V(A). Planned Program (Summary)

Program # 15

1. Name of the Planned Program

Sustainable natural environment--research

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	0%	0%	15%	
111	Conservation and Efficient Use of Water	0%	0%	20%	
112	Watershed Protection and Management	0%	0%	20%	
122	Management and Control of Forest and Range Fires	0%	0%	5%	
123	Management and Sustainability of Forest Resources	0%	0%	10%	
124	Urban Forestry	0%	0%	5%	
133	Pollution Prevention and Mitigation	0%	0%	15%	
135	Aquatic and Terrestrial Wildlife	0%	0%	10%	
	Total	0%	0%	100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Actual Paid Professional	0.0	0.0	1.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	104933	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	104933	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Finding new ways to solve problems related to the sustainability of natural resources

2. Brief description of the target audience

Brief description of the target audiences

- Producers
- Commodity associations
- Owners/Operators
- Managers/Supervisors
- Workers/laborers
- Allied industry representatives
- Small farmers
- Government/Regulatory
- County government
- State government
- Federal Government
- Tribal Government
- International governing bodies
- Harvesting/Packing/processing/distribution/transporting
- Retailers
- Importers/Exporters
- Youth and 4-H
- Youth educators
- Extension faculty
- general public

3. How was eXtension used?

N/A

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2012

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	360	360

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increase watershed protection and management
2	Improve the conservation and efficient use of water
3	Increase new technolgies to improve water quality
4	Increase Florida wildlife sustainability
5	Identify environmental risks through the collection of applications and modifications of risk analysis methodology data

Outcome #1

1. Outcome Measures

Increase watershed protection and management

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Contamination of ground and surface water by heavy metals from previously abandoned disposal sites and some currently operating sites have caused much environmental concern. Considerable attention is now being paid to develop cost-effective technologies to remediate contaminated sites with the primary goal of reducing human metal exposure via drinking water, direct ingestion and dust inhalation. This project focuses on soil contamination and remediation as well as land application of waste products.

What has been done
Specially, we will determine the environmental impacts of Pb in shooting range soils and develop best management practice to minimize its adverse impacts, examine the mechanisms of arsenic uptake, translocation, distribution and detoxification by Chinese brake fern and apply it in phytoremediating arsenic contaminated soils, evaluate waste materials for beneficial use, including yard trash and ditch cleaning and understand hydrological & biogeochemical control of colloid-facilitated metal transport in soils. Such information is important to protect the environment and facilitation remediation of metal-contaminated sites.

Results
Impact: We have accomplished the following for the 3 objectives: 1. Evaluated two best management practices to minimize its adverse impacts, including replacing soil berm with sand berm and recycling of Pb bullets. Based on our results, replacing soil berm with sand berm is effective in reducing Pb weathering. In addition, we have also observed that removing Pb-bullets by physical sieving increased Pb loading into the finer soil fractions. However, sieving Pb shot was effective in removing Pb shot from the berm without increasing Pb concentrations in soil fraction. 2. determine phosphate rock as an effective soil amendment to improve plant biomass and arsenic uptake by arsenic hyperaccumulator Chinese brake fern. Based on 2,5 years of field

experiment, phosphate rock was an effective amendment in increasing plant biomass and arsenic uptake by Chinese brake fern. 3. Evaluate waste materials for beneficial use including humate and coal ash. Humate is produced during mining of mineral Ti. It is currently being piled on site. Our preliminary research shows it can be returned to the soil for land reclamation. We have collected 13 ash samples from various utility companies from Florida and will determine their heavy metal concentrations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
135	Aquatic and Terrestrial Wildlife

