Florida Cooperative Fish and Wildlife Research Unit

Annual Report
January –December 2009

We Dedicate this Annual Report to Dr. Kenneth Rice

Dr. Rice grew up in the mountains of North Carolina and earned his bachelor's degree from North Carolina State University while making his living fixing cars at Western Auto. Although it was his mechanical ability that first got him noticed by Florida Cooperative Fish and Wlidlife Resaerch Unit Leader Franklin Percival, it was intellect that convinced Percival and Alan Woodward of the Florida Fish an and Wildlife Conservation Commission to support him as a master's student. Dr. Rice flourished at the Florida Coop Unit and continued on to earn his doctorate degree with Percival, as well as Woodward and Jim Nichols of Patuxent Wildlife Research Center as committee members.

After a brief post-doc at the Georgia Coop Unit, Dr. Rice landed a research wildlife biologist position with the U.S. Geological Survey in south Florida studying alligators in the Everglades. While developing his highly successful research program, Rice mentored a cadre of graduate students and young biologists, many of whom had been or later beame students of the Florida Coop Unit.

Currently, Dr. Rice is Director at the U.S. Geological Survey's Southeast Ecological Science Center in Gainesville, FL, where he continues his strong association with the Florida Coop Unit by advising students and collaborating on projects with both state and federal biologists of many disciplines.

COOPERATING AGENCIES:
FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION
UNIVERSITY OF FLORIDA
U.S. FISH & WILDLIFE SERVICE
U.S. GEOLOGICAL SURVEY
WILDLIFE MANAGEMENT INSTITUTE

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FLORIDA COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT INTRODUCTION

The Florida Cooperative Fish and Wildlife Research Unit was established in 1979 as one of the first combined units. The purpose of the Florida Unit is to provide for active cooperation in the advancement, organization, and conduct of scholarly research and training in the field of fish and wildlife sciences, principally through graduate education and research at the University of Florida. The Florida Unit has the mission to study wetland ecosystems within the state. Florida is a low relief, sub-tropical peninsula that is ecologically fragile. Though abundant, Florida's water resources are under increasing pressure from a burgeoning human population. Domestic, recreational, and development needs threaten Florida's water / wetland resources. In following its program directive, the Florida Unit has developed a research program, that addresses management issues with approaches spanning species to ecosystem perspectives. Specifically, this Unit conducts detailed investigations of aquatic-terrestrial ecosystem interfaces and their component fish and wildlife resources.

Between 1979 and 2008, over 297 projects totaling more than $42.8 million were funded through the Unit. These projects covered a wide variety of fish, wildlife, and ecosystem subjects and have involved 49 line, affiliate, and adjunct faculty members as principal and co-principal investigators. Unit staff have their own research projects which accounted for about 1/3 of the total effort. Projects associated with the Unit have resulted in 389 publications, 104 technical reports, 89 theses and dissertations, and 155 presentations. Cooperation has been the Florida Unit's strength. As a Cooperative Research Unit of the U.S. Geological Survey, serves as a bridge among the principal cooperators, such as the University of Florida, the Florida Fish and Wildlife Conservation Commission (FFWCC), the U.S. Geological Survey (USGS), the U.S. Fish and Wildlife Service (FWS) and the community of state and federal conservation agencies and non-governmental organizations. Evidence of this role is the Unit's funding which has included contributions from FFWCC, 12 BRD research labs and centers, 12 offices within the USFWS Southeast Region, the University of Florida, U.S. Army Corps of Engineers, U.S. Navy, U.S. Department of Agriculture, U.S. Air Force, U.S. National Park Service, Environmental Protection Agency, St. Johns River Water Management District, South Florida Water Management District, U.S. AID, World Wildlife Fund, The Nature Conservancy, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, BRD, Florida Wildlife Federation, National Audubon Society, Florida Alligator Farmers' Association, American Alligator Farmers' Association, Florida Fur Trappers' Association, and other private contributions. Many Unit projects involve multiple investigators from several agencies. This cooperative interaction stimulates continuing involvement of funding sources, provides for student contacts with potential employers and agency perspectives, and directs transfer and application of research results.

RESEARCH MISSION STATEMENT

The St. Joseph Peninsula in Gulf County, Florida supports the greatest density of nesting loggerhead turtles in Northwest Florida. This is especially critical because turtles nesting in the Florida Panhandle are genetically distinct from those nesting throughout the Southeastern United States.

"The mission of the Florida Cooperative Fish and Wildlife Research Unit is to conduct detailed investigations of wetlands and their component fish and wildlife resources, emphasizing the linkages with both aquatic and terrestrial ecosystems. This charge will include research at a range of levels including populations, community, and ecosystems, and will emphasize the interaction of biological populations with features of their habitat, both natural and those impacted by human activities. "

UNIT COORDINATING COMMITTEE

Larry R. Arrington - Interim Vice President for Agriculture and Natural Resources, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, Florida.

Nick Wiley – Executive Director, Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

James W. Fleming - Southern Supervisor, Cooperative Research Units, U.S. Geological Survey, Biological Resources Division, Atlanta, Georgia.

Cynthia Dohner - Regional Director, U.S. Fish and Wildlife Service Southeast Region, Atlanta, Georgia.

Donald F. McKenzie – Field Representative, Wildlife Management Institute, Ward, Arkansas.

BIOGRAPHICAL PROFILES OF UNIT SCIENTIST

H. Franklin Percival – Unit Leader, Courtesy Associate Professor, Department of Wildlife Ecology and Conservation and College of Natural Resources and the Environment at the University of Florida. His research interests lie in wetland wildlife, and have conducted long term collaborative projects on various aspects of alligator and migratory bird biology. He has teamed with geomaticists and aeronautical engineers to develop an unmanned aserial vehicle for assessment of wildlife populations and habitats. He has a special interest in natural resources administration, especially multidisciplinary, collaborative, and interagency research programs.

Raymond R. Carthy – Assistant Unit Leader, Courtesy Assistant Professor, Department of Wildlife Ecology and Conservation and College of Natural Resources and the Environment at the University of Florida. His research centers on ecology of endangered species. His research interests involve reproductive ecology and physiology of coastal and wetland herpetofauna, with current focus on marine and freshwater turtles. He is also involved in research on threatened upland species and in conservation management oriented studies.

Wiley M. Kitchens – Assistant Unit Leader, Ecologist, Courtesy Professor, Department of Wildlife Ecology and Conservation. Dr. Kitchens' expertise is wetlands ecology with an emphasis on conservation and restoration of wetlands ecosystems. Given the restoration focus of his research, most of his projects are long-term, multidisciplinary, and targeted to resolving vegetation succession and faunal responses to hydrologic perturbations, both natural and anthropogenic. The approach generally involves identifying and quantifying the factors that operate at multiple spatial and temporal scales in regulating ecologic structure and function of wetland ecosystems. In recent years, his research has focused on the Endangered Snail Kite, a wetland dependent species endemic to the Everglades and lacustrine wetlands of Central and South Florida. Given its endangered status and the generally perturbed state of these wetlands the approach has been to document population trends, demography, and movement patterns of the kites in response to habitat structure and quality in these wetlands. The overall goal is provide restoration managers information pertinent to the restoration of these systems.

AGENCY PERSONNEL CO-LOCATED WITHIN FLORIDA UNIT

Robert M. Dorazio – Research Statistician, Florida Integrated Science Center, USGS and Courtesy Associate Professor, Department of Statistics, University of Florida. He conducts scholarly research in the general areas of quantitative population dynamics, community ecology, and conservation biology. He develops and applies novel sampling designs and novel statistical models in quantitative investigations of exploited or imperiled fauna. He is also responsible for developing both theory and practice of adaptive natural resource management.

Fred A. Johnson – Research Wildlife Biologist, Southeast Ecological Science Center, U.S. Geological Survey. His research focuses on the development and application of ecological theory, statistical modeling and estimation, and decision analysis in wildlife population and habitat management. His responsibilities currently include improving the adaptive-management protocols used by the U.S. Fish and Wildlife Service to regulate the take of migratory birds, developing optimal strategies for managing habitat for Florida scrub-jays, and providing training in decision analysis and adaptive management to managers and researchers.

Elizabeth Martin – NBII Bird Conservation Node Manager, National Biological Information Infrastructure (NBII), U.S. Geological Survey, and PhD student, Department of Wildlife Ecology and Conservation, University of Florida. Her principal responsibility with NBII is management of the NBII Bird Conservation Node and coordination with partners to support development of web-based information products useful in management and conservation of North American birds. Her interests include the application of information technologies to avian conservation, and research on tradeoffs in resource use by migratory shorebirds.

COOPERATIVE UNIT PERSONNEL

Joan B. Hill, BA – Administrative Assistant, Florida Cooperative Fish and Wildlife Research Unit, Department of Wildlife Ecology and Conservation, University of Florida. Responsible for administrative details of $3.75M annual research program as well as supervision of staff; student activities, personnel, budgets, research work orders, contracts and grants within University, fiscal reports, travel, purchasing, payables, vehicles (State/Federal), website, and other related functions.

Amanda Burnett – Student Office Assistant, Florida Cooperative Fish and Wildlife Research Unit. Primarily responsible for office management and for purchase order requests. She manages property, invoices, and state and federal project tracking and reconciliation.

Janet Fey – Student Assistant, Florida Cooperative Fish and Wildlife Research Unit. Primarily responsible for greeting people coming into the CRU, general office procedures, copying, filing, and data entry. Also maintains Digital Measures database for the Florida Coop-Unit and is responsible for manuscript processing and organization of publications.

COOPERATORS

University of Florida:

Michael S. Allen	Karen A. Bjorndal	Alan B. Bolten
Meghan Brennan	Mary Christman	Robert M. Cubert
Bon A. Dewitt	Peter C. Frederick	Bill Guiliano
Jeff Hostetler	Peter G. Ifju	Carrie Reinhart-Adams
Susan Jacobson	Steven Johnson	Linda Young
Michael Kane	Ramon Little	Lyn Branch
Frank Mazzotti	Martha C Monroe	Madan Oli
William (Bill) Pine	Carlos H. Romero	Deborah Miller
J. Perran Ross	Scot E. Smith	Marilyn G. Spalding
A. Abd-Elraham	Mark Hostetler	Robert Fletcher
Mark Clark	Todd Osborne	Scott Smith
Peter Ifju	Matthew J. Cohen	Ahmed Mohamed
Leda Kobziar		

St. Johns Water Management District:

Roxanne Conrow	James Peterson	Mike Coveney
Steven Miller		

Florida Fish and Wildlife Conservation Commission:

Joe Benedict	Joan Berish	Tim Breault
Larry Campbell	Dwayne A. Carbonneau	Harry J. Dutton
Cameron Carter	Patrick Delay	Rio Throm
Jim Estes	Julien Martin	Tommy C. Hines
Richard Kiltie	Diane Eggeman	Henry Norris
Tim O'Meara	Zachariah Welch	Mike Allen
Lawson Snyder	Nick Wiley	Blair Witherington
Arnold Brunell	Janell Brush	Allan R. Woodward
Ron Hight	Rebeca Hayman	Charles McKelvey
William Caton		

U.S. Geological Survey:

Beverly Arnold	G. Ronnie Best	Jaime A. Collazo
Paul Conrads	Fred Johnson	Donald L. DeAngelis
Robert M. Dorazio	Michael Conroy	Tara Y. Henrichon
James Hines	William Kendall	Lynn W. Lefebvre
Cynthia S. Loftin	Elizabeth Martin	Kelly McDonald
Clinton Moore	James D. Nichols	Kenneth G. Rice
Michael Runge	John Sauer	Daniel Slone
Pamela Telis	Kenneth Williams	William L. Kendell
Amy Teague	Catherine Langtimm	

U.S. Fish and Wildlife Service:

Jon Andrew	Robert Blohm	Laura Brandt
Ed Eudaly	Chuck Hunter	Heather Tipton
Mark D. Koneff	Mike Legare	Fred Martin
Mark Musaus	Lorna Patrick	John Robinette
Russell Webb	Kathy Whaley	Paul Tritaik
Sandra Sneckenberger	Michael Jennings	Heath Rauschenberger
John Kasbohm	Shannon Ludwig	Paul Souza

Wofford College:	U.S. Air Force	National Park Service
Clarence L. Abercrombie	Bruce Hagedorn	Leonard Pearlstine
	Bob Miller	

University of Central Florida	University of West Florida
Llewellyn M. Ehrhart	Phillip C. Darby
Dean Bagley	

Dynamac Corporation	U.S. Army Corps of Engineers	William Zattau
Eric D. Stolen	William D. Meyer	Larry Taylor
David Breininger	Jon Lane	Paul Stodola
	Susan Conner	

Environmental Project:	Others:	
Ritchie H. Moretti	Howard K. Suzuki	John Wooding
Sue A. Schaf	Lovett E. Williams	

RESEARCH PERSONNEL

Post-Doctoral Associates

Margaret Lamont	Christa Zweig	Virginie Rolland
Adam Watts	Shannon Knapp	

Biologist

Matthew Burgess	Mike Cherkiss	Jemeema Carrigan
Adam Watts		

Ph.D Students

Sadie S. Coberley	Kathryn A. Garland	Fred Johnson
Christopher Cattau	Julie A. Heath	Holly J. Johnson
Taewoo Kim	Joyce L. Merritt	Adam Watts
Mario Mota	Christa Zweig	Brian Reichert
Sara R. Gonzalez	Elizabeth Martin	Zachariah C. Welch

M.S. Students

Melanie A. Craig	Jenny Ketterlin	Amy Schwartzer
James J. Berg	Rio Throm	Kyle Pias
Linda K. Dance	Jesse Senko	Patrick Delaney
Jean Olbert	Kyle Pias	Lara Drizd
Brad Shoger	Althea Hotaling	Brian Reichert
Cameron Carter	Brian M. Jeffery	Amy Teague

Students and Personnel

Full Name: Adam Betuel (Field Tech)
Research: Data collection on Wildlife Usage and Habitat Development on Spoil Islands in Lake Tohopekaliqa, Florida.

Full Name: Chad Anderson (Field Tech)
Research: Snail Kite Survey and Monitoring.

Full Name: Matthew Burgess (Wildlife Ecologist)
Research: Unmanned Aircraft Systems research project.

Full Name: Amanda S. Burnett
Degree sought: B.A. Wildlife Ecology and Conservation
Graduate Date: May 2012
Research: Currently assists in FL Cooperative Unit Office of Administration

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Full Name: Emily Butler (Field Tech)
Research: Snail kite surveying and banding.

Full Name: Jemeema Carrigan (Wildlife Biologist)
Research: Collects morphometric data on the American Crocodile, conducts nesting surveys, and collects data on juvenile growth and survival for the American Crocodile monitoring and assessment program (MAP)

Full Name: Chris Cattau
Degree sought: PhD Wetland Ecology
Graduation Date: December 2012
Research: Demography and Movement of the Snail Kite

Full Name: Mike Cherkiss (Wildlife Biologist)
Research: Project manager for the American crocodile monitoring and assessment program, collects morphometric data on the American Crocodile, conducts nesting surveys, and collects data on juvenile growth and survival (MAP).

Full Name: Lara Drizd
Degree sought: M.S. Wildlife Ecology and Conservation
Graduation Date: May 2010
Research: S. Florida vegetation (hydrilla) by apple snails in Lake Toho.

Full Name: Carolyn M. Enloe (Field Tech)
Research: Project Leader Spoil Island project. Conducts herptofaunal, vegetation and avian community monitoring projects on large and small lakes throughout Florida.

Full Name: Janet Fey
Degree Sought: BA, Civil Engineering
Research: Office Assistant

Full Name: Ikuko Fujisaki (Statistician)
Research: Analyzes American Alligator body condition for the American Alligator monitoring and assessment program (MAP).

Full Name: Kathryn Garland
Degree sought: PhD Wildlife Ecology and Conservation- Human Dimensions focus
Graduation Date: May 2010
Research: A Taste for Turtles: Green Turtle (*Chelonia mydas*) Consumption in Caribbean Nicaragua. This study involves social research looking at the conditions behind sea turtle consumptive use in Latin America.

Full Name: Wellington Guzman (Wildlife Biologist)
Research: Collects morphometric data on the American Alligator for the American Alligator monitoring and assessment program (MAP)

Full Name: Rebecca Blair Hayman
Degree sought: M.S. Wildlife Ecology and Conservation
Graduation Date: December 2009
Research Blurb: To gauge current opinions, knowledge, and risk perceptions of American alligators. Compare changes in knowledge, attitudes, and variations relative to an earlier survey conducted in 1996. This work is in cooperation with FL FWCC and information gained will shape state management decision regarding alligators.

Full Name: Spencer Ingley
Degree sought: Undergraduate Wildlife Ecology and Conservation
Graduation Date: May 2010
Research: Unmanned Aerial Vehicle

Full Name: Brian Jeffrey
Degree sought: MS in Interdisciplinary Ecology
Graduation Date: May 2009
Research: Looking at the impact of off-road vehicles on the small mammal populations in Big Cypress National Preserve

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Full Name: Margaret Lamont (Post-Doctoral Associate)
Research: My research involves examining how coastal species, such as sea turtles and shorebirds, are affected by natural and anthropogenic dynamics of barrier island systems.

Full Name: Elizabeth Martin
Degree sought: PhD Wildlife Ecology and Conservation
Graduation Date: December 2008
Research: Predation risk from diurnal raptors and effects on habitat use and foraging behavior of wintering Dunlin (Calidris alpine) at Merritt Island National Wildlife Refuge in Florida.

Full Name: Mario J. Mota
Degree sought: PhD
Graduation Date: May 2009
Research: Sea Turtle Nesting

Name: Jean Olbert
Degree sought: MS
Graduation Date: August 2011
Research: Monitoring nest predation and provisioning for nesting Snail Kites.

Full Name: Danielle Ogurcak (Wildlife Biologist)
Research: Collects vegetative data for the American Alligator hole, distribution, and occupancy project.

Full Name: Mark Parry (Wildlife Biologist)
Research: Collects morphometric data on the American Crocodile, conducts nesting surveys, and collects data on juvenile growth and survival for the American Crocodile monitoring and assessment program (MAP)

Full Name: Kyle E. Pias
Degree sought: M.S. Wildlife Ecology and Conservation
Graduation Date: December 2011
Research: Snail kite monitoring, habitat use of breeding snail kites.

Full Name: Brian E. Reichert
Degree sought: M.S.
Graduation Date: December 2009
Research: Snail kit monitoring of population demographics; exploring senescence and other aspects of survival.

Full Name: Mike Rochford (Wildlife Biologist)
Research: Collects morphometric data on the American Alligator for the American Alligator monitoring and assessment program (MAP).

Full Name: Kimberly E. Schmidt (Field Tech)
Research: Snail kite and apple snail monitoring.

Full Name: Amy Schwarzer
Degree sought: M.S.
Graduation Date: December 2010
Research: Body condition and pray selection of wintering and migratory Red Knots in Florida.

Full Name: Jesse Senko
Degree sought: M.S.
Graduation Date: December 2010
Research: Fin-scale movements and activity patterns of black turtles at a coastal foraging ground in Baja, California, Sur Mexico.

Full Name: Bradley Noal Shoger
Degree sought: M.S.
Graduation Date: December 2009
Research: Project lead in wildlife use of created Spoil Islands in Lake Tohopekaliga, FL.

Full Name: Jennifer Solis (Field Tech)
Research: Conducts surveys for sea turtle nests along 8-km stretch of Archie Carr Nat'l Wildlife Refuge. Identifies nest to species and collects data and hatching success.

Full Name: Frank Solis (Field Tech)
Research: Conducts surveys for assessment of coastal habitats and species impacted by hurricanes.

Full Name: Brail Stephens (Field Tech)
Research: Conducts surveys for sea turtle monitoring along the St. Joseph Peninsula, Florida.

Full Name: Rio Throm
Degree Sought: MS, SNRE
Graduation Date: May 2011
Research: Surveys in amphibian visual encounter and vocalization at Lake Apopka, FL

Full Name: Adam Watts
Degree sought: PhD
Graduation Date: December 2012
Research: Climate change and fire ecology

Full Name: Zachariah C. Welch
Degree sought: PhD
Graduation Date: December 2009
Research: Restoring pattern without process: Lake restoration in an urban environment.

Full Name: Christa Zweig (Post-Doctoral Associate)
Research: I am tracking changes in vegetation communities in WCA 3A and creating a model to predict community change under different hydrologic regimes.

CURRENT PROJECTS
CO-OP UNIT AND BEYOND

Scrub jays

Conservation

Cooperative Research

Impacts of tropical storms

Manatees

Strategic Habitat Conservation for the Florida Scrub-Jay at Merritt Island National Wildlife Refuge

Principal Investigator: H. Franklin Percival
Co-Principal Investigator: Fred Johnson
Funding Agency: U.S. Geological Survey
Expected Completion: 12/31/11

This project involves the development of a management strategy for oak (*Quercus* spp.) scrub that will maximize the long-term demographic performance of Florida scrub-jays (*Aphelocoma coerulescens*). The project focuses on the Happy Creek Scrub Reserve Unit of Merritt Island National Wildlife Refuge, which is an area with an ecological legacy of fire suppression. Although old-growth oak scrub at Happy Creek has largely been restored to the early-successional state preferred by jays, the scrub generally lacks patches of bare ground. Bare ground is thought to mediate the spread of fire, and thus help maintain the heterogeneous height structure that was characteristic of the scrub prior to human settlement. Prescribed burning has not been successful at creating or maintaining patches of bare ground and so tends to produce large areas of short scrub, which act as demographic sinks for scrub-jays.

