the findings in a presentation on an outbreak of *Perkinsus sp.* in *Tridacna crocea* at the American Association of Zoo Veterinarians Meeting Pathology Workshop, Tampa, FL, September 20, 2006.

New Positions

Dr. Sheppard was given the title of Associate Director for Aquatic Animal Pathology in the Aquatic Animal Medicine Program in the College of Veterinary Medicine on July 1, 2006, in addition to her other roles, in part, due to her interest in invertebrate research which added diversity to that program.

Impacts/Outcomes

The application of two advanced protein identification techniques has provided the first catalogue of *Mercenaria mercenaria* proteins. This catalogue serves as a powerful tool facilitating future studies examining modulation of protein patterns under specific stressful situations. This modulation during acute PbTx-2 exposure has been examined in adult and seed clams as part of the current study. Modulation in protein production patterns due to other stressors such as altered salinity and temperature has also been demonstrated and those proteins await identification. Funding to further examine the proteins and their patterns of expression has been made much more likely by these initial efforts to create a catalogue and demonstrate alteration in protein patterns with changes in temperature, salinity and exposure to brevetoxin. This species holds promise as a bioindicator of environmental health. It is hoped that this work will help elucidate genetic changes and tissue-specific mechanisms which facilitate the development of toxin resistance and help define the role of toxin-resistant species in stabilizing a fragile ecosystem.

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Appendix A.

SNRE Mini -grant Programs FY 2005-2006 Funded and Pending proposals. Total proposals submitted were 31.

Principal Investigator	Grant Title	Program/Agency	Status
David S. Barber	Biochemical Molecular and Cellular Responses of Zebrafish to Exposed Metallic Nanoparticles	Nanotechnology Research Grants Investigating Environmental and Human Health Effects of Manufactured Nanomaterials: A Joint Research Solicitation-EPA, NSF, NIOSH, NIEHS	Awarded: \$350,000
David S. Barber	Role of Protein Absorption in Nanoparticle Uptake, Distribution and Toxicity in Zebrafish	Same as above	Pending: \$398,320
Brian Child	Monitoring Matters: Comparative Analysis of Innovative Approaches	Danish Council for Development Research	Awarded: DKK7.9m (DKK303,626 for UF = USD \$48,903)
Brian Child	Parks as Agents of Social and Environmental Change in Eastern and Southern Africa	NSF/HSD	Awarded: \$366,446
Brian Child	Developing Adaptive Management and Governance Criteria for CBNRM Programmes in Namibia and Southern Africa	RGP Research Opportunity Incentive Seed Fund 2006	Awarded: \$72,500
Brian Child	Inter-disciplinary Adaptive Management and Community Development in Southern Africa	Kellogg Foundation	Pending: Negotiations are on-going
Brian Child	Free-Market Conservation and Democratization in Southern Africa	Randolf Foundation	Pending: \$100-300,000, negotiations are on-going
Brian Child	Governance and Resource Management in Southern Africa	Norwegian Ministry of Foreign Affairs	Pending: \$4,000,000+
Joan Flocks	Support the Outreach Core Program	UF SBRP	Pending: \$100,000/ 5 years

Principal Investigator	Grant Title	Program/Agency	Status
Bala Rathinasabapathi	Biotransformation of Arsenic and Phosphate in Rhizosphere of <i>Pteris vittata</i> : Roles of Microbes and Root Exudates.	USDA-NRICGP.	Pending: \$250,000
Bala Rathinasabapathi	Evolution of Arsenic Hyperaccumulation in Ferns: Generation and Comparative Analyses of Fern Expressed Sequence Tags.	National Science Foundation	Pending: \$350,000
Max Teplitski	Initial Characterization of Controlled Sensor Blockers.	XL TECH Group, Ltd	Contract for \$11,295
Max Teplitski	Initial Characterization of Controlled Sensor Blockers.	Dean of IFAS Research	Funded: \$41,793
Max Teplitski	Bacterial Bioshields: Beneficial Bacteria Protect Corals from Pathogens by Disrupting Cell-to-Cell Communication.	Lindberg Foundation	Funded: \$9,900
Max Teplitski	Master Manipulators: Corals Recruit Beneficial Microbes and Promote Bacterial Information Wars.	National Geographic Foundation	Funded: \$20,000.
Joan Bradshaw	Lake Panasoffkee Lake Restoration Outreach	UF IFAS/IPM Florida Grants	Funded: \$9000
Joan Bradshaw	Water Wise Irrigation	Southwest Florida Water Management District Community Education grant	Funded: \$5000
Matthew Cohen	Quantifying Ecosystem Spatial Self-Organization along a Gradient of Anthropogenic Impairment	NSF/DEB – Ecosystems panel	Pending: \$140,000 for two years (\$280,000 total)
Denise Petty	Tropical Aquaculture Florida	USDA-CSREES	Funded: \$42,579
Barbara Sheppard	Using PbTx-3 in Resident Research project.	College of Veterinary Medicine Resident Research Grant Competition	Funded: \$ 2,000