Outcome #2

1. Outcome Measures

Improve the conservation and efficient use of water

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There is expanding demand for freshwater resources to provide drinking water for the growing population and irrigation water for agriculture, while at the same time preventing pollution and leaving enough water for natural ecosystem functions. These combined pressures define the need for sustainable water resource management. Protection and management of water resources requires the assessment of ecosystem degradation resulting from human activities, and the implementation of measures for the reduction and amelioration of current impacts. Groundwater resources throughout the United States are currently threatened by uncontrolled releases of anthropogenic contaminants such as petroleum hydrocarbons and chlorinated solvents. There are an estimated 300,000 to 400,000 contaminated sites in the U.S. with cleanup costs as high as $500 billion to $1 trillion. Surficial aquifers throughout Florida are threatened by chemical spills, pesticide leaching, landfills, and leaking underground storage tanks. Several large ecosystems in Florida are currently severely impacted by excess nutrients, with ongoing

implementation of control and mitigation measures for the protection of the St. Johns River, Lake Okeechobee, Lake Apopka, the Florida Everglades, and Florida Bay.

What has been done

This project aims to 1) predict the performance of the clean-up of aquifer contaminant source zones based on appropriate and efficient characterization, 2) evaluate and enhance the sustainability of natural and constructed wetlands used for pollutant sequestration through the use of advanced mathematical models, and 3) understand and explain the linked hydrologic and biogeochemical mechanisms controlling the Everglades ridge and slough ecosystem. These objectives will be met through field and laboratory experimentation as well as mathematical modeling.

Results

Impact: Our work on the first goal is funded by SERDP which is sponsored by the US DOE, DOD and EPA. Working closely with the Department of Defense we are extending our management interpretations to contaminated field sites managed by the US Department of Defense. In 2011 we concluded a field experiment at the US Navy base in Alameda, CA. The second objective is funded by the Florida Department of Agriculture and Consumer Services with an emphasis on limiting the impact that agricultural producers are having on water quality in the Lake Okeechobee basin. We work closely with the FDACS scientists and staff who are engaged in on-the-ground implementation of our findings. Work on the third goal is supported by the South Florida Water Management District. We share our findings at the bi-annual Greater Everglades Ecosystem Research Conference, which contributes to both our own improved understanding but also to that of the greater scientific community. We are working towards a synthesized theory of how the ridge and slough landscape was formed and maintained. Once the governing mechanisms are clearly understood, those mechanisms can be emphasized for Everglades restoration. We have made great progress in the synthesis of these ideas in 2011, and we anticipate sharing them with the Greater Everglades research and management community at the international INTECOL conference on this topic in Orlando in June 2012. We have also extended our network of collaborators to include scientists in the mid-western United States (U. Iowa, Purdue U.) and Sweden. We are chairing a session at the INTECOL meeting that will bring in additional collaborators from North Carolina and Canada. We plan to expand our work on catchment discharge with the aim of guiding watershed management policy.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management

Outcome #3

1. Outcome Measures

Increase new technolgies to improve water quality

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Clean Water Act (CWA) is the cornerstone of surface water quality protection in the United States. (The Act does not deal directly with ground water or water quantity issues.) The statute employs a variety of regulatory and nonregulatory tools to sharply reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water." For many years following the passage of CWA in 1972, EPA, states, and Indian tribes focused mainly on the chemical aspects of the "integrity" goal. During the last decade, however, more attention has been given to physical and biological integrity. Also, in the early decades of the Act's implementation, efforts focused on regulating discharges from traditional "point source" facilities, such as municipal sewage plants and industrial facilities, with little attention paid to runoff from streets, construction sites, farms, and other "wet-weather" sources. Starting in the late 1980s, efforts to address polluted runoff have increased significantly. For "nonpoint" runoff, voluntary programs, including cost-sharing with landowners are the key tools. For "wet weather point sources" like urban storm sewer systems and construction sites, a regulatory approach is being employed. Evolution of CWA programs over the last decade has also included something of a shift from a program-by-program, source-by-source, pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach equal emphasis is placed on protecting healthy waters and restoring impaired ones. A full array of issues are addressed, not just those subject to CWA regulatory authority. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining state water quality and other environmental goals is another hallmark of this approach (EPA, 2003). The National Section 303(d) fact sheet (EPA, 2006) showed a total number of impaired waters reported as 38,698. The leading causes of these impairment were pathogens (13.37%), Mercury (13.30%), Sediment (10.61%), Metals (other than Mercury 9.92%), Nutrients (8.77%), Oxygen Depletion (7.01%), PH (5.41%), Cause Unknown Biological Integrity (4.35), and Temperature (4.31%) (EPA, 2006).