Bare ground is an important component of habitat for Florida scrub-jays (photo by B. Powell).

The objective of this project is to determine how creation of bare ground by plowing could supplement prescribed burning to help maintain better habitat conditions for Florida scrub-jays. To date, we have used a Markov decision process to characterize the scrub-management problem and stochastic dynamic programming to derive an optimal, state-dependent management strategy. The state of the managed system is described by the proportions of short, medium-height, and tall scrub, the relative abundance of bare ground, and the number of years since plowing. Using state transition probabilities derived from experience and expert opinion, prescribed burning is the optimal management action for most system states. Plowing is optimal only when bare ground is sparse and there is an abundance of tall scrub. Doing nothing is optimal only when there is an abundance of medium-height scrub. The optimal management strategy was robust to alternative hypotheses concerning the persistence of bare ground created by plowing as opposed to fire. However, the optimal management strategy was very sensitive to transition probabilities for short scrub in the absence of fire. The optimal strategy under a slow-growth (the default) scenario was more management intensive than one under a fast-growth scenario.

P***lowing recently burned scrub at Merritt Island NWR to improve habitat for Florida scrub-jays (photo by M. Legare).***

Monte Carlo simulations suggested that either burning plowing would be required in 99% of all years under the slow-growth scenario, compared with only 58% under the fast-growth scenario. In both cases, however, the expected demographic performance of jays was insufficient to maintain jay numbers in the absence of immigration

Analyses so far suggest there other system attributes and dynamics, such as predator abundance or jay density that may require explicit consideration in formulating an optimal management strategy. The framework we use can accommodate additional features (within computational limits) and can be used to investigate their possible effects on optimal management strategies. Moreover, the decision framework can accommodate multiple, competing hypotheses concerning system dynamics and the effects of management actions. If necessary, these competing hypotheses can form the basis of an adaptive management strategy that can produce optimal management actions in the face of those uncertainties, as well as help reduce uncertainty about system dynamics so that management performance can be improved over time.

Wildlife Usage and Habitat Development on Spoil Islands in Lake Tohopekaliga, Florida

Principal Investigator: Wiley M. Kitchens
Funding Agency: Florida Fish and Wildlife Conservation Commission
Expected completion: August 2009 (PJ #61029)
Field Technicians*:* Melissa DeSa, Carolyn Enloe, Brad Shoger, Amy Schwarzer, Jonathan Chandler,

Field Techs Carolyn Enloe and Amy Reiss repair drift fence herp trap array for Wildlife Usage of Spoil Islands Study on Lake Tohopekaliga.

Following the extreme draw-down and muck removal project of 2004 conducted by the Florida Fish and Wildlife Conservation Commission (FWC) on Lake Tohopekaliga, several in-lake "wildlife islands" were created by stockpiling scraped spoil materials. Although the method of disposal includes moving severed materials outside the lake basin, limited availability of disposal in nearby upland settings and cost prohibitive expenses for trucking the materials long distances resulted in in-lake stockpiles of some materials. Artificially created islands such as these have been documented as having some benefits to wildlife (Chaney et al. 1978, Landin and Newling 1987, Yozzo et al. 2004, Hulon et al. 1998).

Although much research has been done on coastal islands that offer sea bird refuge, very little is known about the habitat value and wildlife usage of freshwater lake islands such as these. By monitoring and documenting the dynamics of the floral and faunal communities present on these islands, we anticipate being able to relate island characteristics including shape, size, grazing, and proximity to shore with wildlife usage and habitat development through time. The intent is to make inferences on what particular island attributes are attractive to wildlife.

OBJECTIVES:
1) Document and describe wildlife occurrence and associated activities on select spoil islands in Lake Tohopekaliga.
2) Document and describe vegetation present on select islands and follow succession throughout the study period.
3) Relate wildlife occurrence to various island characteristics and attempt to elucidate associations. Avian, herpetofauanal, small mammal, and vegetation surveys will be conducted on all islands.

PROGRESS:
The pilot phase of the project came to an end over the summer 2007. Vegetation was surveyed at each island in July 2007 and avian, herpetofaunal, and small mammal surveying techniques were decided upon and initiated in September 2007. Two new field technicians were hired in August and September respectively. The project is completed and final report submitted.

The protocol for vegetation surveys consists of two perpendicular belt transects bisecting each island. The transects face N-S and E-W respectively and cover the full topography of the island. Transects are marked with 2 inch PVC poles placed at 10m intervals. A 1 meter squared quadrat is used to identify species occurrence along the entire transect. At each 10m interval, a diagonal ½ inch PVC with markings every 5cm is laid across the quadrat to determine percent cover.

The herpetofaunal and small mammal sampling is conducted using a single drift fence array located on the lakeward portion of the island. The array is set up as a Y with two legs on the sloped and littoral portion of the island and one leg jutting into the upland. Each leg consists of 15m of industrial silt fencing and wooden stakes. 3 double-ended funnel traps, made with window screening, are placed along each side of each leg of the fence at 5m intervals thus giving 18 funnel traps per array. In addition, baited Sherman traps are placed on the upland leg in between the funnel traps and either side of the slope legs, above water line, giving 8 Sherman traps per array. The traps are run for 4 days per month and checked daily. All captures are identified to species, counted, and weighed before being released at the site of capture. Different arrangements of small mammal traps are being looked at to better sample the community.

Demographic, Movement, and Habitat of the Endangered Snail Kite in Response to Operational Plans in Water Conservation.

Principal Investigator: Wiley M. Kitchens
Funding Agency: USGS/Army Corps of Engineers
Expected Completion: 3/31/2010 (UFPJ#00073318)
Research Staff: B. Reichert, C. Cattau, K. Pias, E. Butler, J. Olbert, A. Bowling

Captured Snail Kite in FL Everglades

Recent demographic analyses indicate alarming trends in the snail kite population in Florida. Kite abundance drastically and steadily declined between 1999 and 2003 and again between 2006 and 2008. The population size estimate for has approximately halved from 2006 to 2008 (1204 in 2006 to 685 in 2008). Our results suggest that the lack of recovery after 2002 is probably due to a reduction in recruitment, which has not shown any indication of changing. There were major droughts in the study area (Water Years 00/01 and 06/07) that negatively impacted both adult and juvenile survival. In addition, there are numerous hydrological management activities in the system that may well be affecting kite reproduction. Lake Okeechobee, one of the productive breeding sites of the system between 1985 and 1995, has undergone radical changes in its' hydrological schedule since 1996 and almost no fledging birds have been produced from this site since 1996. In addition, there have been major lake enhancements (draw downs) and extensive aquatic weed control activities in the Kissimmee Chain of Lakes and water level schedule changes in the in Water Conservation Area 3A (the prime reproductive unit for kites).

Excluding the drought impacted years, adult annual survival has been approximately 90% throughout the study period. This would tend to negate arguments of disease being a major causative factor for the declines. Given adult

survival is relatively high and stable, reproduction and recruitment become particularly important to stemming the perceived declines. PVA models indicate that the lack of recruitment is critical both stemming of this decline and achieving a more sustainable population growth rate.

OBJECTIVES:

The snail kite (*Rostrhamus sociabilis*) is an endangered raptor whose distribution in the United States is restricted to the South Florida Ecosystem including watersheds of the Everglades, Lake Okeechobee, Kissimmee River, and Upper St. Johns River. Human-induced degradation of the hydrologic functioning of these watersheds has prompted large-scale restoration efforts (e.g. the Central and South Florida Project Restudy, Kissimmee River Restoration, and the South Florida Ecosystem Restoration Initiative).

During the first half of this century, snail kite populations declined dramatically. More recently, since the mid-1960's the population appeared to stabilize and perhaps even increase. However, our recent studies suggest the population is currently undergoing an alarming declining phase. The population size appears to have progressively and substantially decreased since 1999. The population in 2003 was estimated to be half its estimated size in 1999. The altered hydrology of wetlands representing its critical habitat is probably the primary environmental influence on the population. These include loss of habitat and changes in foraging and nesting habitat structure.

The objective of this research is to monitor the birds' response to environmental changes (anthropogenic and natural) focusing on the most critical demographic parameters: survival, reproduction, recruitment, and population growth rate. Because those demographic parameters are heavily influenced by the behavior of the birds (i.e. their ability to move and select suitable habitats), movement studies constitute the other major aspect of the research. There are 2 overarching objectives: 1) to evaluate the underlying mechanisms and processes driving the population dynamics of the kites; 2) to provide reliable estimates of demographic parameters and movement probabilities to upgrade management models to optimize management decisions.

PROGRESS:

This study is complementary to the demographic study entitled "Demographic, movement, and habitat studies of the endangered snail kite in response to hydrological changes".

Wing markings on a Snail Kite

Our radio telemetry study conducted in 1992 to 1995 helped identify the critical kite habitat. However given the dynamics of those habitats (changes in hydrology, plant communities), it is reasonable to expect some spatial shifts in the use of those habitats after more than 8 years (for instance large number of kites used Lake Okeechobee between 1992 and 1994, but stop using this area after 1995). Radio telemetry is the most efficient if not only way to track those changes.

Mark-recapture models provide a powerful framework for estimating critical demographic (survival, population growth rate) and movement parameters. The recent advances in modeling allow for the combination of mark recapture and radio telemetry information, providing better estimates of survival and movement rates, and increasing power of statistical inferences (Williams et al 2002, Nasution et al. 2001).

Additional advances in mark-recapture modeling using the multi-state robust design that adjusts for the bias associated with state uncertainty have aided us in producing reliable estimates of snail kite breeding probabilities. Model selection indicates that snail kite breeding probabilities are closely dependent upon the life-history trade-offs associated with aging and harsh environments, such as droughts and habitat degradation. Describing sources of variation within breeding probabilities will help to refine estimates of fecundity and identify the environmental conditions which promote breeding attempts.

Senescence is defined as an increasing intrinsic rate of death, and is common among wild populations. By utilizing the long-term band-resight dataset, which began in 1976, we are able to identify senescence rates among the aging cohorts of the snail kite population. Understanding how severe environmental conditions (such as

droughts) disproportionally impact the survival probabilities of older snail kites will help to refine vital rates that are critical to our monitoring efforts.
Preliminary findings:

- Snail kites are more philopatric than previously anticipated.
- Preliminary aircraft radio surveys have also enabled us to obtain more precise survival estimates during dry wetland conditions.
- Our analyses of radio-telemetry, using multistate models, indicate that snail kite movements are not as extensive as previously thought especially between habitats that have been altered by fragmentation.
- Our study also highlights the importance of taking into consideration the fact that kites movement are both distance dependent and affected by fragmentation, when managing the hydrology of wetlands used by this species.
- Snail kites do experience increased rates of mortality and decreased probabilities of attempting to breed in their oldest ages.
- All young fledged and radioed in the Kissimmee Chain of Lakes (KCOL) in 2008 and 2009 stayed in the KCOL through their entire first year post fledging. Only four young from 2008 were later observed in the Everglades region (also includes Harn's Marsh Preserve) in 2009.

Assessing the Effects of Coastline Alteration on Sea Turtle Nesting and Faunal Assemblages at Cape San Blas, Florida

Principal Investigator: Raymond R. Carthy
Co-Principal Investigator: Margaret Lamont
Funding Agency: U.S. Department of Defense/Eglin Air Force Base
Expected Completion: 03/31/2009 (UF59990)
Graduate Students: Russell Scarpino
Field Technicians: Celeste Warner, Jennifer Solis, Frank Solis, Michelle Wcisel, Lori Brinn

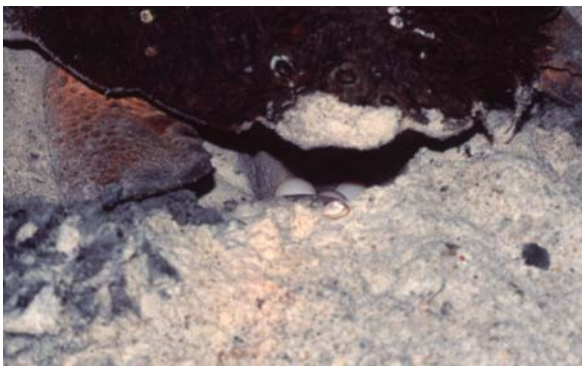
The Eglin Air Force Base (EAFB) property on Cape San Blas and St. Joseph Bay represent important nesting and developmental habitats for threatened and endangered marine turtles. Since 1998, the Florida Coop Unit has maintained a tagging and research program on the nesting turtle population on Cape San Blas, and in 2001 we began a study of the juvenile loggerhead, green and Kemp's ridley turtles that use St. Joseph Bay as a temporary nursery area. The highly dynamic coastline of Cape San Blas is receiving additional stress from Florida's rapid population growth: coastal residential and commercial development are encroaching on the beaches and increasing recreational use of the area. The current work continues to build our long-term dataset through saturation tagging in an effort to examine effects of coastal erosion and accretion and elucidate habitat use by juvenile turtles.

OBJECTIVES:
The objectives of this project are to elucidate specific components of sea turtle ecology and interactions with humans:

1. Adult habitat use- study offshore movements in interesting habitat, effects of erosion debris fields.
2. Juvenile habitat use- population structure, residence time, over-wintering, fine scale movements.
3. Magnetic orientation- compass initiation and calibration in hatchlings.
4. Beach driving- evaluate temporal and mechanical strategies of rut removal to minimize effect on adults and hatchlings.

Juvenile green turtle in St. Joseph Bay, FL

A final report for this project was submitted in November 2009. Nesting success increased from 2006 to 2008 resulting from an increase in number of nests during this time period coupled with a decrease in number of false crawls. This trend may be the result of debris on the beach following the severe tropical storm season in 2005. In 2005 there was a record number (27) of named tropical storms with 14 becoming hurricanes. These storms included Hurricanes Katrina, Rita and Wilma, which all caused significant damage along Florida's Gulf Coast. Tropical storms knock down trees and expose debris along Cape San Blas, such as concrete pads, wiring, and chain link fencing, which may block the beach thereby reducing available nesting area and serving as obstacles to movement. Perhaps the severe storm season in 2005 resulted in a large amount of debris along Cape San Blas. Turtles attempting to nest in this area may have emerged from the water only to find little available beach or to have debris blocking their way to possible nest sites. This would result in an increase in false crawls and a reduced number of nests (decrease in nesting success). Because this trend was not observed state-wide, or even throughout the Panhandle nesting group, it indicates a site-specific cause, such as debris (Witherington et al. 2009). Although Cape San Blas was also affected by tropical storm activity in 2007 and 2008, these storms weren't as severe as the storms in 2005 (indirect effects in 2007 and 2008 versus direct effects in 2005). Perhaps the decrease in storm severity allowed the beach to recover from the severe erosion in 2005. If enough accretion was allowed to occur it may have resulted in an increase in the amount of beach available to nesting turtles and a reduction in exposed debris serving as obstacles to beach movement.



Loggerhead turtle depositing eggs along Cape San Blas, FL

Although nesting success increased from 2006 to 2008, emergence success declined. The most likely reason for this decline was increased tropical storm activity in 2007 and 2008, most notably Hurricane Dean in 2007 and Hurricanes Gustav and Ike in 2008. Although Hurricane Dean did not make landfall in the United States, it crossed the Bay of Campeche in the lower Gulf of Mexico causing extremely high tides along the Florida Panhandle, including Cape San Blas. Fourteen (41%) nests were impacted by high water this season (completely washed away, partially washed away or accreted), while 9 (26%) were completely washed away during the high tides caused by Hurricane Dean. A similar situation occurred in 2008 with Hurricanes Gustav and Ike making landfall in southern Texas. As these storms passed through the Gulf of Mexico south of Cape San Blas, they resulted in an increase in tidal activity thereby washing nests away. In 2006, Cape San Blas experienced no tropical storm activity. This tropical storm activity caused little direct effects (downed trees, damage to structures) to Cape San Blas which would not increase debris along the beach and not affect nesting success; however the indirect effects of high tides and rising water caused nests to wash away or become inundated thereby reducing emergence success.

Site fidelity was low in 2006. However, this was most likely due to sampling difficulties rather than biological factors. The project manager left in 2006 and a new manager was hired just prior to the start of the season. This left little time to hire an appropriate field crew therefore surveys were completed by graduate students who were on site but busy collecting data for their own research projects. Therefore, nightly tagging surveys were not conducted as efficiently as normal and more nesting turtles were missed. This resulted in only 50% of nests being observed in 2006. Coupled with lower nesting numbers in 2006, only 11 nests were observed and only one of those nests was deposited by a turtle that had been previously tagged. In 2007 and 2008 however the survey protocol was improved and the crew observed 88% (2007) and 82% (2008) of the nests deposited along Cape San Blas. This increase in nests observed resulted in a corresponding increase in the number of return turtles observed (43% in 2007 and 42% in 2008).

If this trend in site fidelity observed in 2007 and 2008 continues, it appears that approximately 40% of nests laid along EAFB property on Cape San Blas are deposited by return turtles (i.e. turtles exhibiting site fidelity). This is slightly lower than site fidelity expressed in other areas in the Southeastern United States such as Little Cumberland Island, GA where 51% of turtles returned to a 16.6-km stretch of beach (Bell and Richardson 1978). However, world-wide it is much lower than some reports. In Australia, it has been reported that 98% of loggerheads were recaptured at the original tagging location (Limpus 1985) and in South Africa 93% of loggerheads returned to within 9.6-km of their original tagging location (Hughes 1974). Lower site fidelity along Cape San Blas as compared to other areas in the Southeastern United States may have to do with the extreme dynamics of this barrier island

system. Cape San Blas experiences the greatest rate of natural erosion in Florida (Lamont and Carthy 2007). This erosion constantly alters the beach. Beach characteristics such as temperature, salinity, slope, moisture, width, and sand type have been shown to influence nest placement within the beach (Johannes and Rimmer, 1984; Garmestani et al., 2000; Wood and Bjorndal, 2000). When optimal, these factors may allow turtles to expend less energy in locating nesting sites that will provide the greatest reproductive success. Along dynamic beaches, these factors are constantly changing, which may reduce a turtle's ability to identify high-quality nesting sites thereby reducing site fidelity.

Development of a Sea Turtle Education Program for Gulf County, Florida

Principal Investigator: Raymond R. Carthy
Co-Principal Investigator: Margaret Lamont
Funding Agency: Florida Sea Turtle Grants Program
Expected Completion: 5/31/2010 (UF59990)

Gulf County is located in Florida's panhandle and includes 43 miles of coastline. These beaches provide necessary resources for nesting marine turtles. The greatest number of nests is deposited by loggerhead turtles and these turtles have been identified as genetically distinct from turtles nesting throughout the southeastern United States (Encalada et al. 1996). The greatest number of nests deposited by this genetically distinct group is laid in Gulf County. In addition, the number of green and leatherback turtle nests laid in Gulf County has increased in recent years. In 2008, nine green turtle nests were deposited along 7-km of beach on the St. Joseph Peninsula (pers. obs., Margaret Lamont).

Educational signage asking people to turn off lights for sea turtles in Gulf County, Florida

This project represents the start of a growing educational program designed to increase the knowledge of Gulf County beach users about sea turtle ecology and conservation. We hope to continue to expand this educational program to include a sea turtle display at the new Gulf County Visitor's center, creation of booklets providing Gulf County-specific information on sea turtle nesting distribution and ecology of turtle species nesting in this area, and books, DVD's and additional education materials for use by residents and tourists. Increasing the knowledge of beach users may help decrease disturbance to nesting turtles, nests and hatchlings, increase nesting and hatching success and aid in conservation of this unique nesting group

Progress 2009:
Two large signs (48"H x 96"W) and nine smaller signs will be purchased using money from this grant. The design of the large signs is identical to one large sign already in place at the entrance to the St. Joseph Peninsula on Cape San Blas Road (Figure 1) with changes made to reflect the Sea Turtle Grants Program funding (Figure 2). Estimates for the large signs have been attained from SignPrinters in Tallahassee, FL and from Ramsey's Printing and Office Products in Port St. Joe, FL.

The design of the smaller signs will be nearly identical to signs used by the Apalachicola National Estuarine Research Reserve in Franklin County, FL with changes made to reflect the Sea Turtle Grants Program funding. We are in the process of getting estimates from SignPrinters and Ramsey's Printing and Office Products for production of 9 small signs.

Currently, one large sign is in place from May 1 through November 30 at the entrance to the St. Joseph Peninsula along Cape San Blas Road. The Gulf County Code Enforcement Officer (Michael Aiken) has identified locations for installation of the two large signs: 1) on Hwy 98 entering St. Joe Beach and 2) along the entrance to Indian Pass Road. Cape San Blas Road and Hwy 98 are state owned roads so permission from the Florida Department of Transportation (FDOT) is needed before these signs can be installed. Mr. Aiken has made arrangements with FDOT to preview placement of the signs prior to installation in April. If FDOT does not give approval for erection of the signs directly on the state right-of-way, a secondary location, situated just off the right-of-way but still highly visible from the road and to beach-users will be used.

The small signs will be installed at beach access points in St. Joe Beach, Indian Pass, and along the St. Joseph Peninsula.

Educational brochures providing information on the effects of artificial lighting on sea turtle orientation and beach tags providing information on the effects of beach equipment on hatchling and adults turtles will also be printed. We have requested estimates from Ramsey's Printing and Office Supplies for printing of 500 brochures and 500 beach tags. The beach tags will consist of one double-sided card with a hole in the top that will allow us to attach a rubber band and hang the card on equipment. One side of the card will contain graphics and the other side will contain text-only. Text will simply state that beach equipment poses a hazard to adult and hatchling sea turtles trying to return to the water. The lighting brochure will be tri-fold design. The first page will ask people to turn off lights from May 1 to November 30, the second page will provide facts on sea turtle nesting in Gulf County, the Gulf County lighting ordinance and the effects of artificial lighting on nesting and hatchling turtles (including a phone number to call for more information or to report disoriented turtles) and the third page will contain a maze that illustrates the hazards turtles face on the beach.

Development of Unmanned Aerial Vehicles for Assessment of Wildlife Populations and Habitats: Phase 3

Principal: H. Franklin Percival
Co-Principal Investigator: Peter Ifju,
Funding Agency: U.S. Geological Survey
Expected Completion: 12/31/09 (UFID#75564)
Biological Scientist: Matthew Burgess

The purpose of this project is to pursue enhancements to an existing unmanned aerial vehicle (UAV) system to improve its present applicability and future potential for a variety of natural-resource uses. The research is interdisciplinary in nature and includes engineering, ecological, photogrammetric, and remote sensing elements and experts in those disciplines.

Photo by: Matthew Burgess - *Unmanned Aerial Vehicle*

OBJECTIVES: Research objectives and major tasks of this three-year project include, but are not limited to, the following:
1) Improvements in construction and electronics to enhance the reliability and ease of operation of the aircraft.
2) Progress in the development of geographical referencing capability for imagery collected from the aircraft.
3) Training of personnel for testing of a complete UAV system for research and management applications.
4) Development and testing of thermal infrared (TIR) sensor capability.
5) Evaluation of operating and maintaining a UAV system.
6) Exploration of future UAV system enhancements for remote-sensing applications.

2009 PROGRESS:
Four Nova 2 small unmanned aircraft systems (sUAS) were delivered to the U.S. Army Corps of Engineers, Jacksonville District (USACE) in early 2009. The Nova 2 airframe increased the technical capability of the program, and brought us closer to realizing goals that we only dreamed of accomplishing. The Nova 2 was able to repeatedly deliver 45 minute sustained operational missions over Lake Okeechobee, while gathering high resolution imagery and data for post processing. Improvements in the georeferencing hardware and software also helped position the Nova 2 substantially above any of its competitors. The imaging platform was equipped with its own inertial measurement unit (IMU), increasing both the accuracy and precision of the imagery data collected. The Nova 2 proved to be a durable airframe for repeated takeoffs and landings, including repeatable safe water landings. During the spring and early summer 2009, the Nova 2 was able to conduct aerial imagery missions over 2,700 ha of invasive aquatic vegetation in Lake Okeechobee, as well as over several nesting bird colonies in Loxahatchee National Wildlife Refuge. These large datasets have been archived, and will be used for time-elapsed comparisons with data scheduled to be collected in calendar year 2010.

It became apparent in mid-2009 that the Nova 2 sUAS had several shortcomings that limited its continued use. Weaknesses in the water proofing and aerospace design led to the decision of building an alternative airframe that incorporated the positive features of the Nova 2 with additional engineering to produce the Nova 2.1. During the fall of 2009, the majority of the project's efforts were focused on the design and construction of the Nova 2.1 airframe. Templates and molds were fabricated to help in the production of Nova 2.1 aircraft in-house; improving the speed and efficiency of future airframe construction efforts.

The Nova 2.1 aircraft is considerably lighter, stronger, and more aerodynamic than its predecessor. These features allow the current aircraft to fly more efficiently, for longer duration, and at slower speeds. Redundant water proofing features and technical improvements promise to make the Nova 2.1 a workhorse for operational missions in 2010.

Southeastern Adaptive Management Group (SEAMG)

Principal Investigator: H. Franklin Percival
Co-Principal Investigators: Robert M. Dorazio, Fred A. Johnson
Funding Agencies: Florida Fish & Wildlife Conservation Commission / U.S. Geological Survey / U.S. Fish & Wildlife Service
Expected Completion: 6/30/2010 (UF62829 New UF75703)

The Southeastern Adaptive Management Group (SEAMG) was created in 2001 for the purpose of achieving a better science-based approach to wildlife conservation and management. The principal mission of the group is "To better integrate research and management for the purpose of improving how natural resource management decisions are made.? As part of this mission, the SEAMG is responsible for exploring and developing quantitative tools that improve and facilitate the integration of research and management. A distinguishing feature of the SEAMG is that it seeks ways to achieve a heightened level of integration between researchers and managers. At this level of integration, management actions themselves are viewed as opportunities for learning through experimentation, and the selection of management actions generally includes compromises between the (possibly) long-term value of learning and the short-term value of achieving more immediate management objectives. However, practical considerations also are expected to constrain the selection of management actions in most, if not all, resource management problems. A truly integrated program of research and management potentially offers great rewards; however, it is far more difficult and more costly to achieve than the more common situation where research is conducted in support of management without any direct involvement in the selection of alternative management actions. The SEAMG is interested in finding ways to achieve higher levels of integration in the activities researchers and managers to improve the decisions in problems of natural resource management and conservation. Institutional arrangements for establishment and operation of the SEAMG are described in a formal Cooperative Agreement among signatories of the U.S. Geological Survey (USGS), the U.S. Fish and Wildlife Service (USFWS), and the Florida Fish and Wildlife Conservation Commission (FFWCC). It is guided by a Steering Committee

Statistics and the Program for Environmental Statistics at the University of Florida. SEAMG scientists interact closely with scientists and managers of cooperating organizations to solve problems of natural resource management.

American Alligator Distribution, Size, and Hole Occupancy and Crocodile Juvenile Growth and Survival

Principal Investigator: H. Franklin Percival
Co-Principal Investigators: Frank J. Mazzotti
Funding Agencies: U.S. Army Corps of Engineers
Expected Completion: 04/01/2010 (UF569014, #69015, #69016)

Responses of crocodilians are directly related to suitability of environmental conditions including hydropattern. Correlations between biological responses and environmental conditions contribute to understanding of species' status and trends over time. Positive or negative trends of this indicator relative to hydrologic changes permit assessment of positive or negative trends in restoration impacts. Restoration success or failure would be evaluated by comparing recent and future trends and status of crocodilian populations with historical population data and model predictions; as stated in the CERP hypotheses
related to alligators and crocodiles (CERP MAP section 3.1.2.5 and 3.1.2.6, 2004). Importantly, these data can be used in an analysis designed to distinguish between effects of CERP and non-CERP events such as hurricanes or droughts.

Progress in 2008
Task 1-Alligator Distribution and Condition: Second round of surveys completed. Captures of alligators were conducted in twelve (12) study areas.
Task 2- Alligator Nesting Ecology: No alligator nesting ecology work was conducted this quarter.
Task 3- Alligator Hole Mapping and Occupancy.
Task 4- Estimate juvenile growth and survival rates of crocodiles in areas affect by CERP projects: Spotlight surveys were performed of accessible coastal and estuarine shore line from western Everglades Nat'l Park around the coast to the mouth of the Miami river, including Key Largo, Barnes and Card Sounds, and Biscayne Bay.

Alligators seek refuge in a cave during an extreme dry event in the Florida Everglades

Worked Planned For 2009
Task 1-Alligator Distribution and Condition: Evaluate hydrologic conditions to determine the start of night light surveys.
Task 2-Alligator Nesting Ecology: None scheduled
Task 3-Alligator Hole Mapping and Occupancy: None scheduled.
Task 4-Estimate juvenile growth and survival rates of crocodiles in areas affect by CERP projects.

Spotlight surveys will be performed of accessible coastal and estuarine shoreline from Everglades City around the coast to the mouth of the Miami River, including Everglades National Park, Key Largo and Biscayne Bay.

Crocodiles
1. Finish developing and testing a monitoring program for nesting, condition, growth and survival of crocodiles in areas that will be affected by CERP projects.
2. Monitor changes in nesting, condition, growth, and survival of crocodiles in response to CERP projects.

Experimental Evaluation of a Habitat Enhancement Project for Fish and Wildlife at Gant Lake, Florida

Principal Investigator: Mike S. Allen, Wiley M. Kitchens, H. Franklin Percival
Funding Agencies: Florida Fish and Wildlife Conservation Commission
Expected Completion: 12/20/2009 (UF65181)

Many Florida lakes have experienced altered hydrologic regimes due to channelization and water control structures for flood control, agriculture, and water supply activities. Altered hydrology has resulted in stabilized water levels compared to historical regimes and modified temporal (i.e., within and among year) patterns in water levels. Stabilized water levels allow dense emergent plants to flourish in the narrow zone of lake fluctuation, which leads to excessive deposition of organic matter and eventual loss of littoral habitat for fish, including recreationally important sport fish (Moyer et al. 1995; Allen and Tugend 2002). These degraded vegetation communities have been characterized as dense (percent-area coverages of 90-100%), with extremely high plant biomass (> 50 kg/m2) and poor habitat for fish (e.g., low dissolved oxygen) (Moyer et al. 1995; Allen and Tugend 2002).

To mitigate the influence of altered hydrology on fish habitat, The Florida Fish and Wildlife Conservation Commission (FWC) has conducted some of the world's largest lake habitat enhancement projects. Enhancement efforts have focused on lake drawdowns and muck (i.e., organic plant material and sediment) removals, with the goal of improving sport fish populations, angler access, and fishing quality. Although habitat enhancements improve fish habitat in the treated areas (Allen and Tugend 2002), these efforts do not always cause significant lake-wide increases in the population abundance and angler catch rates of sport fish such as largemouth bass Micropterus salmoides (Allen et al. 2003).

Minns et al. (1996) argued that freshwater habitat enhancement efforts should focus on ecosystem and multi-species benefits rather than benefits to a single species or group. Lake habitat enhancement projects have the potential to benefit all components of lake ecosystems including wildlife (e.g., amphibians, reptiles, birds) and fisheries resources. However, work is needed to understand the collective wildlife and fish community responses and processes, which can then be used to maximize the benefits of habitat enhancement efforts on lake ecosystems. Our proposal to evaluate the wildlife and fish community responses to a habitat enhancement project at Gant Lake, Florida has begun and is finishing the first year of field research. Our research approach will measure habitat characteristics and fish and wildlife community composition and abundance at Gant Lake and two control lakes before and after the habitat enhancement effort.

Student Brad Shoger approaching Gant Lake study sites for early morning bird point transect surveys

OBJECTIVES

This project is evaluating the wildlife and fish community responses to a habitat enhancement project at Gant Lake, Florida. The objectives of this study are to:

1) characterize aquatic vegetation communities including defining the environmental variables structuring these communities temporally and spatially within the littoral reaches of the lake.
2) quantify habitat composition including substrate type, water depth, and aquatic plant abundance and community composition before and after the habitat enhancement at Gant Lake with comparison to two referenece systems, and

3) quantify fish and wildlife community composition and abundance before and after the habitat enhancement with comparison to two reference systems.

PROGRESS:
The protocol for characterizing the aquatic vegetation communities in the littoral reaches of the lake were taken from previous research done on Lake Tohopekaliga in central Florida. Thus far, habitat sampling occurred at Gant Lake, Johnson Lake and Lake Lindsey in June 2008 and Decemeber 2008, at the peak and end of the growing seasons.

Vegetation sampling involves cutting the stems of all plants within a $0.25m^2$ area plot at the sediment surface at 24 randomly-selected locations on each lake during each sampling period. Plants are separated by species and the number of stems are counted and weighed in the field. There are eight vegetation sample locations in each of the three vegetation strata at Gant Lake, and 12 vegetation sample locations in each of the two strata at Johnson Lake and Lake Lindsey.

The vegetation data collected thus far in the first sample of the peak and the end of the growing season will be coupled with the vegetation sampling of the coming project year to gain insight into the habitat communities of Gant Lake. The data will be used to develop a multivariate statistically based regression tree modeling capability, CART and/or MRT. This modeling will provide managers both a descriptive and predictive capability defining plant community structure and responses to the habitat manipulation. Thus far no analysis has taken place but will for the June 2008 annual report to FWC.

The herpetofaunal community of Gant Lake has been sampled by littoral vegetation strata three times this year in April and October 2007 and January 2008. Because of the extended drought during the summer we were not able to sample during July 2007. However, in following years the lake will be sample four times a year. The two reference lakes were each sampled four times because of sufficient water levels.

Each sample occasion consisted of six consecutive trapping days per lake. Fifteen permanent trapping transects were randomly placed at each lake. Each transect of Gant Lake has three individual trap locations, one in each of the three vegetation stratum at the approximate midpoint of each stratum. One crayfish trap and one minnow trap, each constructed of ½-inch vinyl coated hardware cloth, are used at each trap location. During the sampling period, each trap is checked every 24 hours and its contents are identified, counted, weighed, and measured depending on the species captured. The animals are then released at the trap site. After the initial 48-hour sampling period, the traps are moved 10 meters to the left or right for 48 hours, then in the other direction for another 48 hours. This sampling design results in a total of 45 trap locations per stratum per sample period.

Monitoring of Wading Bird Reproduction in WCAS 1, 2, and 3 of the Everglades

Principal Investigator: Peter Frederick
Funding Agency: U.S. Army Corps of Engineers
Expected Completion: 3/30/2009 (RWO 230 - UF54346)
Graduate Students: Rena Borkhataria, Kate Williams
Research Coordinator: John Simon
Field Technicians: Sam Edmonds, Andrew Spees, Becky Smith, Elizabeth Kreakie

The proposed work is to continue a long-term monitoring project that annually measures responses of breeding wading birds to hydrological conditions in the water conservation areas of the Everglades. This project is compatible and integrated with a larger effort designed to monitor reproductive responses of wading birds to Everglades water management and restoration activities, from Lake Okeechobee to Florida Bay. Responses monitored will be numbers of nesting pairs of 8 species (nesting effort) and reproductive success and productivity of selected species (White Ibises, Wood Storks, Great Egrets, Snowy Egrets) in large and regionally significant colonies.

Surveying wading birds via airboat

OBJECTIVES:

- Annually document numbers of nesting pairs in WCAs 1, 2, and 3 of the Everglades through the use of aerial and ground survey techniques.
- Develop new methods for estimating numbers of nests, particularly in large colonies.

Wading bird nesting responses (timing, location, numbers of nests) are an important variable in evaluating the success of the Comprehensive Everglades Restoration Plan (CERP). Although records of nesting wading birds go back to the late 1800's and the coverage has been thorough in some parts of the Everglades for a decade, there are several parts of the south Florida ecosystem that have not been surveyed at all, or have not been surveyed regularly or systematically. The purpose of this CERP-funded MAP project is to expand coverage of the surveys to give a comprehensive picture of nesting in the south Florida ecosystem, including Lake Okeechobee, the Water Conservation Areas, Big Cypress National Preserve, Holey Land and Rotenberger, Everglades National Park and Florida Bay. Not all species of wading birds are considered of equal importance in monitoring the success of CERP, and the focus is now on large white species, especially Wood Storks, White Ibises, Snowy Egrets, and Roseate Spoonbills. Four entities were involved in the systematic surveys – University of Florida (BICY and WCAs), Florida International University (Lake Okeechobee), National Audubon Society (Florida Bay) and Everglades National Park (ENP).

During this reporting period we have concentrated largely on reporting issues (below), getting prepared for the next field season, and progressing on the development of unmanned aerial devices (UAS or Unmanned Aerial Systems) for use in the 2009 field season.

Reporting issues – We've concluded an agreement with USGS, USCOE and MAP personnel that will in effect substitute the System Status Report due in March 2009 for the 2008 final report on this project.

Preparation for next field season – We have to date hired all of the technicians necessary to pursue this work in spring 2009. We also have renovated and prepared field equipment for same. We have also rented a house in south Dade county for the 2009 spring and early summer.

Development of UAS for use in 2009. This work is progressing reasonably smoothly. The UAS airframe developed for us by Mechanical and Aerospace Engineering at UF (MAE) has now been flown six times and has performed admirably on all of those flight dates. The airframe seems robust to its design carrying capacity, seems to respond well to gusty winds, seems to take off and land well, and is forgiving enough for student pilots to fly. Resolution of pictures has been a difficult hurdle, and until late October we were still getting only rough resolution of flamingo decoys from 200ft. altitude. However the introduction of an SLR camera in combination with a pancake lense, and the use of high speed aperture settings has overcome this. We are now able to count golf balls easily that are laid out as though in a nest, from 400 ft altitude. This is a major hurdle that now opens the way for many different applications of this device. We have also made tremendous progress on integration of systems on the airframe, including communications, storage and sensors on the aircraft, which have all now been bundled onto a single custom designed computer board. There is reasonable hope that the pictures will be GPS stamped, and that the GPS stamps will be accurate to a minimum of 40 meters. Given the other landmarks that are probably available in most pictures of colonies, this seems reasonable criteria for the use of this UAS in wading bird colonies. Finally, John Simon is our staff member who has been trained to fly the UAS, and all reports indicate that he has progressed well and will be able to fly the aircraft in spring 2009.

WORK PLANNED FOR NEXT 30-60 DAYS we plan to:

1) Move equipment and machinery to south Florida 2) Train field technicians for field operations
3) Develop contract for aerial surveys 4) Design and test an airboat mounted launch system for the UAS
5) Field test the UAS in January over existing targets and wading bird colonies.

Wading Bird Colony Location, Size, Timing and Wood Stork Nesting Success

Principal Investigator: Peter Frederick
Funding Agency: U.S. Army Corps of Engineers
Expected Completion: 10/30/2009 (RWO 236 - UF68415)
Research Staff: John Simon, Kate Williams

The proposed work is to continue a long-term monitoring project that annually monitors responses of breeding wading birds to hydrological conditions in the water conservation areas of the Everglades, and to monitor reactions of Wood Storks (*Mycteria americana*) to hydrological change. While this work continues the work carried out over the past decade, this project expands the area covered to include nesting in Big Cypress National Preserve and Everglades National Park, and to facilitate and standardize surveys occurring in Florida Bay and Lake Okeechobee.

This work is to continue a long-term monitoring project that annually documents responses of breeding wading birds to hydrological conditions and restoration efforts, and to expand the coverage of these surveys to include Everglades National Park and Big Cypress National Preserve. In addition, we hope to document specific responses of Wood Storks to restoration activities. A final goal is to ensure coordination and standardization of breeding wading bird surveys in the entire watershed, from Lake Okeechobee to Florida Bay. This will greatly enhance our ability to detect both system-wide responses, and to compare responses in different parts of the ecosystem.

Wood Stork rookery in the Everglades

PROGRESS ACCOMPLISHED THIS PERIOD
Monitoring was terminated in the last week of June, since all wading bird colonies had dissipated and surveys in the middle of June indicated no new colonies forming.

In general, we had a successful field season and the birds had a very successful breeding season. Wood Storks nested somewhat earlier than usual (late January and early February), and were able to bring off successful nestings in three colonies in WCA 3, and 11 colonies in Everglades National Park. This is a record-setting year, both in numbers of storks nesting and in location. The coastal zone of Everglades National Park was used heavily by storks, and storks were seen in at least five novel locations in addition to six that have been used with varying consistency in earlier years. In addition, surveys in ENP and in WCA 3 suggest that storks were raising between 2 and 3 chicks per nest, indicating that a large cohort of young was produce this year. Other wading birds also did well this year, with large White Ibis colonies in WCAs 1 and 3, and at the Tamiami West colony in ENP. Ibises appeared to rear large numbers of young in each of these places, again suggesting that a big cohort was produced.

Annual wading bird report: We collated and submitted our data to the annual South Florida Wading Bird Nesting Report coordinated by the South Florida Water Management District. This will probably be an historic document since it reports the largest nesting event in south Florida since the 1940's.

System Status Report: We contributed a section to the three-year System Status Report to Congress, due out this summer. This report shows immense strides in understanding of wading bird nesting in response to hydrology and prey patterns, and represents a success story of monitoring and targeted research in the service of adaptive management and ecosystem restoration.

Nest success analyses: Over the summer we have shifted towards using Program Mark for nest success analyses. While this program offers both plusses and minuses for the analysis, we now have this mark-resight analysis tool as an alternative to the more cumbersome Mayfield method.

Following the successes of this spring's work with the Nova II UAS, we have:

1. Presented a paper and poster at a national ecosystem restoration conference on use of this system for estimating numbers of wading birds in the Everglades. There was considerable interest in the presentation and accompanying poster, and it seems clear that the natural resource management community is ready for this kind of tool. As well, it is also clear that we are way out ahead of most agencies in developing and using this tool.
2. Designed and built a larger, drier, and more capable aircraft for testing and use in the 2010 season. This aircraft has a number of design features that should overcome the sometimes twitchy handling characteristics, tendency for wet components and high wing loading of the Nova II. In addition the Nova II now has new wings, which are currently undergoing field tests. This will allow continued use of the Nova II while we obtain an airworthiness certificate for the new aircraft.

3. Begun the application process for obtaining a COA to fly in Class C airspace of the Miami Traffic Control Area. This COA is a key to successful use of this tool for monitoring wading birds, since over 60% of the 2009 colonies were located in this zone.

4. Development of a mount that will enable using the electronics from the UAS to be flown on a full sized helicopter. If we can do this, it will allow us much greater flexibility for flying in weather that is challenging for the UAS, and in airspace currently off limits for the UAS.