What has been done
Because of the immensity of the stream miles, lakes and estuaries involved and the jurisdictional differences within the impaired watersheds, tools are needed to better understand the causes and potential processes that can be used to restore and protect these water bodies. Combining remote sensing, monitoring, geographical information systems, and numerical simulation has been shown to be an effective and economic solution to these issues (R. Munoz-Carpena et al.,

2006).

Results

Impact: The methods and tools developed in this reporting period have been presented to different stakeholders through a variety of methods to ensure the impact of the results (workshops, public web-based distribution of model and analysis tools, publications, reports and presentations). During the last reporting period I chaired the S-1042 Regional Project and organized a well-attended annual project meeting (25 project members from 15 institutions) at the University of Florida in November 2012. The meeting allowed sharing of results and ideas for this Project and also to initiate the development of a new Regional project this year. Among specific impacts of our work during the past reporting period, VFSMOD (http://abe/ufl.edu/carpena/vfsmod) has been accepted as a reference tool for analysis and design of densely vegetated areas (grass and others) placed between disturbed lands (i.e. in agro-forestry, mining, road, construction, and urban settings) and a receiving water body. Vegetative filter strips are commonly used as a BMP in TMDL implementation plans to trap surface runoff contaminants like nutrients, sediment, and pesticides. The model has received renewed interest in the context of pesticide registration and licensing both in the U.S. and Europe. For registration of pesticides that do not pass higher-tier environmental exposure assessments, grass dense vegetation areas can be successful in limiting surface water pollution from pesticide treated areas (agricultural, roads, train tracks, urban landscape, etc.). The research has shown that the proper implementation of this practice requires consideration of complex interactions between physical (hydrology and sedimentology), chemical (pesticide chemistry) and human (land use) processes. In Europe the model is now part of SWAN 3.0 (http://www.york.ac.uk/environment/pesticides/#tab-2), the computer tool used by EU agencies and industry for long-term pesticide environmental assessments in the regulatory process. The application of modeling evaluation tools that our team pioneered in hydrology and water quality (global sensitivity and uncertainty analysis) is now becoming standard in many model applications. Our FITEVAL (http://abe.ufl.edu/carpena/software/fiteval.shtml) tool is the basis for collaboration with other key members of the modeling community to add procedures for model evaluation with uncertainties in the measured data and model outputs. We expect the modeling community will accept this tool soon as a standard

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management

Outcome #4

1. Outcome Measures

Increase Florida wildlife sustainability

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
By 1990s, the endangered Florida panther ? a flagship species and one of the last remaining symbols of wilderness in Florida - was in serious trouble. There were fewer than 30 panthers remaining in the wild. The population suffered from several biomedical and morphological abnormalities, including low genetic diversity, heart defects, reproductive dysfunctions and kinked tails. Many of these problems were thought to be indicative of inbreeding, and conservation biologists recommended genetic restoration. This recommendation was controversial but was ultimately implemented after careful planning.

What has been done
Eight female Texas pumas were released into Florida panther habitat in southern Florida in 1995. The Texas puma females bred with Florida panther males. Subsequently, genetic diversity increased, frequency of biomedical and morphological abnormalities decreased, and the panther population size increased substantially reaching 100-120 panthers by 2010. This raised an important question: was the observed increase in panther numbers due to genetic restoration?A recent study led by University of Florida ecologists and the Florida Fish and Wildlife Conservation Commission tackled this difficult question.