Wading Bird Colony Location, Size, Timing and Wood Stork and Roseate Spoonbill Nesting Success

Principal Investigator: Peter Frederick
Funding Agency: U.S. Army Corps of Engineers
Expected Completion: 9/1/2009 (UF63308)
Graduate Students: Louise Venne
Research Staff: John Simon, Rena Borkhataria, Jason Fidorra, Melissa Schlothen, Erin Posthumus

The proposed work is to continue a long-term monitoring project that annually monitors responses of breeding wading birds to hydrological conditions in the water conservation areas of the Everglades, and to monitor reactions of Wood Storks (*Mycteria americana*) to hydrological change. While this work continues the work carried out over the past decade, this project expands the area covered to include nesting in Big Cypress National Preserve and Everglades National Park, and to facilitate and standardize surveys occurring in Florida Bay and Lake Okeechobee. This work is to continue a long-term monitoring project that annually documents responses of breeding wading birds to hydrological conditions and restoration efforts, and to expand the coverage of these surveys to include Everglades National Park and Big Cypress National Preserve. In addition, we hope to document specific responses of Wood Storks to restoration activities. A final goal is to ensure coordination and standardization of breeding wading bird surveys in the entire watershed, from Lake Okeechobee to Florida Bay. This will greatly enhance our ability to detect both system-wide responses, and to compare responses in different parts of the ecosystem.

Wood storks nesting in Big Cypress Preserve

Progress 2009:
This research and monitoring project is designed to enhance restoration of Everglades wading bird populations through understanding of the mechanisms by which wading birds reproduce, particularly in relation to hydrological manipulations. In addition, this project is also aimed at gathering key information that will allow defensible projections of the demographics of endangered Wood Storks.

Historic Pond Restoration in the Florida Panther National Wildlife Refuge

Principal Investigator: Carrie Reinhardt-Adams
Co-Principal Investigator: Michael Kane
Funding Agency: U.S. Fish and Wildlife Service
Expected Completion: 5/1/2008 (UF63308)
Graduate Students: Scott Stewart, Danielle Watts
Research Staff: Nancy Steigerwalt, Christine Wiese, Stacy McCauley

In the Comprehensive Conservation Plan for Florida Panther National Wildlife Refuge, the U.S. Fish and Wildlife Service (USFWS) identifies the restoration of the historical ponds and wetlands on the refuge as critical for development of wading bird and epiphytic orchid habitats, and ensuring ecological diversity. As a consequence of both natural and man-made impacts on hydrological regimes, many ponds and wetlands found in the Refuge have experienced deterioration in both their function and biodiversity. This is especially important since 26% of the plants and 45% of the animals listed as threatened or endangered are directly or indirectly dependant on these habitat types for survival. To mitigate further degredation, the USFWS have developed the following priorities:

- Protect, restore and manage candidate, threatened and endangered species and their habitats.
- Protect, restore and manage migratory birds and protect, restore and manage their habitats.
- Protect, restore and manage wetlands and other freshwater habitats.
- Protect, restore and manage for biodiversity.

OBJECTIVES:
The overall goal of the proposed research is to develop best management practices for efficient and ecologically-sound pond restoration procedures which will ensure re-establishment of habitats critical to threatened and endangered flora and fauna. The specific objectives of the project are to:

- Excavate a minimum of three historic ponds on the Refuge;
- Develop a floristic list of the aquatic/wetland species associated with the historic ponds on the Refuge
- Collect aquatic and wetland plant propagules (seed, stem and rhizome cuttings) from numerous on-site genotypes for propagation by greenhouse seed/cutting propagation and micropropagation;
- Provide ecologically focused input into the elevation and contour design and resultant hydrologic regime of the excavated ponds which will ensure long-term sustainability and decreased post-planting maintenance;
- Evaluate effects of genotype, planting density and elevation on establishment of propagated aquatic and wetland species over numerous growing seasons;
- Evaluate post-planning maintenance practices which promote long-term sustainability of the plant community in the restored ponds.

Progress through 2009:
In addition to several brief site visits and consultation with refuge staff during Spring 2006, during a four-day field campaign in May 2006 we collected data and samples to be analyzed at the UF campus. During a field campaign in September 2006, samples of recolonizing species were collected and pressed. At the UF campus, the seed bank recolonization experiment has completed its six month growing period and any remaining species have been enumerated and removed. Another site visit was conducted in March 2007 to observe contour resulting from excavation and to observe further recolonization. A planting scheme was developed for revegetation of the two ponds. Selected high wildlife value-species were propagated in the UF greenhouses for the revegetation study. During a field campaign in June 2007, plants propagated for the two revegetation experiments were installed in the two study ponds. In September 2007, we observed plant survival and growth, invasive spread (*Typha* spp.), and natural recolonization. Quantitative and qualitative data were collected in February 2008. Since project initiation, progress was made on objectives 1-5 as summarized here:

1) Excavate a minimum of three historic ponds on the Refuge;
Two ponds were excavated May 25-27, 2006. Although three ponds were originally intended for excavation, the decision was made to excavate two sites, and to apply knowledge gained from these excavations to management of further sites in the future.
2) Develop a floristic list of the aquatic/wetland species associated with the historic ponds on the Refuge;
Plant cover data was assessed across elevation zones in both experiments to construct a pre-excavation floristic list. Further contributing to our list of target vegetation, a list of historic pond species was compiled with the assistance of Refuge botanical staff. Initial vegetation cover of the two ponds was mapped. Both ponds contained a dense stand of *Salix caroliniana* in the interior; the exterior was dominated by *Cladium jamaicense* with an herbaceous ground cover including *Bacopa caroliniana* and *Ludwigia* spp. The seed bank experiment, which shows which species are likely to recolonize by seed in the two ponds, has finished its six-month growing period. Most of the individuals in the experiment have been identified and tallied, and the remainder are currently being identified. A list of the currently identified species from the seed bank experiment has been generated.
3) Collect aquatic and wetland plant propagules (seed, stem and rhizome cuttings) from numerous on-site genotypes for propagation by greenhouse seed/cutting propagation and micropropagation;
Propagules were collected through our seed bank study, which also initiated successful propagation of several target species. Selected plants from the seed bank experiments were used for a series of recolonization experiment following regrading of the sites. Several different species were chosen for investigation, rather than focusing on several different genotypes of one species, to achieve project goals of plant community diversity. Species were selected based on their wildlife value, likelihood of recolonization and potential for propagation. Plants were propagated through cutting (instead of micropropagation) due to the large collection of high quality, site-specific individuals generated by the seed bank study. Cuttings were made from species grown in the seed bank experiment, and were planted in trays and placed in a mist house on the UF campus for 2-3 weeks to aid in root development. They were then placed in a shade house to continue growing and were fertilized once a week for three weeks before being transported to the refuge. Plant installation occurred in June 2007.
4) Provide ecologically focused input into the elevation and contour design and resultant hydrologic regime of the excavated ponds which will ensure long-term sustainability and decreased post-planting maintenance;
During a site visit in Spring of 2006, faculty advised refuge staff on excavation plans for the historic pond sites. Further refinement of these plans was conducted via email and phone to ensure that ponds were excavated to a shallow depth with gently sloping sides. These plans will maximize the elevation gradient to support a diversity of aquatic species.

Soils were characterized in each pond by vegetation zone to focus target plant community composition and determine establishment conditions for transplants and volunteers. Soil cores were taken from surface to the rock layer, and were divided into an organic layer (depth of this layer ranged from 3-7 cm) and a mineral layer (deepest core was 75cm). The soil was analyzed at the UF Analytical Research Lab for pH, percent organic matter, and nutrients (total phosphorus, total nitrogen, ammonia, and nitrites/nitrates). Values for analyzed soil parameters have been generated.

Seed bank samples were taken for use in spatial and depth characterization. Soil samples were spread in the greenhouse under conditions most likely to promote germination. Emerging individuals were identified and recorded. Results show that the seed bank under the willow-dominated zone of the ponds differs significantly from the non-willow zones, and is lacking in several species characteristic of the wet prairie ecosystem type.
The depth characterization seed bank experiment demonstrated which species are likely to recolonize from the seed bank given a specific excavation depth. Results suggest that there are very few seeds in the deeper soils, and that the existing seed bank would contribute little to recolonization following excavation.
5) Evaluate effects of genotype, planting density and elevation on establishment of propagated aquatic and wetland species over numerous growing seasons;
Two recolonization experiments were designed to examine a multi-species response to hydrologic position (elevation), planting density, and propagule type (as study design focuses on multiple species instead of multiple genotypes). Plant establishment, volume, survival, and cover will be examined in both ponds. Experiment 1 was installed in pond 1 and pond 2, and examines the effects of elevation and planting density on plant establishment. Experiment 2 was installed in pond 2 only, and examines the establishment of 2 propagule types: plugs and 5" container plants. Species selected for planting are perennial obligate and facultative wetland species, and include grasses and forbs. In June 2007, the propagated species were transported to the refuge and planted in the two regraded ponds.

Vegetation in pond 1 and pond 2 was qualitatively analyzed visually September 7-9, 2007. Soils samples were taken at either elevation in either pond in replicates of five to be analyzed for pH, TKN, NH_4-N, P, NO_3-N + NO_2-N, KCl, and loss on ignition. Among the most significant of our observations, in Pond 1 *Typha spp.*has begun to invade, whereas *Typha spp.*has limited establishment in the other pond.

Qualitative and quantitative data were collected February 2008. Quantitative data collection consisted of measuring plant volume and recording plant survivorship. Qualitative data collection consisted of visually assessing percent cover per plot and whether seed production was present or not. Wells were constructed and installed to monitor water levels. Preliminary results show that plant growth and establishment is highly dependent on species and location (pond 1 or pond 2), but not elevation. Growth and establishment data was also analyzed for plugs and 5" container plants. Initially, results indicate that survivorship is highly dependent on species, but not elevation or location. Statistical significance of these differences is currently being analyzed. Further monitoring will continue every 3 months.

Quantitative data was collected again June 2008. ANOVA (α=0.05) was used to compare significant differences for both experiments. Species, species*density, elevation, and species*pond were significant in both study ponds 6- and 12-months after planting. Species*density*elevation and pond showed significant differences 6-months after planting on plant volume (m^3). Density, species*elevation, elevation*pond, species*elevation*pond, and density*elevation*pond were significant on plant volume (m^3) 12-months after planting. Percent survival was determined to be species-dependent for both experiments, however, the trend in percent survival increased as time increased. This increase in survival is likely associated with the seasonal fluctuation in hydrology of this ecosystem; dry conditions supported fewer plants, and wetter conditions supported more plants Plant volume significantly differed with species for both experiments, but also interestingly, plant volume differed per pond. Dense and rapid *Bacopa caroliniana* recolonization in pond 1 may have suppressed plant establishment which causes overall plant volume to be lesser in pond 1 compared with pond 2 for experiment 1. In contrast, limited recolonization of *Bacopa caroliniana* in pond 2 allowed plants to establish more quickly and increased plant volume for experiment 1. Because both 6- and 12-months after planting 5-inch potted plant survival was greater in all species, it is recommended to revegetate with larger propagules (5 inch potted plants) if the desired results are quick establishment and greater surface area of vegetation. However, if project objectives include reduced initial costs, then smaller propagules (plugs) may suffice for some species; species-level information for this recommendation will be available after more observation and data collection.

Qualitative data were collected October 2008. Since ponds were inundated, very little data were collected. Because of the extensive precipitation, very few species were in flower in either pond . Interestingly, *Najas wrightiana*, a plant native to the Big Cypress Basin, was discovered in the bottom of pond 2. Since a majority (~75%) of pond 1 is being infested with *Typha latifolia*, a chemical treatment (maximum rate of Rodeo (glyphosate) in concert with 24 ounces of Habitat (imazapyr) per acre) will be applied in late winter since this is the best application time as translocation is maximal in the downward direction. The main objective in chemically treating these species is to maintain an open-water marl prairie pond.

Overall statistical analysis for 6 and 12 months after planting (MAP) was completed Spring 2009. Species richness was significantly affected by months after planting (MAP), MAP*density, pond, MAP*pond, and density*MAP*pond likely because of species growth habit, seasonal temperature, and hydrologic fluctuations. Mean species richness was greater in high elevation plots 3 and 6 MAP and greater in low elevation plots 12 MAP for pond 1. Mean species richness was greater in high elevation plots 6 MAP; whereas species richness varied 3- and 12 MAP for pond 2. This change in species richness is possibly caused by changes in hydrology since 6 MAP, the water table in pond 2 was decreasing.

Directing Succession Through Adaptive Management in National Wildlife Refuges: Reed Canary Grass Control & Transition to Wetland Forests & Meadows

Principal Investigator: Carrie Reinhardt-Adams
Funding Agency: Department of Interior / U.S. Geological Survey
Expected Completion: 10/31/2010 (RWO 237, PJ#66026)
Graduate Students: Julie Sorenson
Research Staff: Nancy Steigerwalt, Leah Cobb, Ryan Graunke

Invasive species present a challenge to the efforts of National Wildlife Refuges (NWRs) to preserve appropriate plant community habitat. Reed canary grass (*Phalaris arundinacea,* RCG) is an invasive plant species that presents such a challenge. This species has partially or heavily infested approximately 37,400 acres of NWRs located in U.S. Fish and Wildlife Service Region 3 (Midwest Region) and Region 6 (Mountain-Prairie Region). To improve management of RCG and assist in the recovery of degraded wet meadow and floodplain forest ecosystems within these NWRs, an adaptive management (AM) framework will be utilized. Through AM, the goal of this project is to generate the information needed for refuge managers to *make good and defensible decisions about when, where, and how to treat RCG for purposes of maintaining or restoring target communities and the wildlife they support* (from RCG Workshop Problem Statement, July 2006, Williams et al. 2007).

OBJECTIVES:

- Conduct initial coordination meeting and annual coordination meeting
- Conduct visits by the science team to the participating refuges to facilitate the selection of experiment sites
- Launch project website
- Design experiments and select sites
- Create a study plan and field protocols
- Train participants and collect initial vegetation monitoring data, seed bank samples and soil samples

YEAR 2: Implement experiments and collect pre-treatment and response data

- Collect pre-treatment vegetation data
- Implement herbicide treatments at selected sites
- Conduct visits by the science team to participating refuges
- Collect response data
- Conduct annual coordination meeting
- Implement re-vegetation treatments

YEAR 3: Continue treatments and data collection

- Implement follow-up herbicide treatments
- Collect response data
- Conduct visits by the science team to participating refuges
- Conduct annual coordination meeting

YEAR 4: Finish data collection and create final report

- Collect response data and write final report

PROGRESS 2009:

Soils and Seed bank Analysis

Seed bank densities were determined for all management units. Initial germination of reed canary grass seedlings occurred after one week of spreading the seed bank samples in the greenhouse. Wet meadow species were identified and recorded only for wet meadow MUs. No tree seedlings were observed in any forest MU seed bank samples. Results indicate that most MUs have significantly dense RCG seed bank densities; for comparison, published accounts of heavily invaded RCG sites have a seedbank density of 475-872 seeds m^{-2} (Reinhardt Adams and Galatowitsch 2006).

Soil texture determinations and nutrient analyses were completed. These values were incorporated into the GIS layer representing each MU, and will be used to analyze differences in response to management actions.

Coordination Meeting

The 2009 coordination meeting took place in February in Onalaska, WI. This two-day meeting focused on several important project issues, including 1) presentation of preliminary 2008 seed bank, soils, and vegetation data, 2) addressing the coordination role currently filled by UF biologist Nancy Steigerwalt, 3) solving problems related to incomplete data collection and reporting, 4) providing further guidance for 2009 revegetation efforts. The preliminary data demonstrate the wide range of edaphic and biotic characteristics encompassed by MUs, and highlight the dense RCG seed bank present at most MUs that warrants a second year of RCG control prior to revegetation efforts. We discussed the transfer of coordination (currently estimated at 20 hrs/week) to an FWS position, and determined ways to reduce coordination effort, including double-checking and uploading data efficiently. We drafted protocols for determining appropriate seed mix, acquiring seed, and sowing seed for both meadows and forests. These protocols were further developed by the Science Team and reviewed and edited by regional coordinators.

Data collection at Refuges

In addition to well and staff gauge data, vegetation data were collected during the 2009 field season. Treatments (2008 and 2009) and data collection (2008 and 2009) are complete for 25 out of 41 MUs,; these data represent our first opportunity to assess response to treatments. The effects of the herbicide treatments are generalized. Using these data, we are able to demonstrate that Glyphosate reduces RCG cover more effectively than Fusilade, and that Glyphosate and Fusilade similarly promote WM cover, but in nearly RCG MUs, Glyphosate may better promote WM cover.

Refuges also completed a second round of seed trap sample collection to support the determination of natural seed rain from adjacent floodplain forests. Seeds have been counted and identified, and are currently being analyzed.

Modeling Progress

Over the year 2009, we've developed a spatially-explicit model specific to each refuge in our cooperative study. The model describes state-dependent changes in vegetation composition over time in which the changes are dependent on site-specific soil conditions and hydrologic dynamics. The model also incorporates distance-dependent seed dispersal that makes vegetation dynamics in one location dependent on the state in nearby locations. Furthermore, the model integrates spatially-explicit patterns of management actions on the landscape so that we can evaluate different management strategies. We also developed a ArcGIS tool that uses insights gained from the model to provide a decision-support tool for refuge managers. Managers will ultimately be able to use the tool to enter spatial monitoring data directly into ArcGIS database and the tool will suggest a management action map. In the next year using data collected from field and current vegetation maps, we will use the model to map future RCG distributions and high risk areas for RCG on each refuge. The predictions of the landscape model will be compared to observed changes on the landscape so that we can reduce the uncertainty in key parameters. We will also be testing and refining the decision-support tool by getting feedback from the refuge managers as they use it.

Rapid Delineation of Provenance for Florida Sea Oats Used for Beach and Dune Stabilization

Principal Investigator: Michael Kane
Funding Agencies: U.S. Department of the Interior
Expected Completion: 6/30/2009 (UF#58323)
Research Staff: Nancy Philman, Pete Sleszynski, Scott Stewart, Daniela Dutra

Florida's coastal dune system not only provides unique wildlife habitats, it also serves as a natural defense system against erosion resulting from hurricanes and human activity. The extremely active 2004 and 2005 hurricane seasons has resulted in 365 of the 825 miles of Florida's sandy beach shoreline e now been assessed as critically eroded. Beach and dune restoration typically involves beach renourishment followed by planting of native species for stabilization. The most effective species planted for dune stabilization and building are perennial grasses including Sea oats (*Uniola paniculata*). Nursery-grown sea oats propagated from seed as liners or containerized plants have planting sites. One major ecological concern is the planting of non-adapted sea oats genotypes geographic source of sea oats

plants. The overall goal of the project is to develop a reliable genetic database used to delineate and determine the source of sea oats to ensure ecologically sound beach and dune restoration. Ultimately, plant micropropagation technology and cryopreservation will be used to create a germplasm library of multiple genotypes from each major sea oats population. This both ensures a long-term reserve of population specific genotypes for beach and dune restoration.

OBJECTIVES:

- To establish a germplasm library of sea oats genotypes from all major populations along Florida's Atlantic and Gulf coasts.
- To determine the genetic diversity and distance of seedlings collected from the major sea oats populations along the Florida Gulf and Atlantic coasts using AFLP fingerprinting procedures.
- To evaluate use of the sea oats diversity genetic database as a tool to delineate sea oats provenance distance along Florida's Atlantic and Gulf coasts.

PROGRESS:

All immediate objectives have been accomplished. Sea oats seed was harvested from sixteen Florida State Parks or Recreation Areas: Perido Key, Navarre Beach, Henderson Beach, St. Andrews, St. George, Little Talbot Island, Anastasia, Gamble Rogers, Honeymoon Island, Sebastian Inlet, John D. MacArthur, Don Pedro Island, Delnor-Wiggins Pass, John U. Lloyd, and Bill Braggs Cape Florida. Park managers and biologists were consulted to assure that seed was only harvested from areas that had not been replanted. Seed production varied significantly between populations. Seed was surfaced sterilized in a three-step process and germinated *in vitro* on Murashige & Skoog Medium in 150 X 25 mm glass culture tubes. We found that germination could be significantly enhanced by maintaining the culture tubes on a heating mat at about 37 C. In vitro germination rates and seedling growth varied considerable between the sea oats populations and genotypes. We have now completed establishment of seed cultures from all sea oats the populations sampled. These data are being analyzed to determine if there are any population specific differences in germination and initial seedling growth. To establish clonal lines, unbranched 7-week old seedlings were transferred to sea oats shoot multiplication medium.

Determination of Population Diversity in the Florida Endangered Orchid Cyrtopodium punctatum

Principal Investigator: Michael E. Kane
Funding Agencies: U.S. Department of Interior, USGS
Expected Completion: 9/30/2010 (RWO 251, UF#77491)

Cytopodium punctatum, the cigar orchid, is an endangered plant in the state of Florida. The species distribution ranges from Florida and the West Indies. The genus *Cyrtopodium* comprises about 35 species, with *C. punctatum* being the only epiphytic member and northernmost ranging species. *Cyrtopodium punctatum* is a very large showy orchid that bears showy flowers. Due to its appeal, the species was over collected during the past century and today only a few plants still exist in inaccessible and protected areas. Three distinct populations are located in Unit 51 (ca. 7 plants), 54 ca. 14 plants) and an 3 plants in Unit 38 at the Florida Panther National Wildlife Refuge (FPNWR; Collier Co., FL). With previous funding from the FPNWR, a seed propagation protocol has been developed for the future reintroduction of *C. punctatum*. Breeding system type is one of the most important determinants of the genetic composition of plant populations. Consequently, pollination biology and breeding system studies are being completed in two FPNWR *C. punctatum* populations to understand the ecology and population genetics of this species *in situ*. However, the current genetic diversity and structure in the FPNWR *C. punctatum* populations is not known. This information is critical for development of ecologically sound integrated conservation plans.

OBJECTIVES OF PROJECT:

- Determine genetic diversity of *C. punctatum* populations in the FPNWR.
- Compare genetic diversity between and within *C. punctatum* populations
- Interpret results in light of ongoing reintroduction efforts with this species.

OBJECTIVES YR 1: Determine genetic diversity of *C. punctatum* populations in the FPNWR.

TASKS: Leaf samples from newly developed leaves will be collected from all known plants throughout the FPNWF (totaling about 20 plants). DNA will be extracted using DNeasy Plant Mini Kits. Purified DNA will be subjected to Amplified Fragment Polymorphism (AFLP) analysis.

OBJECTIVES YR 2: Compare genetic analysis between and within *C. punctatum* populations.

TASKS: Analyze AFLP data using GeneMarker software, Use POPGENE software to estimate fixation indexes (F_{IS}, F_{IT}, and F_{ST}), effective population size (N_m), H_O, and expected Nei's and Shannon's heterozygosity estimates (H_E). Use the program STRUCTURE v 2.2 for population assignment and principle coordinate analysis of data. Intepret results with respect to development of a ecologically-sound re-introduction program.

PROGRESS 2009:

A site visit was made to the FPNWR on December 2, 2008 to discuss sampling procedures with Larry Richardson. Since newly developed leaves of *C. punctatum* are required for "clean" DNA extraction, sampling will not begin until late March 2009 when new leaves on the donor plants will available. A site visitation with Larry Richardson was made on March 17, 2009 to identify the locations of the individual plants from which tissue samples will be taken for DNA analysis. Plants were just beginning to flower. The DNA extraction kits have been ordered and arrangements were made to work in the laboratory of Dr. Charles Guy to perform the DNA extractions. Various methods are being compared to decide which method to use to store the plant tissues prior to DNA extraction.

Techniques for Field Establishment and Reintroduction of Calopogon tuberosus Var. tuberosus

Principal Investigator: Michael E. Kane
Co-Principal Investigator: Philip J Kauth
Funding Agencies: U.S. Department of Interior, FWS
Expected Completion: 8/30/09 (UF#69941)

Calopgon tuberosus in the FL Panther National Wildlife Refuge

While much of the literature regarding orchids focuses on propagation techniques, little information exists on reintroduction, trans-location, and field transplanting. Habitat destruction or degradation is responsible for loss of orchid habitat and orchid populations. Reintroduction of seedlings into natural habitats is becoming a popular technique for conservation, but field-establishment often fails. Much of the information regarding re-establishment focuses on seedlings. A major obstacle to field establishment is initial survival. Only a few articles discuss techniques for increasing survival of orchid seedlings. One technique used to increase survival is planting dormant storage organs such as tubers or corms.

Calopogon tuberosus var. tuberosus is a cormforming species found throughout eastern NorthAmerica including southwest Florida. In south Florida, this species has up to ten magenta flowers that open in succession. The flowering season begins in April and continues through the end of May in south Florida. Seed capsules are fully ripe approximately 6-8 weeks after pollination. Reintroduction of *Calopogon tuberosus* to suitable habitats is the next logical step in a propagation experiment. We have successfully germinated seeds of *C. tuberosus* to the seedling stage, and have successfully grown seedlings from other populations under greenhouse conditions.

OBJECTIVES:

- Reintroduce *Calopogon tuberosus* seedlings and corms to the Florida Panther National Wildlife Refuge (FPNWR).
- Compare survival of seedlings and corms of *C. tuberosus* following field reintroduction.
- Determine the time of year that ensures the highest survival of *C. tuberosus* propagules.
- Establish permanent field transplant plots.
- Determine if mycorrhizal fungi colonize roots of reintroduced propagules.

PROGRESS:

In April 2008, 192 *C. tuberosus* propagules were planted at the Florida Panther National Wildlife Refuge. Three 10 m transects were randomly selected in unit 23 of the FPNWR in an area where C. tuberosus currently grows. Within each transect four quadrats (30 cm x 30 cm) were placed every 2.5 m. Each quadrat was divided into 16 subplots. Of the 16 subplots, eight were randomly assigned for seedlings and eight were assigned for corms. In July 2008, data was taken on survival comparing the effects of planting seedling vs. corms. In February 2009, about 200 seedlings were transferred to soil at the FPNWR. Two transects were established in a burned prairie while two transects were established in an unburned part of the same prairie. Each transect contains three plots of 16 seedlings each. As of April 2009, most seedlings in the newly established transects have survived. However, due to the dry weather most seedlings from this year and last year's plant out are currently in the dormant stage as shoots have turned brown. In transects established April 2008, several seedlings are green and still growing, and one seedling is in the flowering stage. Data from the 2009 plant out will examine growth and survival of seedlings planted in a burned vs. unburned area.

Seed Ecology, Habitat Characterization, and Reintroduction Methods of Rare and Endangered Florida Orchidaceae—Bletia purpurea and Eulophia alta

Principal Investigator: Michael Kane
Funding Agencies: U.S. Department of the Interior
Expected Completion: 8/30/2009 (UF69301)
Biological Scientist: Nancy Philman
Research Staff: Tim Johnson, Daniel Dutra, Philip Kauth,

North America possesses approximately 250 unique species of bothepiphytic and terrestrial orchids with Florida having 118 of thosespecies. Florida native orchids are faced with a constant on-slaught of habitat loss due to land conversion to agricultural usesor home site construction, exotic plant invasion, poaching, and habitat mismanagement. While no Florida native orchid is federally-listed as endangered or threatened, many of the state's orchid species face the immediate possibility of extinction if conservation and recovery plans are not investigated and instituted. This research is designed to study the seed ecology, habitat preferences and reintroduction methods of the native Florida terrestrial orchids *Bletia purpurea* (Lamark) de Candolle and *Eulophia alta* (Linnaeus) Fawcett & Rendle. At the current time, these species have no formal conservation plan. A study of the biotic and abiotic factors that influence seedling recruitment in order to develop reintroduction protocols and implement best management practices for *B. purpurea* and *E. alta* is proposed.

The ecology and reproductive biology of the native FL orchid species, *Eulophia alta*

OBJECTIVES:

1) Identify the critical biotic and abiotic features of sites containing *B. purpurea* and *E. alta* populations, and use the data to predict suitable sites for reintroductions.
2) Conduct symbiotic germination experiments on *B. purpurea* and *E. alta* under greenhouse and semi-natural conditions to determine the timing of germination, germination percentage *in situ*, and rates of seedling growth *in situ*.
3) Confirm the identity of germination-promoting mycobionts of *B. purpurea* and *E. alta* from field grown seedlings and use these data to validate conclusions about *in vitro* fungal specificity.
4) Assess the intra- and inter-population genetic diversity of *B. purpurea* on the FPNWR and interpret these results in the context of pending reintroduction efforts.
5) Develop integrated management practices that protect existing populations and promote the recruitment of seedlings in existing and new populations.

Objective 1: Soil analysis and accompanying species data has been completed for *Eulophia alta* at two sites: Public Trail (PT) and Western Refuge (WR). Key results of this study include that soils and accompanying species at these two sites are distinct. PT soils were found to have a higher pH, detectable soil phosphorus, total Kjeldahl nitrogen, organic matter, and moisture content with lower bulk density than WR soils. Principal coordinate analysis of species presence/absence data reveals some overlap in species compositions at the two sites, but indicates that the two sites have detectably distinct plant communities.

Habitat characterization of *Bletia purpurea* sites is scheduled to begin in May 2009. Populations to be sampled include those at the Western Helipad, Pistol Pond, and McBride's Pond sites.

Objective 2: Two attempts were made to examine the effect of burial on symbiotic seed germination of *E. alta* under greenhouse conditions. Results of the second run of this experiment revealed that seeds had lost their viability during cold storage. A new set of experiments will be conducted to examine how storage affects viability, germinability, and symbiotic germination of *E. alta* seeds since seed storage appears to be a major obstacle to experimentation.

Two attempts were made to isolate germination promoting fungi from *B. purpurea* roots for symbiotic seed germination in July 2002 and again in December 2007. None of the isolates tested supported symbiotic seed germination. Attention has thus been turned to optimizing asymbiotic seed germination procedures.

Objective 3: Objective 3 could not be met during this period due to limitations in seed viability of *E. alta* seeds and lack of symbiotic fungi for *B. purpurea*.

Objective 4: In 2007, leaf tissue was collected from three populations of *B. purpurea* on the FPNWR and stored over silica gel desiccant. DNA extracted from these samples was degraded, likely due to slow drying of the fibrous leaves of *B. purpurea*. Fortunately DNA extracted from fresh material was high quality. Because fresh material appears to work better for DNA extraction, a library of living material is currently being compiled by collecting *B. purpurea* corms in the field and growing plants under greenhouse conditions in Gainesville, FL. This living library will be used for future studies on morphological differences among *B. purpurea* populations within the FPNWR.

As an accompaniment to this study, an investigation of cleistogamy rates of B. purpurea on the FPNWR has also been initiated. Year one results are that exclusion of pollinators did not limit capsule set, indicating that cleistogamy may be the dominant mode of reproduction.

Objective 5: At the completion of this project, management plans and suggestions for additional study will be developed for *E. alta* and *B. purpurea*. It appears that *E. alta* populations on the west side of the FPNWR and those found near the public access site occupy very different habitats, though it is not clear if they require different management strategies. Observations of these two populations over two years indicates that both populations are healthy, flowering copiously, and producing numerous capsules per inflorescence.

Suggestions for the management of *B. purpurea* would be premature at this time. It is disconcerting that germination promoting fungi have not yet been successfully isolated since symbiotic seed germination would be the preferred method of propagation for reintroductions. However, asymbiotic seed germination methods have worked will with this species in the past and may be the most reliable method of propagation for reintroductions.

This project is a continuation of efforts to insure that native Florida orchids will continue to thrive in their natural habitats as independent organisms. The development of successful procedures for the conservation of these native orchid species will allow others to apply these same procedures to other orchid species throughout Florida.

Conservation of South Florida's Orchids—Developing Reintroduction Methods for Eight Native Species Including the State Endangered Ghost Orchid (Dendrophylax lindenii)

Principal Investigator: Michael Kane
Funding Agencies: U.S. Department of the Interior
Expected Completion: 8/30/2009 (UF69944)
Research Staff:: Tim Johnson, Daniela Dutra,
Philip Kauth, Nancy Philman

North America possesses approximately 250 unique species of both epiphytic and terrestrial orchids, with Florida having 118 of those species (56 state endangered, 17 state threatened; Coile and Garland, 2003). Florida native orchids are faced with continual habit loss due to land conversion to agricultural uses, habitat urbanization, exotic plant invasion, poaching, and habitat mismanagement. While no Florida native orchid is federally-listed as endangered or threatened, many of the state's orchid species face the immediate possibility of extinction if face the immediate possibility of extinction if conservation and recovery plans are not developed and implemented.

Given the current rate of ecosystem degradation, fragmentation, and destruction of Florida ecosystems, the stability of Florida's native orchid populations seems uncertain at best. Because of these threats, *in situ* habitat protection may not be enough to protect Florida's native orchids from extinction. Therefore *ex situ* germplasm conservation combined with scientifically sound reintroduction methods should be used to help insure the continued existence of orchids in Florida. This project addresses the current need to develop reintroduction methods for subtropical epiphytic and terrestrial orchids in Florida. In addition, the information gained by using a number of orchid species to test hypotheses about the reintroduction of orchid plants may prove useful in developing effective management and reintroduction plans for orchid taxa throughout North America.

OBJECTIVES:

- Assess the use of various *in situ* reintroduction methods and the effect of substrate on the survival and growth of epiphytic orchids native to south Florida in intact and hydrologically altered habitats.
- Assess the impact of various reintroduction methods on the survival, growth, and recruitment of terrestrial orchids native to south Florida.
- Determine whether home-site advantage improves reintroduction success of *Bletia purpurea* seedlings at various sites within the Florida Panther National Wildlife Refuge.
- Incorporate findings into existing management plans for the study species.

PROGRESS:

Reintroduction methods for epiphytic Florida orchids
Five epiphytic orchid species (*C. punctatum*, *Dendrophylax lindenii*, *Encyclia tampensis*, *Epidendrum nocturnum*, and *P. cochleata* var. *triandra*) are being used to examine how reintroduction method, substrate, aspect, hydrology, and elevation affect plant survival and growth within the confines of the FPNWR. Currently, seedlings are being generated using asymbiotic orchid procedures. Seedlings of *Cyrtopodium punctatum* have been acclimatized to greenhouse conditions and are ready for use in our re-establishment studies. Two sites have been selected for the

Daniela Dutra and Tim Johnson conducting native orchid surveys in Florida Panther NWR

reintroduction which will begin in May 2009. As of this date, we have been unable to obtain seed of *D. lindenii*. It is anticipated that seed will become available in May 2009. Seedling development has been slow for *Encyclia tampensis*. We suspect that this may be due to a poor seed lot. This has also been the situation with *Epidendrum nocturnum*. Additional seed will be collected. Seedlings of *Prosthechea cochleata* var. *triandra* and *Habenaria odontopetala* are being produced but are displaying some yellowing. The cultural reasons for this are being examined. Depending on the species, seedling will be secured to various tree substrates (i.e. *Annona glabra*, *Fraxinis caroliniana or Taxodium distichum*) at various heights with one of three methods: adhesive, monofilament line, or plastic gutter mesh. Preliminary studies have indicated the usefulness of using plastic gutter mesh in the reintroduction of *P. cochleata* var. *triandra* (S. Stewart and L. Richardson, pers. com.) and *E. nocturnum*. In March 2009, another visit was made to the Florida Panther National Refuge to begin surveying potential sites. It has been calculated that 20 seedlings will be used per site for each placement treatment. Plants will be introduced both at sites where orchids are currently found, as well as sites where orchids are not found. In this way, seedlings will be used as bioassays for suitable habitat. This may be helpful in identifying key factors that limit the establishment of orchid populations in south Florida.

Reintroduction methods for terrestrial Florida orchids
Two terrestrial orchid species (*E. alta* and *H. odontopetala*) will be used to examine the effect of reintroduction method on survival, growth, and recruitment. Seedlings will be introduced into plots that have been cleared of vegetation mechanically, mowed, burned, or tilled. Unaltered plots will be used as control treatment. Seedlings of both species are currently in the production phase. A randomized block design will be used for these experiments. The exact number of replications/site will be determined after a thorough field site assessment. No fewer than three replicates, each consisting of 20 seedlings, will be performed at as many as five reintroduction sites at the FPNWR.

Assessing the importance of home-site advantage on Bletia purpurea reintroduction success
Home-site advantage, the result of localized selection pressure, may be a significant factor in dictating the successful introduction or reintroduction of a species. For this study, *B. purpurea* seedlings originating from four locations in the FPNWR will be used in a reciprocal planting to determine whether provenance effects survival and growth. Additionally, seedlings will be planted at sites that do not currently support this species, but which resemble suitable habitat for *B. purpurea* based on dominant vegetation, disturbance regime, and soil composition. A randomized block design will be used for this experiment. Each 1 m × 5 m block will contain five treatments consisting of seedlings from five different populations (each occupying a 1 m2 plot). Each replicate will contain up to 50 seedlings. A minimum of three blocks will be established at each site.

Data collection and analysis
For each species of study data will be collected every two months for 12 months. Experimental treatments will be compared to each other and to control treatments by collecting data on seedling survivorship, root growth (number and length), and plant size (height, width, number of shoots, flowering/nonflowering) over the course of the study. In addition, the initial biomass, shoot and root number of each plant will be recorded. Data will be analyzed using general linear modeling procedures, ANOVA, and (when applicable) ANCOVA with SAS statistical software. Least square mean separation and Waller-Duncan mean separation will be used to identify statistical differences between treatments.

Factors Affecting Population Density and Harvest of Northern Bobwhite (Colinus virginianus) on Babcock/Webb Wildlife Management Area, Charlotte County, Florida

Principal Investigator: **H.F. Percival, Ralph W. Dimmick**
Co-Principal Investigator: Madan Oli
Funding Agency: Florida FWCC
Expected Completion: 6/30/2009 (PJ#62565)
Research Staff: Susan Dimmick, Steven Brinkley, Jeff Hostetler
Field Technicians: Gerald Coker, Amy Brinkley, Chris Jones

Babcock/Webb WMA has been an important recreational resource in south Florida since at least the early 1940's, with quail hunting being a particularly significant activity on the area for more than a half-century. Bobwhite populations have varied widely over time, as have the annual harvest and hunting pressure. Since 1981, the annual harvest has declined to a persistently low level, and the population has not produced summer gains comparable to those experienced prior to 1981. Hunting effort remained relatively constant at less than 2000 hunter-days until 1988. Following that season, hunting pressure increased markedly, peaking at 4000 hunter-days in 1992. A decline in harvest and productivity preceded the increase in hunting pressure by 7 or 8 years. Available data suggest that neither harvest nor hunting pressure may be the dominant factor suppressing population recovery, but neither do the data imply that hunting pressure and/or harvest may not be contributing factors.

Other environmental and demographic factors may be interacting to influence population behavior. Such factors may include non-hunting mortality of adults and chicks, nesting effort and success rates, habitat quality and availability, and catastrophic events such as hurricanes or extended drought.

The basic hypotheses to be tested are that neither harvest nor hunting pressure influences bobwhite population demographics significantly on Babcock/Webb WMA. Three levels of hunting pressure and harvest have been established by regulation on the WMA. Zones A-D permit hunting 4 days per week for 6 consecutive weeks beginning in November. Zones A and B each admit 10 hunters per day, providing a hunting opportunity for 240 hunter-days and a potential seasonal harvest of 1440 birds in each zone. Zones C and D allow unlimited hunter access with equivalent daily bag limits, but a potential harvest limited only by the total number of hunters who choose to hunt there. The Field Trial Course permits 2 days hunting for 25 hunters in January with a potential harvest of 600 bobwhites.

Other data to be obtained and evaluated will include spring call counts of territorial males, fall covey counts, and survival rates, nest success rates, home range size, and habitat use as determined by radio-telemetry techniques. Weather information from regional weather stations will be evaluated to detect patterns or unusual events that may impact elements of bobwhite survival or ecology on the WMA.

OBJECTIVES:

- To determine if annual survival rates of bobwhites on the three experimental hunt units are related to hunting pressure.
- To determine if survival rates are related to annual harvest.
- To determine if productivity is influenced by harvest and /or hunting pressure.
- To delineate nest success rates and factors influencing nest success including predation and weather.
- To identify and quantify non-hunting mortality factors affecting bobwhite survival.
- To identify habitats utilized and preferred by bobwhites seasonally.
- To delineate home range size and movement patterns related to habitat, disturbance, and weather events.
- To chronicle hunter perceptions and behavior related to hunter access and harvest regulations.

PROGRESS:

- For the period 10 Oct 2002 to 23 Dec 2008, 2135 bobwhites were captured and 2015 were radio-tagged.
- Currently, 84 quail are being radio-tracked.
- During 2008, from April 1 to October 1, 77 bobwhite nests were located. Of these nests, 44 hatched (57.1%), 28 were destroyed, and 5 were abandoned.
- 25 of 56 females that were alive on 4/01/200 were known to incubate a nest. These females incubated a total of 30 nests, an average of 1.2 nests per nesting female.
- The cohort of 56 females alive on 4/01 produced 20 successful nests (1 successful nest per 2.8 hens).
- 10 of the 56 females (17.9%) survived until the end of the nesting season (October 1).
- 10 of 79 males alive on 4/01/2008 incubated 10 nests. Five hatched and 5 were destroyed.
- 27 of the 79 males (34.2%) survived until the end of nesting season (October 1).
- Quail hunters logged 849 hunter-days during the 2008 quail hunting season, harvesting 754 bobwhites (0.9 birds/hunter-day). The mortality rate due to hunting (retrieved birds and non-retrieved cripples) was estimated to be 28.2%.
- The number of hunter-days was slightly higher than the targeted number (832). Including an estimated crippling loss of 13.8%, the total harvest was 874 quail (1.0 birds/hunter-day)

PROJECT SUMMARY; 2015 bobwhites have been radio-tagged during this study. 84 are currently being radio-monitored. During the 2008 nesting season, 77 bobwhite nests were located; 44 (57%) were successful. 849 hunter-days resulted in a recovered harvest of 754 quail (0.9 birds/h-d). Hunting mortality including cripples not retrieved was 28.2%.

Evaluating Decomposition Dynamics, Community Composition, and Ridge-Top Senescence in the Ridge-Slough Mosaic in Response to Climate Change and Water Management.