Results
Using long-term field and genetic data and sophisticated statistical and mathematical models, researchers show that the improved survival of hybrid panthers was likely the main cause of observed population increase. They report that, without genetic restoration, the Florida panther population would have continued to decline and faced a substantial risk of extinction. These results provide strong evidence that genetic restoration can help small, isolated populations that suffer from inbreeding-related problems.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife

Outcome #5

1. Outcome Measures

Identify environmental risks through the collection of applications and modifications of risk analysis methodology data

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Many non-native species have invaded Florida's aquatic habitats, including freshwater fishes (e.g., tilapia, walking catfish, and Asian swamp eels), marine fishes (e.g., lionfish), snails (e.g., channeled apple snail), and bivalves (e.g., Asian clam, green mussel). Non-native species may be undesirable additions to Florida's fauna due to competition with native species for food or other resources, predation on native species, alterations to habitat, introduction of novel pathogens, and invasion of parks and preserves. Nevertheless, non-native aquatic species may provide benefits to the people and economy of Florida. For example, there are several important non-native sport fish in the state (e.g., butterfly peacock bass, hybrid striped bass). Other species are grown in aquaculture for food (e.g., tilapia) or ornamentals (i.e., aquarium or water garden species). Indeed, Florida aquaculture is dominated by the production of non-native species and had a farm-gate value of almost US$100 million in 2003. The relationships and effects of non-native species for aquatic systems and humans may be complex and multi-directional. For example, sport fishing in Florida is valued in excess of US$5.3 billion. Non-native species potentially affect recreational fishing by negative interactions with native fish, destruction of aquatic macrophytes, or reduced aesthetics; however, recreational fisheries are commonly enhanced by the introduction of non-native sport and prey fish as well as by the use of non-native bait. Despite the threats posed by non-native species and their importance to the people and economy of Florida, there is relatively little known about Florida's non-native aquatic species, particularly their ecological effects. Because of a general lack of information, predicting the successful invasion and subsequent effects is difficult. Given uncertainty and poor predictive ability it is extremely difficult for resource managers and regulators to carry out their mandates in a science-based manner.

What has been done
Information generated under this research program will provide stakeholders with information to facilitate better decision-making. The overall objective of this project is to develop data on the

ecology, life history, and effects of non-native aquatic species in Florida to facilitate science-based management by natural resource agencies. Specific objectives include: 1) Document the species identity, range, and spread of introduced aquatic species in Florida; 2) Document the life history of non-native aquatic species in Florida; 3) Investigate the ecological interactions between non-native aquatic species, native species, and their environment; 4) Determine the effects of non-native aquatic species on native species, aquatic systems, and human activities (e.g., aquaculture, recreational fishing) in Florida; 5) Risk analysis of aquatic species that have been or may be introduced into Florida, including testing and development of methodology; 6) Development of eradication and control methods for non-native aquatic species. Studies will incorporate a combination of field sampling with laboratory and field experimentation.

Results

Impact: Information developed in this project included applications and modifications of risk analysis methodology, data on abiotic factors limiting the spread of non-native fishes, and data concerning the ability of native predators to resist the invasion of new species. The Fish Invasiveness Scoring Kit (FISK) was updated and modified to FISK v2 to better estimate risks of non-native freshwater fishes in warmer climate zones and to improve the software tool user interface. FISK v2 has been used in Europe, North America, Asia, and Australia to assess non-native fish risks, including the risks associated with transgenic fluorescent ornamental fishes. Data on physiological tolerances have shown that some non-native freshwater fish species are capable of surviving at elevated salinities, facilitating spread between river basins through use of estuarine habitat. The results of this project support the hypothesis that predation is a resistance to the invasion of small-bodied, non-native fishes, that habitat influences the predator-prey dynamic, that prey behavior has a large influence on vulnerability to predators, and that multiple predators may interfere with or facilitate one another. Information developed in this project has been used as a basis of regulatory and management changes in Florida and globally. New regulations for barramundi (Lates calcarifer) aquaculture were implemented for Florida based on risk analysis work conducted in this project. Additional risk analysis work on blue tilapia (Oreochromis aureus) has led to reevaluation of existing regulations and additional research investigating the environmental performance of tilapia hybrids. Global standards for sustainable use of non-native tilapia in aquaculture were developed and disseminated. The information has made target audiences more aware of risks associated with non-native fishes and management options to mitigate risk