Principal Investigator: **Mark W. Clark**
Co-Principal Investigator: Todd Osborne
Funding Agency: Department of Interior / U.S. Geological Survey
Expected Completion: 03/31/2010 (PJ#65362)
Graduate Student: Danielle Watts
Research Staff: Tae-Goo Oh, Justine Vogel

The proposed work will build on the findings of Clark et all. (2003, 2004), Lewis (2005 and Jorczak (2006). Previous research was conducted under a CESI funded project titled: *Spatial Variability and Modeling of Soil Accretion in Shark River Slough.* That study evaluated ridge and slough vegetative characteristics, accretion rates and mechanisms of formation. Findings from that study indicate that study indicate that although soil surface elevation varied between ridge and slough communities, underlying bedrock surface elevation did not significantly vary and did not vary in any pattern similar to surface soil characteristics. This suggests that mechanisms regulating differences in surface soil topography are mostly independent of bedrock geomorphologic factors and instead driven by the interaction of biologically mediated organic and inorganic matter deposition with environmental forcing functions such as fire, hydrology and nutrient regime. Differences in standing biomass production within ridge and slough communities indicate a large difference in potential organic matter input to these systems. Investigation of the quality (nutrient content and tissue fiber recalcitrants) indicated that species most commonly found in ridges (*C. jamaicense*) have three times greater amounts of residual fiber (lignin) than species found in wet prairie or slough communities. In addition, C:N ratios indicate that ridge biomass has a greater limitation for nitrogen than that of slough biomass suggesting a reduced decomposition rate. Therefore, based on tissue recalcitrants and C:N ratio, tissue being produced in ridges indicates a slower decomposition rate potential than that of sloughs. This combined with increased biomass production rates in ridges suggest that Ridges have a greater soil accretion rate potential than slough habitat. To corroborate these findings a decomposition study was preformed using litter bags. *C. jamaicense* tissue (representing ridge biomass) and Eleocharis spp. (representing slough biomass) were deployed in ridge and slough environments. Findings suggest that tissue characteristic is the primary regulator of litter decomposition (*Eleocharis spp.* decomposed faster than *C. jamaicense*) followed by environmental conditions (ridge decomposition faster than slough decomposition rate) although both factors had significant effects

OBJECTIVES:
YEAR 1: Meetings for finalizing workplan, locate field sites,initiate mesocsom experiments, intitate ramet transplant study
YEAR 2: Continue field research on mesocosm and ramet transplant
YEAR 3: Conclude filed rasearch and data analysis, prepare final reports, and participate in AT Committee final report process.

PROGRESS 2008:
Current research effort aims to clarify the relationships between hydrology (hydroperiod, inundation depth)and evolution of dominant plant communities that make up the unique mosaic of ridge and slough systems in the Everglades. Recently, the ridge/slough mosaic has begun to fragment and decompose (spatial patterns) presumably due to alteration of natural hydrology. It is the purpose of this research program to determine the appropriate hydrology for the maintenance and successful restoration of the unique ridge and slough ecosystem of the

Everglades. Recon flights for Sawgrass senescene conducted in March 2008. Video and pictures of 12 PSU sites were taken.

Regional Distribution of Soil Nutrients - Hierarchical Soil Nutrient Mapping for Improved Ecosystem Change Detection

Principal Investigator: **Todd Z. Osborne**
Co-Principal Investigator: Matthew J. Cohen
Funding Agency: Department of Interior / U.S. Geological Survey
Expected Completion: 03/31/2009 (RWO 242, PJ#65365)
Personnel: S. Lamsal, B. White

The proposed research enhances and builds-upon previous work funded by the South Florida Water Management District (SFWMD) for mapping soil nutrients throughout the Greater Everglades. The Everglades Soil Mapping (ESM: K.R. Reddy - Principle Investigator [PI], S. Newman – Co-PI) was intended to provide a regional benchmark for restoration assessment (Bruland et al. 2006, Corstanje et al. 2006). Soil nutrients and other chemical and physical attributes integrate environmental condition; monitoring soils as performance measures of ecological restoration progress requires a regional benchmark. The scope of ESM was comprehensive: samples were obtained via helicopter from over 1300 locations throughout Everglades National Park (ENP), Big Cypress National Preserve (BCNP), the Water Conservation Areas (WCAs) and various other parcels comprising the Greater Everglades. Samples, collected during 2003-2004, were analyzed for a suite of key biogeochemical indicators that have been used to both improve understanding of regional ecological dynamics and also to specify a comprehensive benchmark for future studies. Our proposed MAP activities interface directly with the ESM project and will be implemented by the personnel responsible for much of the ESM work. In particular, this project focuses on change detection. Future iterations of the comprehensive sampling protocol developed in the ESM project will provide maps of key variables that can be compared with 2004 conditions. The key problem will be determining whether observed differences arise from natural variability, which is known to be substantial even over short distances in the Everglades, or from regional ecosystem responses to restoration efforts. In order to effectively evaluate change, additional data are required on small-scale variability, spatial patterns of local ecosystem-driven variability and signal detection; the MAP activities that we propose will assist in this regard, greatly enhancing the interpretive value of additional soil monitoring efforts, which have a high probability of being implemented as soon as 2008.

OBJECTIVES:

Mapping soil quality (nutrients, carbon quality, process dynamics) has recently been undertaken as part of an effort to characterize baseline conditions for performance assessment of Everglades recovery activities. While large scale maps are useful for characterization of spatial pattern, several layers of uncertainty limit use as measures of performance and restoration progress. In particular, large scale maps (Greater Everglades) make specific assumptions about short range variability that are not well quantified. Nugget variance (variability in space over short separation distances) directly confounds use of baseline map products because future spatial sampling will not, in practicality, be at identical locations. If nugget variability is high, then significant uncertainty about ecosystem change arises from not knowing if observed differences arise from intrinsic ecosystem processes or from responses to human management. *Our primary objective is to determine the extent to which spatial variability and sampling uncertainty confound ecological change detection.* We will use hierarchically nested sampling of soils to establish nugget variability so that change through time can be assigned as observational uncertainty or management response.

YEAR 1: Meetings for work plan and finilazation of work plan, literature review,determine field sites, field sampling, initiate laboratory anlaysis, reporting.
YEAR 2: Conclude laboratory anlaysis, semi-variogram development, metrics of change analysis, variance partitioning, reporting.

PROGRESS 2009:
To determine if CERP restoration targets are being met and whether or not efforts at restoration of the Everglades are making headway, we must be able to measure change effectively at the landscape scale. This works is designed to measure landscape properties, specifically soil nutrients (a designated CERP performance measure), and determine the amount of relative variability involved with the scale and number of observations used to measure ecosystem changes in the Everglades. Without a measure of variability, it is unclear how much change is actually being detected over long term monitoring programs and how much of the variability is attributable to natural variation at the landscape scale. This work will both quantify and project that variability in measuring soil nutrients so that future monitoring efforts can be effectively designed and instigated, and the data more clearly interpreted with respect to change in landscape scale measurements.

Science Fellowship for Assessment of Coastal Habitats and Listed Species

Principal Investigator: **Raymond R. Carthy, PhD.**
Co-Principal Investigator: Margaret Lamont, PhD.
Funding Agency: Fish and Wildlife Service
Expected Completion: 04/30/09 (RWO 240, PJ#61306)
Research Staff:

Loggerhead turtle nesting

One of the world's prime areas for coastal species is found along 20 miles of Florida's eastern coast. Designated in 1991 as the Archie Carr National Wildlife Refuge (ACNWR), this area represents the most important nesting site for loggerhead turtles (*Caretta caretta*) in the Western Hemisphere. Nearly 25% of all loggerhead nests laid in Florida are laid along ACNWR beaches. In addition, nearly 35% of all nests deposited by the endangered green turtle (*Chelonia mydas*) in Florida, and an increasing number of critically endangered leatherback turtle (*Dermochelys coriacea*) nests, are found within the Refuge. The Refuge also supports a large number of other species that rely on this protected stretch of beach for foraging and nesting, such as the endangered Piping Plover (*Charadrius melodus*), American Oystercatcher (*Haematopus palliatus*), and Brown Pelican (*Pelicanus occidentalis*). Although critically important to many coastal species, this area is also affected by a large number of tropical storms that create extensive instability along the coast. In 2004 and 2005, five storms affected this area, causing significant damage to homes and businesses and greatly affecting the natural habitat. How these storms influenced abundance and distribution of coastal species relying on ACNWR for survival, including nesting of threatened and endangered sea turtles, is unknown.

When attempting to nest, sea turtles must first select a beach, then emerge from the water, and finally place a clutch within that beach. Beach characteristics such as temperature, salinity, slope, moisture, width, and sand type have been shown to influence nest placement within the beach (Johannes and Rimmer 1984, Garmestani et al. 2000, Wood and Bjorndal 2000). When optimal, these factors may allow turtles to expend less energy locating nesting sites that will provide the greatest reproductive success. Along dynamic beaches, these factors are constantly changing; this may reduce a turtle's ability to identify high quality nesting sites.

PROJECT SUMMARY:
To determine how erosion, and the human activities that follow, have affected coastal species along Archie Carr National Wildlife Refuge (ACNWR), we defined the following goals: 1. assess dynamics of selected portions of ACNWR including winds, longshore drift, and changes to beach profiles, 2. compare current and historical sea turtle nesting patterns, 3. assess success of turtle nests deposited along selected portions of ACNWR.

Beach nourishment is used to repair eroded beaches

Surveys for nesting sea turtles were conducted along 8-km of beach in ACNWR in 2009. Historically, the study area has been divided into 8 zones of uneven length and we continued to use those zones for cohesiveness throughout this study. Sea turtle nesting data from 1989 through 2005 was gathered from the Florida Fish and Wildlife Conservation Commission. In 2009, 1,215 sea turtle nests were recorded within our study area. These numbers represent the third lowest numbers of nests deposited along this 8-km stretch of beach since 1989. Average number of nests in 2009 was lower in every zone (except zone 6 where numbers were equal) as compared to historic numbers. In 2009 there were 1,588 false crawls, and from 1989 to 2005 there was a mean 1,605 false crawls. The percentage of false crawls was slightly higher in 2009 (57%) to percentages from 1989 to 2005 (mean = 47%). We are currently analyzing hatching success to compare success in 2009 to historical success numbers. In addition, we will enter all nest locations from 1989 through 2009 into the GIS to spatially analyze nesting data.

Increasing development of coastal areas further reduces available habitat for coastal species. Therefore, it is becoming increasingly important to provide proper management of this remaining habitat.

Ecology and Conservation of Snowy Plovers in the Florida Panhandle

Principal Investigator: **Steven Johnson**
Co-Principal Investigator: N/A
Funding Agency: U.S. Geological Survey
Expected Completion: 06/30/09 (PJ#65109)

In Florida, recent statewide surveys have shown that Snowy Plovers nest along sandy Gulf beaches in two main regions: the Panhandle from Escambia County east to Franklin Co. and Southwestern Florida from Pasco Co. south to Collier Co. The panhandle region supports the majority of breeding pairs in Florida. Threats to Snowy Plovers include development of beachfront property, disturbance by people and pets, predation, and potential habitat loss or degradation due to coastal engineering activities for shoreline protection such as beach nourishment, armoring, and/or inlet management. Florida's panhandle has been severely impacted by hurricanes over the past few years. The resulting engineering response with a large number of projects designed to re-nourish beaches, armor shorelines, and reestablish dunes have the potential to cause major impacts to Snowy Plovers, though little is known about how such projects will specifically affect Snowy Plover nesting, foraging, roosting, and brood rearing ecology. In order to minimize impacts from state or federally sponsored and permitted projects on Snowy Plovers and their habitat (e.g., projects conducted by the Florida Department of Transportation, the Florida Department of Environmental Protection, or the US Army Corps of Engineers), basic ecological research is needed. Such research will form the basis for sound management actions targeted at preventing the species from being federally listed.

Snowy Plovers along the St. Joseph Peninsula, FL

The ultimate goal of this proposed project is to collect such data and make management recommendations for Snowy Plovers in Florida. The proposed project will occur over the course of two breeding seasons—Feb.-Aug. 2007 and 2008. It will occur in an area of some of the most densely-nested barrier islands in the panhandle, namely

Crooked Island and St. Joseph Peninsula in Bay and Gulf Counties. This is collaborative project among the USFWS, FWC, American Bird Conservancy, and the University of Florida.

OBJECTIVES:
The specific objectives of this project will be developed over the next several months (see project schedule) through a collaborative effort of the project partners and a Snowy Plover Working group. Likely objectives include, but are not limited to the following:

1) Determine nest and brood success for two breeding seasons
2) Identify sources of nest and brood failure (e.g. predators, disturbance)
3) Identify important habitat features of nest sites
4) Identify and quantify important brood foraging habitats
5) Test the hypothesis that brood success is tied to habitat quality
6) Develop protocols to compare site quality among locations that could be used to evaluate the effects of engineering projects on foraging and/or brood rearing habitat.

During the 2008 breeding season, we were able to locate 183 nests and 7 additional broods for a total of 190 breeding events. Nests were initiated from March until July, with the peak in initiation occurring in April. A total of 101 nests (53.2% of the 190 breeding events) hatched successfully. Hatch rates differed by site, with Windmark experiencing the lowest hatch rate (0%) and Crooked Island East experiencing the highest (79%). The sources of depredation also differed among sites with ghost crabs and an unknown source responsible for highest proportion of the depredation.

In total, we banded 197 chicks and 118 adults, which allowed us to accurately determine fledge rates. Through band re-sights we determined that 93 chicks fledged from 64 nests for an apparent fledge rate of 63.4%. We estimated a mean of 1.45 (SD ± 0.62) fledglings per nest for all sites surveyed. The proportion of fledged nests was similar at all sites. However, the absolute number of fledglings differed, potentially in response to environmental variables.

Snowy plover nests in 2008 appeared to be distributed throughout the 6 survey sites in a similar fashion to those observed in 2002 and 2006 (Lamonte et al 2006, Himes et al. 2006). Nest densities resembled the 2002 season more closely than 2006, possibly in response to rainfall. The 2006 season was a particularly dry year and had increased nest densities in areas with more permanent foraging areas (e.g. bay flats, inlets, or freshwater lakes).

We observed nests in a variety of human disturbance levels (as determined by human index counts). Increased nesting in high disturbance areas (i.e. close to beach access points) is likely a response to an increase in posting efforts to protect nests at all survey sites.

All data collected to compare our 4 alternative habitat selection hypothesis are not presented here, as they have not been fully analyzed. Additionally, all reproductive performance data presented here is apparent success and does not represent our final analyses of these data.

Discussion
Through banding chicks and adults we were able to accurately determine fledge rates as well as determine the type of foraging habitat used and the distance from nest site to foraging location. However, we have yet to fully analyze these data. We plan to analyze these data with program MARK, using a Cormack-Jolly-Seber mark-recapture analysis that includes environmental variables.

Our high fledge rates for the 2008 season may have been as a result of relatively high rain levels. We will be able to look at the relationship between rain and fledge rate for 2008, but will not be able to compare data to previous seasons. Although, we can get rain data for previous seasons, we do not feel that previous FWC studies provided accurate fledge rate estimates, which precludes comparisons with our data. We will however be able to compare the 2008 season with the data we collect during the 2009 breeding season.

The differences in both hatch and fledge rates among seasons and sites indicates variation in impacts caused by a suite of factors. Our research in 2009 will continue to focus on the relationships between human disturbance, predator presence, food availability, habitat features, and the importance of brood rearing habitat (i.e. ephemeral habitat).

Structured Decision Making, Ecological Thresholds and the Establishment of Management Trigger Points

Principal Investigator: **Wiley M. Kitchens**
Funding Agency: U.S. Department of Interior / U.S. Geological Survey
Expected Completion: 12/31/2009 (PJ#68409)
Research Staff: Julien Martin

Discussions of "ecological thresholds", "acceptable variation" and "management trigger points" occur frequently in discussions of ecological monitoring programs (e.g., Noon 2003). However, these discussions tend to be vague and rambling, with some agreement on the general need for thinking about such issues, but little detail about how to proceed to actually define these concepts either generally or for specific problems (e.g., specific monitored systems). This recognition appears to have motivated the Request for Proposals on this topic as part of the USGS National Park Monitoring Program.

The concepts of "ecological thresholds", "acceptable variation" and "management trigger points" all refer (explicitly or implicitly) to values of system state variables that should prompt specific management actions. In the simple case where a management decision is to perform a single management action or not, the threshold or trigger point simply divides the state space into two regions where management is or is not recommended. For example, if the state variable was population size of an indicator species or species of special interest, then we might seek a population size such that management was recommended if population size declined below this value, but not if population size exceeded the value.

Some discussions about defining such thresholds or trigger points have viewed the problem as one of statistical hypothesis testing (e.g., Skalski 1995, Noon 2003). This framework invites discussion about type I and II error rates and the relative risks associated with these different kinds of errors (e.g., Schrader-Frechette and McCoy 1993). Decisions are then made about what error rates are most likely to yield good decisions with respect to the true objectives of management.

We prefer an approach to decision making that focuses directly on the objectives of management, with an aim to provide decisions that are optimal with respect to those objectives, given existing knowledge (and lack of knowledge) about system behavior. Such an approach clearly distinguishes the components of the decision process that are inherently subjective (objectives, available management actions) from those that are more objective (models of system behavior, estimates of system state). We believe that issues about ecological thresholds, acceptable variation and management trigger points are most usefully considered to be problems in structured decision making rather than as problems in statistical hypothesis testing (Yoccoz et al. 2001, Williams et al. 2002, Nichols and Williams 2006).

Structured decision making is an approach to conservation and management that has been specifically identified by the U.S. Geological Survey and the U.S. Fish and Wildlife Service as an approach meriting increased collaboration between scientists and managers of the two agencies. The U.S. Department of Interior guidance on adaptive management similarly recognizes this specific approach to structured decision making as an approach to be emphasized. In addition to this institutional support, structured decision making, both in general and specifically as a means of integrating monitoring and conservation, has strong scientific support (Walters 1986, Kendall 2001, Yoccoz et al. 2001, Williams et al. 2002, Burgman 2005, Nichols and Williams 2006).

OBJECTIVES:

- To provide a conceptual framework for thinking about the concepts of thresholds, acceptable variation and trigger points in terms of a structured decision process. In particular, we will demonstrate that structured decision making provides a natural framework for such concepts and leads to clear thinking about the nature of such concepts and means of defining them.

- To provide a step by step procedure that leads to a decision matrix for optimal decisions. Decision matrices specify what management action to take for each possible set of values of the state variable(s) of interest and thus explicitly provide thresholds and trigger points that are optimal with respect to objectives.
- To work with National Park personnel from one or more parks to implement the approach with one or more example issues. Specifically, we will begin with the development of objectives and available management actions, move to model(s) development, consider the kind of monitoring program(s) available to estimate system state and then develop decision matrices that are optimal with respect to the objectives.

PROGRESS:
Thresholds and their relevance to conservation have become a major topic of discussion in the ecological literature. Unfortunately, in many cases the lack of a clear conceptual framework for thinking about thresholds may have led to confusion in attempts to apply the concept of thresholds to conservation decisions. We have published a peer reviewed publication that advocate a framework for thinking about thresholds in terms of a structured decision making process. The purpose of this framework is to promote a logical and transparent process for making informed decisions for conservation. Specification of such a framework leads naturally to consideration of definitions and roles of different kinds of thresholds in the process. We distinguish among three categories of thresholds. *Ecological thresholds* are values of system state variables at which small changes bring about substantial changes in system dynamics. *Utility thresholds* are components of management objectives (determined by human values) and are values of state or performance variables at which small changes yield substantial changes in the value of the management outcome. *Decision thresholds* are values of system state variables at which small changes prompt changes in management actions in order to reach specified management objectives. The approach that we present focuses directly on the objectives of management, with an aim to providing decisions that are optimal with respect to those objectives. This approach clearly distinguishes the components of the decision process that are inherently subjective (management objectives, management actions) from those that are more objective (system models, estimates of system state). Optimization based on these components then leads to decision matrices specifying optimal actions to be taken at various values of system state variables. Values of state variables separating different actions in such matrices are viewed as decision thresholds. Utility thresholds are included in the objectives component, and ecological thresholds may be embedded in models projecting consequences of management actions. Decision thresholds are determined by the above-listed components of a structured decision process. These components may themselves vary over time, inducing variation in the decision thresholds inherited from them. These dynamic decision thresholds can then be determined using adaptive management. In our first publication we provided numerical examples (that are based on patch occupancy models) of structured decision processes that include all three kinds of thresholds. We have also developed models for the Golden Eagle case study in Denali National Park, Alaska.

An Assessment of Gulf Sturgeon Population Status in the Gulf of Mexico

Principal Investigator: **William Pine**
Funding Agency: Fish and Wildlife Service
Expected Completion: 12/31/09 (PJ#69001)
Research Staff: H. Jared Flowers

A juvenile *Acipenser oxyrinchus desotoi* (Gulf Sturgeon) was collected from the Santa Fe River, a major tributary of the Suwannee River, FL, on 6 December 2006. The Suwannee River is believed to contain the largest existing population of Gulf Sturgeon; however, our specimen is only the third Gulf Sturgeon collected from the Santa Fe River. Based on these observations, we believe that the Santa Fe River should be studied further to determine its importance as Gulf Sturgeon habitat, especially in the face of future management plans that may alter the hydrology of the system.

Acipenser oxyrinchus desotoi Vladykov (Gulf Sturgeon) is listed as Federally Threatened and as a Species of Special Concern by the State of Florida (USFWS 1995). Gulf Sturgeon can reach sizes of over 90 kg and 2.4 m total length, live over 25 years, and are thought to reach sexual maturity between ages 7–12 years (Huff 1975). Gulf

Gulf Sturgeon from the Apalachicola River

Sturgeon range throughout the northern Gulf of Mexico from Tampa Bay, FL to the Mississippi River drainage (Wooley and Crateau 1985). They are anadromous, spending over half the year in freshwater rivers, where they generally spawn on shoals with a hard, rocky bottom (Huff 1975). The mainstem Suwannee River of northwest Florida is believed to support the largest remaining population of Gulf Sturgeon and has been frequently studied (i.e., Carr et al. 1996, Pine et al. 2001, Sulak and Clugston 1998). Its tributaries, however, have received much less attention in regard to Gulf Sturgeon research. Observations discussed in this paper suggest the tributary Santa Fe River also may provide important Gulf Sturgeon habitat

OBJECTIVES: This project will conduct a series of workshops to compile historical data and conduct a stock assessment to assess the current status of Gulf sturgeon and identify areas for future research to fill knowledge gaps identified by the stock assessment.

Throughout the range of Gulf sturgeon, modifications to in-river and nearshore habitats such as dam construction, dredging, modifications to flow regimes and ongoing anthropogenic mortality threats are thought to have contributed to population declines. These population declines ultimately led to regulatory closure of directed Gulf sturgeon fisheries and the species was granted protective listing status in the 1980s in different states and 1986 assigned to Gulf sturgeon in the 1980s. Research efforts on Gulf sturgeon have occurred throughout its distribution with the majority of research focused on basic population ecology including movement, growth, food habits, and population size estimation from tagging programs. We developed two types of population models using information from commercial landings and data from these previously conducted studies to develop an assessment of trends in Gulf sturgeon population abundance. We fit these models to data from the Apalachicola and Suwannee rivers from the western Gulf of Mexico. These rivers were chosen because of the availability of historical fishing records and long-term tagging data. Additionally, these two systems represent contrasting population abundances with the Apalachicola River supporting very small Gulf sturgeon populations (100-400 adults) and the Suwannee River thought to support the largest Gulf sturgeon population remaining in the Gulf of Mexico of 5000-7500 adult fish. We were interested in population abundance model performance between these two systems possibly large differences in abundance. We used a series of age-structured mark-recapture models (ASMR) to estimate abundance, recruitment, and mortality of Gulf sturgeon in the Apalachicola and Suwannee rivers, the two rivers that likely supported the largest fisheries. Key results for the Suwannee River demonstrate increasing trends in population size during the 1980s from about 2,500 age-2+ Gulf sturgeon to approximately 5,000 age-2+ individuals in the mid-1990s. However, trends in abundance since the late 1990s differ between model structure, with some models showing sharp population declines and others showing population increases. These differences are likely due to low recapture rates and sparse data. The Apalachicola River population has shown similar increasing patterns since the 1980s from 200 to 400 age-2+ Gulf sturgeon to 400-600 age-2+ Gulf sturgeon in the 1990s. Population estimates since 2000 differ between model structures assumed either showing a decline in recent years, or an increase in age-2+ Gulf sturgeon abundance to 600-1,000 individuals. Estimated natural mortality rate for the two populations also differ widely from about 5 to 7% annually in the Apalachicola River to 10-21% in the Suwannee River. A key result of our research is a demonstration of large uncertainty in population trajectories since the late 1990s, concurrent with changes in the monitoring programs, depending on model structure is used. We also used a stock reduction analysis (SRA) to reconstruct historical population biomass prior to the onset of commercial fishing. Our results suggest that population biomass for this species in Florida was severely reduced by about 90% during a short, but intense, period of commercial harvest. After large-scale fishing was abandoned, a small (exploitation less than 5% annually), but sustainable, fishery persisted until the fishery was closed in 1984. Assessing Gulf sturgeon population status is difficult due to a combination of life history characteristics (skip spawning where individuals do not return to spawn each year), behavior (gear avoidance), and variations in sampling programs (effort and location) that all contribute to uncertainty in current population estimates. This highlights key uncertainties in available data for assessing status and trends in Gulf sturgeon populations. This uncertainty could lead to divergent management policies related to this listed species.

Spectral and Response Assessment of Turtle-Friendly Lighting Study

Principal Investigator: **Raymond R. Carthy**
Co-PI: Margaret Lamont
Funding Agency: Progress Energy of Florida
Expected Completion: 04/30/2010
Research Staff: Frank Solis, Jennifer Solis, Brail Stephens

Artificial lighting disrupts the orientation ability of hatchling sea turtles as they crawl from their nest to the sea. Both intensity and wavelength of the light contribute to this disruptive effect. Studies have indicated that loggerhead and green hatchlings will orient towards shorter wavelength light and will have minimal response to longer wavelength light (Witherington 1991; Levenson et al. 2004). Therefore, managers attempting to reduce hatchling disorientation due to artificial lighting have promoted lights with shorter wavelengths such as low-pressure sodium lamps. Currently, low-pressure sodium lamps are the only lamps to be labeled "turtle friendly" by the Florida Fish and Wildlife Conservation Commission. Development of an alternative to the low-pressure sodium lamp that has minimal to no effect on orientation of hatchling turtles would provide options for residents, business owners and energy companies.

Artificial lighting may disorient hatchling turtles

Experimental arena trials will be conducted at one site along Eglin Air Force Base property on Cape San Blas, Florida. Hatchlings that emerge naturally from a nest will be placed in the center of the arena and then remotely released. Their movements will be recorded to determine orientation. Orientation data will be analyzed to determine if groups of turtles were significantly oriented, to assess whether groups of turtles were significantly oriented toward the most direct route to the sea (0°), and to determine if orientation significantly differed between control and experimental treatment groups.

OBJECTIVES:
The primary objective of this project is to determine the effect of the newly designed turtle-friendly lamp on sea turtle hatchling orientation. We will also gather spectral information and hatchling orientation data on the most popular lamps, including low pressure sodium and high pressure sodium lamps.

PROGRESS:
After analyzing data from the 2008 field season, we determined that the radiometer was not gathering sufficient detail about the amount of light emitted by each bulb, therefore the radiometer was re-calibrated during the winter of 2008/2009. On July 23, 2009 a second set of lighting trials were conducted. During these trials, readings for each lamp were taken in 40° increments between 380nm and 740nm using two filters for a total of 10 readings per lamp. On 9/16/09, 84 loggerhead turtle hatchlings emerged from one nest along the St. Joseph Peninsula. Lighting trials commenced using the 100W lamps (HPS, LPS, Amber and Test) located 45 meters from the arena. These variables were chosen because they represent the wattage and distance that are most commonly used in real-world situations (i.e. street lighting). Two trials of 8 hatchlings each were conducted per lamp (a total of 16 hatchlings per lamp), in addition to two trials (16 hatchlings total) representing a control (no light). Using standard circular statistics software, a Rayleigh Test, Rao's Spacing Test and Watson's U^2 indicates non-uniform distributions for hatchlings released under each lamp ($p < 0.05$). Compared to each other, a Watson-Williams F-Test indicated that there was no significant difference between the orientation of hatchlings released under the Test Lamp and those released under the LPS or Amber lens. There was a significant difference between hatchlings released under the Test Lamp and

those released under Control conditions and the HPS lamp; however all lamps showed significantly different orientation than the control and HPS. Although initial lighting measurements indicated the Amber lens produced less light in the non-turtle friendly wavelengths, more detailed lighting measurements indicated that the Test lamp performed better than the Amber lens and slightly less so than LPS. In hatchling orientation trials however the Test lamp performed as well as LPS and significantly better than the Amber lens.

PROJECT SUMMARY STATEMENT:
Artificial lighting disrupts the orientation ability of hatchling sea turtles as they crawl from their nest to the sea and currently there are few options for turtle-friendly lighting. Development of an alternative to the low-pressure sodium lamp that has minimal to no effect on orientation of hatchling turtles would provide options for residents, business owners and energy companies.

Supplement to 'Directing Succession through Adaptive Management in National Wildlife Refuges: Reed Canary Grass Control and Transition to Wetland Forests and Meadows'

Principal Investigator: Carrie Reinhart-Adams
Funding Agency: USGS/Fish and Wildlife Service
Expected Completion: 02/28/2009
Research Staff:

Soil Texture and Nutrient Analysis:
By characterizing the soil at experimental sites, we will be able to explain how treatment differences are related to these abiotic conditions, thereby yielding more predictive power to our recommendations for further treatment. We have an agreement with the UF soils judging team to test the samples and provide a texture characterization for each sample. Their coordinator, James Bonczek, has offered to do regular quality control testing to ensure data reliability. We also have an agreement with the Environmental Horticulture program who will conduct a suite of nutrient analyses (TKN, Nitrite/Nitrate, Organic Matter, and pH) for each sample under the coordination of Nancy Steigerwalt. Soil storage will be provided by University of Florida.

Soil texture characterizations will begin Fall 2008 and will be complete in 2009.
Soil nutrient analyses will begin Fall 2008 and will be complete in 2009.

Seed Bank Assay:
Characterizing the seed bank at experimental sites will allow us to explore the relationship between potential vegetation at the site and community composition resulting from treatments. Seed bank samples have been collected from Upper Mississippi Refuge meadow sites and from Region 6 meadow sites from refuges where flooding prevented earlier collection. Forest site seed bank samples will be collected in October 2008. Approximately 305 samples will be assayed for species composition for this second seed bank assay of the project. Equipment and supplies (pond liner, trays, potting medium) will be provided by the University of Florida. The assay which will begin November 2008 and will be complete by August 2009.

Monitoring of Wading Bird Reproduction in WCAS 1,2, and 3 of the Everglades - UAV

Principal Investigator: H. Franklin Percival
Funding Agency: USGS
Expected Completion: 03/30/2009 (PJ# 75986)
Research Staff: A. Watts, J. Perry, M. Burgess, S. Ingley

This original work of this project is modified to add continued UAV research for FY08 at no additional cost to the project. The SOW includes monitoring of wading bird colonies by coordinated systematic aerial (via manned aircraft) and ground surveys during the breeding season. The University of Florida, in collaboration with USGS and US Army Corps of Engineers, has been developing unmanned aerial vehicles (UAV) specifically for use in natural resources applications. These small aircraft have the ability to follow flight paths very closely, resulting in remarkable repeatability of survey paths that can be georeferenced. The UAVs also have the distinct advantage of being unmanned, alleviating the risk of accident involving humans, over that of manned flights.

UAV on a test flight

One promising application of UAVs is their use with the discovery and monitoring of wading bird colonies. A pilot study in early May 2008 suggests that pictures taken from UAVs can be used to identify and count colonies accurately. Early estimates suggest that use of the UAV may keep human observers out of the air for an estimated 125 hours per field season, thus reducing fuel costs, labor coasts, and safety risks.

Work to be performed during Summer 2008 is to have three fully functional aircraft and one training aircraft with capabilities and spare parts ready for the 2009 field season. A working prototype of the aircraft exists and is to be used to guide this task. The work to be performed includes the following:

1) Building four aircraft from the fully functional existing prototype (three fully functional units, one trainer), with associated travel cases.
2) Development of an airboat-based launch system.
4) Testing and fitting a better quality SLR digital camera into the body.
5) Development of software capabilities to allow accurate georeferencing and overlays.
6) Radio control pilot training of one member of the wading bird team, and training in all aspects of post-processing.
6) Field testing of prototypes and refinement of launch, retrieval, post-processing, and maintenance procedures.

Effects of Climate Change on Barrier Island Habitat and Nesting Sea Turtles

Principal Investigator: Raymond R. Carthy
Co-Principal Investigator: Margaret M. Lamont
Funding Agency: USGS/Eglin Air Force Base
Expected Completion: 05/31/2012 (PJ# 00078317)
Research Staff: Brail Stephens

As the global climate changes it is likely to have significant effects on coastal habitats and the species that rely on this habitat for survival. Warmer temperatures and rising seas can increase beach erosion, altering oceanographic patterns and influencing sand temperatures. These changes to the coastal environment may greatly affect species such as sea turtles. Sea turtles spend most of their life at sea but rely on the shoreline for one critical life-history phase: nesting. Changes to beach topography, sand temperatures and oceanographic patterns may impact nesting success, change incubation rates and influence nesting site fidelity. Determining the effects of climate change on nesting sea turtles will help provide better management information for this threatened species.

Eglin Air Force Base (EAFB) owns approximately 250 hectares along Cape San Blas, Florida. Research conducted by the Florida Cooperative Fish and Wildlife Research Unit from 1994 to 1997 indicated that this property supports the greatest density of loggerhead turtle nesting in the Florida panhandle. In 1998 it was Cape determined that turtles nesting in Northwest Florida are genetically distinct therefore EAFB property on Cape San Blas is critical for the success of this nesting group. Although this region supports a significant group of nesting sea turtles, it has also been determined that Cape San Blas experiences one of the greatest rates of erosion in Florida. Portions of the west beach of Cape San Blas lose approximately 10 meters of sand per year, while sections of the east beach gain about 4 meters per year. These fluxes may increase substantially when influenced by tropical storms.

Extreme beach erosion along Cape San Blas Florida

This project aims to further elucidate specific components of sea turtle ecology and climate change by:

a. continuation of a long-term tagging study and nest monitoring
b. investigating effects of changes in beach morphology on sea turtle movements during the internesting period
c. 1) examining effects of erosion debris fields on nesting success 2) identification and GIS mapping of Coast Guard Station debris onshore and off-shore 3) statistical comparison of mean number of false crawls in debris areas versus non-debris areas
d. researching effects of climate change on incubation length

These activities will be conducted annually for 3 nesting seasons (2009, 2010 and 2011), and will augment our research in support of management as well as strengthen the context of our conceptual framework for effects of climate change in this dynamic coastal region.

Progress 2009: In 2009 we recorded 83 total crawls including 37 nesting crawls along EAFB property on Cape San Blas. Overall nesting success (# nesting crawls/total # crawls) was 45% which is slightly greater than the 15 year mean of 40% for this beach. Sixteen turtles were tagged and 86% of nests were observed during oviposition. Although nesting success is equal between the eroding west beach and accreting east beach over the long-term, in 2009 nest success was lower on west beach (39%) than on east beach (51%). There were more total crawls (57%) and more nesting crawls (65%) on east beach than on west beach in 2009 however false crawls were split evenly between east (50%) and west beach (50%). A visual comparison of false crawl locations to locations of debris indicates no clear relationship, however further analyses are in progress. Incubation rates are shorter on west beach (57 days) than on east beach (63 days) which is consistent with the 15-year mean.

Logs and broken concrete may act as barriers to turtles attempting to traverse the beach.

Upper St. John's River Basin: Habitat Use and Reproduction of Snail Kites

Principal Investigator: **Wiley Kitchens**
Co-Principal Investigator:
Funding Agency: USGS/USACE
Expected Completion: 07/1/2009 (PJ# 00078317)
Research Staff:

Recent demographic analyses indicate alarming trends in the snail kite population in Florida. Kite abundance drastically and steadily declined between 1999 and 2003 and again between 2006 and 2008. The population size estimate for has approximately halved from 2006 to 2008 (1204 in 2006 to 685 in 2008). Our results suggest that the lack of recovery after 2002 is probably due to a reduction in recruitment, which has not shown any indication of changing. There were major droughts in the study area (Water Years 00/01 and 06/07) that negatively impacted both adult and juvenile survival. In addition, there are numerous hydrological management activities in the system that may well be affecting kite reproduction. Lake Okeechobee, one of the productive breeding sites of the system between 1985 and 1995, has undergone radical changes in its' hydrological schedule since 1996 and almost no fledging birds have been produced from this site since 1996. In addition, there have been major lake enhancements (draw downs) and extensive aquatic weed control activities in the Kissimmee Chain of Lakes and water level schedule changes in the in Water Conservation Area 3A (the prime reproductive unit for kites).

Snail kites in the Florida Everglades

Excluding the drought impacted years, adult annual survival has been approximately 90% throughout the study period. This would tend to negate arguments of disease being a major causative factor for the declines. Given adult survival is relatively high and stable, reproduction and recruitment become particularly important to stemming the perceived declines. PVA models indicate that the lack of recruitment is critical both stemming of this decline and achieving a more sustainable population growth rate.

OBJECTIVES:

The snail kite (*Rostrhamus sociabilis*) is an endangered raptor whose distribution in the United States is restricted to the South Florida Ecosystem including watersheds of the Everglades, Lake Okeechobee, Kissimmee River, and Upper St. Johns River. Human-induced degradation of the hydrologic functioning of these watersheds has prompted large-scale restoration efforts (e.g. the Central and South Florida Project Restudy, Kissimmee River Restoration, and the South Florida Ecosystem Restoration Initiative).

During the first half of this century, snail kite populations declined dramatically. More recently, since the mid-1960's the population appeared to stabilize and perhaps even increase. However, our recent studies suggest the population is currently undergoing an alarming declining phase. The population size appears to have progressively and substantially decreased since 1999. The population in 2003 was estimated to be half its estimated size in 1999. The altered hydrology of wetlands representing its critical habitat is probably the primary environmental influence on the population. These include loss of habitat and changes in foraging and nesting habitat structure.

The objective of this research is to monitor the birds' response to environmental changes (anthropogenic and natural) focusing on the most critical demographic parameters: survival, reproduction, recruitment, and population growth rate. Because those demographic parameters are heavily influenced by the behavior of the birds (i.e. their ability to move and select suitable habitats), movement studies constitute the other major aspect of the research. There are 2 overarching objectives: 1) to evaluate the underlying mechanisms and processes driving the population dynamics of the kites; 2) to provide reliable estimates of demographic parameters and movement probabilities to upgrade management models to optimize management decisions.

Tagging a snail kite to track its movements

PROGRESS:

This study is complementary to the demographic study entitled "Demographic, movement, and habitat studies of the endangered snail kite in response to hydrological changes". .Our radio telemetry study conducted in 1992 to 1995 helped identify the critical kite habitat. However given the dynamics

of those habitats (changes in hydrology, plant communities), it is reasonable to expect some spatial shifts in the use of those habitats after more than 8 years (for instance large number of kites used Lake Okeechobee between 1992 and 1994, but stop using this area after 1995). Radio telemetry is the most efficient if not only way to track those changes.

Mark-recapture models provide a powerful framework for estimating critical demographic (survival, population growth rate) and movement parameters. The recent advances in modeling allow for the combination of mark recapture and radio telemetry information, providing better estimates of survival and movement rates, and increasing power of statistical inferences (Williams et al 2002, Nasution et al. 2001).

Additional advances in mark-recapture modeling using the multi-state robust design that adjusts for the bias associated with state uncertainty have aided us in producing reliable estimates of snail kite breeding probabilities. Model selection indicates that snail kite breeding probabilities are closely dependent upon the life-history trade-offs associated with aging and harsh environments, such as droughts and habitat degradation. Describing sources of variation within breeding probabilities will help to refine estimates of fecundity and identify the environmental conditions which promote breeding attempts.

Senescence is defined as an increasing intrinsic rate of death, and is common among wild populations. By utilizing the long-term band-resight dataset, which began in 1976, we are able to identify senescence rates among the aging cohorts of the snail kite population. Understanding how severe environmental conditions (such as droughts) disproportionally impact the survival probabilities of older snail kites will help to refine vital rates that are critical to our monitoring efforts.

Preliminary findings:

- Snail kites are more philopatric than previously anticipated.
- Preliminary aircraft radio surveys have also enabled us to obtain more precise survival estimates during dry wetland conditions.
- Our analyses of radio-telemetry, using multistate models, indicate that snail kite movements are not as extensive as previously thought especially between habitats that have been altered by fragmentation.
- Our study also highlights the importance of taking into consideration the fact that kites movement are both distance dependent and affected by fragmentation, when managing the hydrology of wetlands used by this species.
- Snail kites do experience increased rates of mortality and decreased probabilities of attempting to breed in their oldest ages.
- All young fledged and radioed in the Kissimmee Chain of Lakes (KCOL) in 2008 and 2009 stayed in the KCOL through their entire first year post fledging. Only four young from 2008 were later observed in the Everglades region (also includes Harn's Marsh Preserve) in 2009.

A Land of Flowers on a Latitude of Deserts: Aiding Conservation and Management of Florida's Biodiversity by using Predictions from "Down-Scaled" AOGCM Climate Scenario in Combination with Ecological Modeling

Principal Investigator: **Franklin Percival**
Co-Principal Investigator: Wiley Kitchens, Christa Zweig
Funding Agency: USGS
Expected Completion: 12/31/2011 (PJ# 00078317)
Research Staff: Dr. Shannon Knapp, Patrick McElhone

We are interested in the effects of climate change on the low energy system of the Suwannee River-Big Bend ecosystem of Florida. Fluctuations in sea levels and temperature can greatly alter communities of flora and fauna inhabiting the salt marshes of this area. In particular, the *Distichlis spicata* dominated marshes in the region seem to be preferred by the endangered Florida Salt Marsh Vole (*Microtus pennsylvanicus dukecambelli*; Woods et al., 1982; Woods, 1992; Barlow and Mitchell, 2004). With only 43 known captures of this vole since its discovery 31 years ago, we are interested in obtaining more baseline information on the presence and location of this species within these marshes. Vegetation and raptors surveys will aid our efforts to understand the hierarchical nature of the

relationship between hydrology, vegetation, small mammals, and raptors in this ecosystem and how climate change may alter this relationship.