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Florida is still being heavily impacted by the economic situation. Public higher education in Florida has lost more than 50% of state funding and research has been impacted by other losses caused indirectly by the economic down turn including a reduction of funding opportunities available at the national level. In some cases faculty who leave or retire are not being replaced because of economic issues. Changes in state, county and federal appropriations can also affect the outcomes related to the Florida research land-grant mission. Because of limited resources in Florida and continuing devolution research projects can always be affected by changing public and governmental priorities policies, regulations and laws.

Natural and national disasters can also affect research field studies and multistate research. Natural disasters such as tropical storms and hurricanes are common annual occurrences in this state and often cause severe damage to plants and the environment in which active research is taking place.. Severe weather conditions such as droughts frequently led to large-scale fires which can also impact studies. In 2012 we were heavily impacted by severe storms and fires. We also had other weather extremes such as floods leading to large scale damage especially along the coastal regions and the panhandle of the state. All of these can have a direct and indirect impact on research.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The human population is continuing to grow, and with this growth natural landscapes are becoming less common, smaller in size, and more isolated from other remaining habitats, primarily through an intensification of agriculture and urban land uses. Human-induced pressures within natural habitats also remain common, including increased human recreation and activity, increased numbers and diversity of invasive species, and the degradation of habitats. Understanding how ongoing anthropogenic change influences wildlife populations and biodiversity is crucial for both short-term and long-term management and conservation plans.

Key Items of Evaluation

Approximately 15% of the 10 million acres of public conservation lands in Florida have been disrupted by invasive nonindigenous plants, costing the state more than $29 million annually for control and management practices (Don Schmitz, personal communication, 2005). The majority of plants considered invasive today were originally introduced as ornamentals and there is often a lag time between when a species is determined to be invasive and when it is no longer produced commercially. An alarming 60% of plants on The Florida Nursery Growers and Landscape Association?s (FNGLA) voluntary ?do not sell? list (compiled in 2001) were still commercially available in 2004 from Florida nurseries (Caton, 2005). About 27% of FLEPPC Category I and II species are still commercially available in Florida, with some having more than 100 known cultivars that could potentially impact our natural areas. Some cultivars have the potential to cross with closely related native species. Controlled crossing can definitively tell us if they are a potential threat to our native flora. Research is critical to provide scientific evidence of the potential negative impacts invasives may have with regards to crossing with related native species, seedling trueness to type, invasive potential, and site specificity. We propose to evaluate Category I and II ornamental species that are currently available in the nursery trade. Field trials will be conducted in north and south FL and subsequent seeds will be subjected to viability and germination tests. Three of the most popular ornamental species (Mexican Petunia, Lantana, and Nandina) will be subjected to breeding selection for genetic sterilization. Potential for hybridization between native and invasive genera will be assessed. This information will be directly beneficial to our scientific community, nursery industry, and general gardening community.
Impact: In summary, the substantial economic (Pimentel et al., 2005) and ecological (Simberloff, 1997) costs of invasive species management and removal warrant aggressive early detection and prevention programs. This research illustrates the importance of evaluating cultivars for invasiveness in more than one region. Several cultivars (already existing in the industry) of invasive plants have been approved for recommendation by the University of Florida Infraspecific Taxon Protocol. These include Nandina domestica 'Firepower', Nandina domestica 'Harbour Dwarf', and Ruellia tweediana 'Purple Showers'. Extensive breeding efforts to produce novel and safe cultivars are currently underway with statewide landscape trialing. Availability of non-invasive cultivars will provide the horticulture industry with a ready substitute to invasive species for continued use of these popular plants.