This research is part of a larger project that will also study the ecosystem of the Greater Everglades. Downscale climate predictions from coupled Atmospheric-Ocean General Circulation Models will be used to predict how changes climate will influence water availability and stage in the system. Responses of particular flora and fauna indicator species will be linked to the changes in water availability over 30 years.

OBJECTIVES:

1. To develop the knowledge necessary to make accurate predictions of the response of species and their ecosystems to climate change.
2. To link indicator species (an endangered vole and small mammals, raptors, and fish communities) to predicted changes in water availability from downscaled climate predictions from Atmospheric-Ocean General Circulation Models (AOGCMs) to peninsular Florida.

The lead technician and post-doc both began work on project in January of 2010. The project study design has been outlined and equipment for the field season is being organized. Small mammal trapping and vegetation sampling will begin in late January 2010.

COMPLETED PROJECTS of Florida Unit….

1. Winter Feeding Ecology of Black Skimmers on the Florida Gulf Coast,
   PI: L.D. Harris; Personnel: B. Black; Completion Date: 1981

2. Winter Food Habits and Factors Influencing the Winter Diet of River Otter in North Florida.
   PI: L. Cooley; Completion Date: December 1983

3. Feeding Ecology of the Common Moorhen (*Gallinula Chloropus*) and Purple Gallinule *Porphyrula Martinica*) on Orange Lake, Florida. PI: R. Mulholland; Completion Date: December 1983

4. Monitoring River Otter Population: Scent Stations vs Sign Indices. PI: M. Robson;
   Completion Date: December 1983

5. Aspects of the Thermal Biology and Ecological Considerations of the Blue Tilapia.
   PI: J.A. McCann; Personnel: A.V. Zale; Completion Date: December 1984

6. Winter Food Habits & Factors Management Influencing the Winter Diet of River Otter in North Florida.
   PI: H.F. Percival; Personnel: L.S. Cooley

7. Habitat Preference of Early Life Stages of Fishes in Orange Lake, Florida With an Evaluation of Alligator Sampling Methods –Winter Ecology of Ring-Necked Ducks in North-Central FL.
   PI: H.F. Percival, J. Thul; Personnel: C.W. Jeske; Completion Date: August 1985

8. Reproductive Behavior & Florida Wild Turkey (Meleagris Gallopavo Osceola) Nesting.
   PI: L. Williams; Completion Date: December 1985

9. Evaluation of Alligator Hatchlings Removal From Wild Populations in Florida.
   PI: H.F. Percival; Personnel: M.L. Jennings, Completion Date: March 1986

10. Nest Site Selection and Habitat Use by Largemouth Bass. PI: R.W. Gregory; Personnel:
    N.A. Bruno; Completion Date: December 1984

11. Research/ Management Plan For The Crystal River West Indian Manatee Population Levy & Citrus Counties, FL. PI: R.W. Gregory, H.F. Percival; Completion Date: December 1983

12. Site-Specific Reduction of Manatee Boat/Barge Mortalities in Florida. PI: H.F. Percival,
    R.W. Gregory; Personnel: M.F. Kinnaird; Completion Date: May 1984

13. Mitigation of Fish & Wildlife Values in Rock-mined Areas of S. Florida. PI: R.W. Gregory,
    H.F. Percival; Personnel: R.W. Repenning; Completion Date: August 1984

14. Wildlife Values of Southeastern Bottomland Forests. PI: L.D. Harris; Completion Date: September 1984

15. The State of Knowledge of Gray Fox Harvest. PI: R.F. Labisky, S.R. Humphrey, H.F.Percival;
    Personnel: J.A. Hovis; Completion Date: January 1984

16. Foraging Habitat Requirements of The Red=Cockaded Woodpecker in Pine Habitats of North Florida.
    PI: R.F. Labisky; Personnel: M.L. Porter; Completion Date: September 1984

17. Habitat Suitability Index Models for Gulf of Mexico Coastal. PI: R.W. Gregory, H.F. Percival;
    Personnel: R. Mulholland; Completion Date: November 1984

18. Effect of Nutrient Leaching on Fish Spawning & Nursery Habitat in Great Lakes Nearshore Water.

PI: R.W. Gregory, H.F. Percival; Personnel: L.C. Brasel; Completion Date: November 1984

19. Development of Hybrid Grass Carp Production Techniques. PI: J.V. Shireman; Completion Date: September 1984

20. Conceptual Model of Salt Marsh Management on Merritt Island, Florida. PI: C.L. Montague, H.F. Percival; Personnel: A.V. Zale; Completion: December 1984

21. Studies of Grass Carp in Aquatic Weed Control. PI: J.V. Shireman; Completion Date: October 1984

22. Factors Affecting Reproductive Success of Sea Turtles on Cape Canaveral Air Force Base. PI: R.F. Labisky; Completion Date: September 1984

23. Ecology & Management of Impounded Coastal Wetlands of The Georgia Bight. PI: C.L. Montague, H.F. Percival; Personnel: A.V. Zale; Completion: June 1985

24. Status Survey of the Rosemary Wolf Spider in Florida. PI: J. Reiskind; Completion Date: April 1985

25. Determination of the Food Habits of Manatees. PI: G.B. Rathbun, H.F. Percival; Personnel: L.A. Hurst, Completion Date: August 1985

26 Evaluation of Captive Breeding & Reintroduction of the Flroida Panther. PI: J.F. Eisenbert; Completion Date: June 1985

27. Biometrical support For GFC's Gainesville Research Laboratory. PI: H.F. Percival: Personnel: C.L. Abercrombie, T.O'Brien; Completion Date: June 1985

28. Black Bear Habitat Variables. PI: L.H. Harris, D. Maehr; Personnel: C.W. Jeske; Completion Date: July 1985

29. Status Survey of the Florida Grasshopper Sparrow. PI: M.L. Delany, H.F. Percival; Personnel: J. Cox; Completion Date: March 1985

30. Status Survey of the Schaus' Swallowtail in Florida. PI: T.C. Emmel; Completion Date: March 1985

31. Population Index & Mark/Recapture Methodology For the West Indian Manatee In Florida. PI: H.F. Percival, Completion Date: August 1985

32. Effects of Low Altitude Training Flights on Florida's Brown Pelican & Wading Bird Colonies. PI: M.W. Collopy, B.B. Black, P.G. Bohall; Completion Date: January 1985

33. Habitat Use & Management of Sherman's Fox Squirrel. PI: S.R. Humphrey; Personnel: A.T. Kantola; Completion Date: June 1986

34. Evaluation of Electro-fishing Systems for Quantitative Sampling of Blue Tilapia. PI: H. Schramm; Completion Date: May 1986

34. Pancreatic Necrosis Virus as a Pathogen of Striped Bass. PI: R.W. Gregory, W.M. Kitchens, J.V. Shireman; Personnel: S. Wechsler; Completion Date: May 1987

35. Production, Sterility, & Food Habits of Bighead Carp. PI: J.V. Shireman; Completion Date: July 1987

36. Evaluation of Population Parameters of Black Duck. (RWO27) PI: H.f. Percival, M.J. Conroy, M. Haramis; Personnel: D.G. Krementz, B.R. Charest; Completion Date: July 1987

37. Status of the Cape Sable Seaside Sparrow in East Everglades. PI: W.R. Marion; Personnel: T.O'Meara; Completion Date: September 1987

38. Evaluation & Control of Bird Damage to Rice. PI: M. Avery, H.F. Percival, P. Lefebvre; Personnel: D. Daneke; Completion Date: December 1987

39. The Ecology & Management of Impounded Coastal Wetlands of the Georgia Bight: Workshop (RWO33) PI: C.L. Montague, H.F. Percival; Personnel: A.V. Zale; Completion Date: September 1987

40. Movement & Survival of Captive-Reared Gharials in the Narayani River, Nepal. PI: H.F. Percival; Personnel: T.M. Maskey; Completion Date: December 1988

41. Egg Viability From Four Wetlands in Florida. PI: H.F. Percival, A.R. Woodward: Personnel: M.L. Jennings; Completion Date: April 1988

42. The Ecology & Management of Hydric Hammocks (RWO24). PI: S.R. Humphrey; Personnel: S. Vince; Completion Date: July 1988

43. A Comparison of Passerine Feeding Habits in Two Tidal marsh Communities (RWO30). PI: G.W. Tanner, W.M. Kitchens; Personnel: L. Peterson; Completed: January 1989

44. Population Analysis & Roosting & Feeding Flock Behavior of Blackbirds Damaging Sprouting Rice in SW Louisiana. PI: R.R. Labisky, N.R. Holler; Completion: September 1989

45. Performance of the Female Habitat Use, Movements, Migration Patterns, & Survival Rates of Sub- Adult Bald Egles in Florida. PI: M.W. Collopy; Personnel: P.B. Wood; Completion Date: December 1991

46. Effectiveness of Wildlife Crossing Structures on Alligator Alley (I-75) For Reducing Animal/Auto Collisions. PI: S.R. Humphrey; Personnel: M.L. Foster; Completion Date: December 1991

47. Impact Assessment of Grass Delivery Program on Wading Carp (RWO34). PI: J.V. Shireman, W.M. Kitchens; Completion Date: September 1989

48. Status Survey of Three Florida Lizards (RWO35). PI: P. Moler, H.F. Percival, R.F. Labisky; Personnel: K. Enge; Completion Date: October 1986

49. Vegetation Management for Key Deer (RWO36) PI: S.R. Humphrey G.W. Tanner: Personnel: J. Wood, P. Carlson; Completion Date: December 1989

50. Status Survey of Seven Florida Mammals: Micro Cottontail Rabbit, Micro Cotton Rat, SE Beach Mouse, Goff's Pocket Gopher, Anastasia Island Cotton Mouse and Beach Mouse (RWO37). PI: S.R. Humphrey, M. Bentzien; Completion Date: July 1987

51. Relative Abundance, Size Class, Composition, & Growth Patterns of Wild Green Turtles at the Culebra Archipelago, Puerto Rico (RWO38) PI: J.A. Collazo, H.F. Percival; Personnel: T. Tallevast; Completion Date: December 1989

52. Effects of Modified Water Bird Nesting Success & Foraging Dispersion in Water Conservation. PI: M.W. Collopy; Personnel: P.D. Frederick, Completion Date: April 1988

53. Effects of the Modified Water Delivery Program on Nest Site Selection & Nesting Success of Snail Kites in Water Conservation Area 3A (RWO40). PI: M.w. Collopy, s. Beissinger; Personnel: R. bennetts; Completion Date: February 1988

54. Comparative Graminoid Community Compositon & Structure Within the Northern Portion of Everglades Nat'l Park, NE Shark River Slough, Water Conservation Area 3A & 3B (RWO41)
PI: G.W. Tanner; Personnel: J.M. Wood; Completion Date: November 1986

55. Human/Wildlife Interaction J.N. "DING" Darling Nat'l Wildlife Refuge (RWO42).
PI: S.R. Humphrey, H.F. Percival; Personnel: M.V. Klein; Completion Date: June 1989

56. Status Survey of Two Florida Seaside Sparrows (RWO43). PI: K. McNab, V. MacDonald; Completion Date: October 1988

57. Soil/Plant Correlation Studies in Florida (RWO46). PI: G.R. Best, W.M. Kitchens; Completion Date: March 1987

58. Reproductive cycles in Striped Bass Maintained in Recirculation Silos: Histological Analysis.
PI: L.J. guillette, Jr.; Personnel: C.A. Goudie; Completion Date: October 1986

59. Aquatic Plant Management Technology Improvement (RWO47). PI: J.C. Joyce, W.T. Haller; Personnel: V. Ramey, T. Willard; Completion Date: April 1988

60. Effects of Ground Water Levels Upon Reproduction success of American Crocodiles In Everglades Nati'l Park (RWO50). PI: F.J. Mazzotti; Completion Date: April 1989

61. Factors Affecting Productivity & Habitat Use of Florida SandHill Cranes: An Evaluation of Three Areas in Central Florida as Potential Reintroduction Sites for a Mommigratory Population of Whooping Cranes. PI: M.W. Collopy; Personnel: M. Bishop; Completion: October 1988

62. Manatee Protection Project: Survey of Boat Usage Patterns. PI: J.W. Hutchinson, J.W. Alba; Completion Date: September 1988

63. An Evaluation of Manatee Distribution Patterns in Response to Public Use Activities, Crystal River,) Florida. (RWO52) PI: W.M. Kitchens; Completion Date: December 1989

64. An Evaluation of Cumulative Impacts to the Habitat of The West Indian Manatee, Crystal River Nat'l Wildlife Refuge (RWO53) PI: W.M. Kitchens; Personnel: L.G. Pearlstine, C.Buckingham; Completion Date: December 1989

65. Status Survey of The Florida Saltmarsh Vole (RWO54) PI: C.A. Woods; Personnel: L. Hay-Smith; Completion Date: September 1988

66. Impact of Mosquito Control Pesticides on the Endangered Schaus Swallowtail & Related Insects in The Florida Keys (RWO56) PI: T.C. Emmel; Personnel: P. Eliazar; Completion Date: Jan 1989

67. Effects of Mosquito Control Pesticides on Non-Target Organisms in the Florida Keys (RWO57)
PI: D.H. Habeck; Personnel: M. Hennessey; Completion Date: October 1989

68. Development of Guidance Manual For Monitoring Water Quality & Vegetative Changes on Nat'l Wildlife Refuges (RWO58) PI: W.M. Kitchens; Completion Date: December 1988

69. Applicability & Comparison of Satellite Image Data to Delineation of Cover type in The Lower Suwannee River Region (RWO60) PI: W.M. Kitchens; Completion Date: December 1988

70. Distribution & Population Structure of Sea Turtles Inhabiting The Cape Canaveral Entrance

Channel (RWO62) PI: A.B. Bolten, K.A. Bjorndal; Completion Date: December 1991

71. Determination of the Causes of Low Response with the Water Fowl Hunter Questionnaire & Estimation of the Resultant Biases (RWO76) PI: H.F. Percival; Personnel: R.J. Barker, P.H. Geissler: Completion Date: September 1990
72. The Ecology of Manatees in Georgia with Emphasis on Cumberland Sound (RWO65) PI: H.F. Percival, B.J. Zoodsma; Completion Date: December 1990

73. Scientific Review of Alligator Export Proposals to USFWS (RWO69) PI: H.F Percival; Personnel: P.N. Gray, F. Nunez-Garcia; Completed: July 1990

74. Fish Community Structure in Naturally Acid Florida Lakes (RWO73) PI: W.M. Kitchens; Personnel: C.A. Jennings, D.E. Canfield, Jr.; Completed: July 1990

75. Development & Application of A Habitat Succession Model For the Wetland Complex of the Savannah river Nat'l Wildlife Refuge (RWO30) PI: W.M. Kitchens; Personnel: L.G. Pearlstine, P. Latham, L. Peterson, G. Tanner; Completion Date: December 1990

76. Plant species Association Changes & Interactions Across a Gradient of Fresh, Oligohaline & Mesohaline Tidal Marsh of the Lower Savannah River (RWO30) PI: W.M. Kitchens; Personnel: P.J. Latham; Completion Date: December 1990

77. Biology of Florida's Mottled Duck. PI: H.F. Percival; Personnel: P.N. Gray; Completed: May 1992

78. Modeling Waterfowl Harvest & The Effects of Questionnaire Non-response on Harvest Estimate. PI: H.F. Percival; Personnel: R.J. Barker, J.D. Nichols; Completion Date: May 1992

79. Environmental Influences on Reproductive Potential & Clutch Viability of the American Alligator From Seven Study Sites in Florida. PI: H.F. Percival; Personnel: G.R. Masson; Completion Date: July 1992

80. Nesting Biology of the American Alligator in Florida. PI: H.F. Percival; Personnel: K.G. Rice; Completion Date: September 1992

81. Alligator Egg Viability & Population Trends on Lake Apopka, Florida. PI: H.F. Percival, L.J. Guillette, Jr.; Personnel: G.R. Masson, K.G. Rice, Completed: June 1993

82. Alligator Nest Production Estimation in Florida. PI: H.F. Percival; Personnel: K.G. Rice, A.R. Woodward; Completion Date: August 1992

83. Habitat Use By Migratory Shorebirds at the Cabo Rojo Salt Flats, Puerto Rico (RWO78) PI: J.A. Collazo, H.F. Percival; Personnel: J.S. Grear; Completion Date: August 1992

84. Wading Bird Use of Wastewater Treatment Wetlands in Central Florida (RWO83) PI: P.C. Frederick; Completion Date: December 1992

85. Evaluating The Regional Effects of Citrus Development on The Ecological Integrity of South-West Florida. PI: F.J. Mazzotti, W.M. Kitchens; Personnel: L.A. Brandt, L.G. Pearlstine; Completion Date: May 1992

86. Workshop in Florida Manatee (*Trichechus Mantus*) Population Biology (RWO88) PI: T.J. O'Shea, H.F. Percival; Personnel: B.B. Ackerman; Completed: October 1993

87. Issues & Options Related to Management of Silver Springs Rhesus Macaques. PI: C.L. Montague, H.F. Percival; Personnel: J.F. Gottgens; Completed: December 1993

88. Sea Turtles Inhabiting The Kings Bay, St. Mary's Entrance Channel: Distribution & Population Structure (RWO72) PI: K.A. Bjorndal, A.B. Bolten; Completed: September 1983

89. Wading Bird Nesting Success Studies in The Everglades (RWO110) PI: P.C. Frederick, Completed: December 1993

90. Captive Propagation & Restoration Ecology of The Endangered Stock Island Tree Snail (RWO94) PI: T.C. Emmel; Completion Date: October 1993

91. Status Monitoring & Experimental Reintroduction of The Endangered Schaus Swallowtail (RWO84) PI: T.C. Emmel, P.J. Eliazar, M.C. Minno; Completed: September 1993

92. Conservation Status of The Freshwater Mussels of The Apalachicola River Basin (RWO86) PI: J.D. Williams; Personnel: J.C. Brim-Box; Completion Date: October 1993

93. Statistical Aspects of Line Transect Sampling (RWO68) PI: K.M. Portier, Completed: 1993

94. A Geographic Information System Model of Fire Damage & Vegetation Recovery in The Loxahatchee Nat'l Wildlife Refuge. PI: W.M. Kitchens; Personnel: J.E. Silveira, J.R. Richardson; Completion Date: December 1993

95. Mercury Concentrations in Blood & Feathers of Nestling Bald Eagles (RWO108) PI: P.B. Wood; Personnel: J.H. White, A. Steffer, H.F. Percival; Completed: December 1994

96. Effects of Artificial Lighting on Nesting Adult & Hatchling Sea Turtles (RWO75) PI: K.A. Bjorndal, A.B. Bolton; Personnel: B.E. Witherington; Completed: September 1994

97. Summary Report of Air Quality Studies Done at Chassahowitzka Nat'l Wildlife Refuge (RWO102) PI: E.R. Allen; Completion Date: June 1994

98. Evaluations of The Efficacy of Exotics as Aquaculture & Management Species in Florida (RWO109) PI: J.V. Shireman; Personnel: J.E. Weaver, K. Opusbynski; Completed Date: February 1994

99. Assessing The Impact of Vehicular Traffic on Beach Habitat & Wildlife, Cape San Blas, FL PI: H.F. Percival; Personnel: J.H. Cox, Jr., S.V. Colwell; Completion Date: June 1994

100. Early Life History & Relative Abundance of Sturgeon In The Suwannee River (RWO61) PI: J.V. Shireman, J.P. Clugston, A.M. Foster; Completion Date: October 1994

101. Distribution, Population Structure & Exploitation of Sea Turtles in The Bahamas (RWO67) PI: K.A. Bjordnal, A.B. Bolton; Completion Date: September 1994

102. Sea Turtle Populations in The Eastern Gulf of Mexico: Biology, Distribution & Population Structure (RWO77) PI: K.A. Bjordnal, A.B. Bolten; Personnel: J.R. Schmid; Completion Date: September 1994

103. Distribution & Status of The Red-Cockaded Woodpecker on The Eglin Air Force Base, Florida. PI: H.F. Percival, R.J. Smith; Completion Date: March 1994

104. Factors Affecting Abundance of Spotted Seatrout & Year-Class Strength (RWO81) PI: H.F. Percival, N.A. Funicelli, J.V. Shireman; Completion Date: June 1994

105. Re-establishment of the Anastasia Island Beach Mouse (*Peromyscus Polionotus Phasma*) PI: S. Humphrey; Personnel: P.A. Frank; Completion Date: January 1994

106. Captive Propagation and Habitat Reintroduction for the Schaus Swallowtail Following Hurricane

Andrew. PI: T.C. Emmel; Personnel: J.C. Daniels A. Sourakov, P.J. Eliazar; Completion Date: September 1994

107. Development Abnormalities of the Reproductive System of Alligators From Contaminated & Control Lakes in Florida. PI: H.F. Percival; Completion Date: May 1994

108. Land Management Practices in the Mountain Region of Puerto Rico: Monitoring Bird Reproductively in Carite State Forest PI: H.F. Percival; J.A. Collazo; Personnel: F. Nunez-Garcia; Completion Date: December 1995

109. Methods For Determining change in Wetland Habitats in Florida (RWO95) PI: W.M. Kitchens; Personnel: J. Silviera, W. Bryant; Competed: September 1995

110. Population Ecology of Bartram's Ixia (RWO101) PI: G.W. Tanner; Personnel: A. Miller; Completed: October 1995

111. Maintenance, Propagation, and Restoration of the Endangered Stock Island Tree Snail Following Hurricane Andrew (RWO106). PI: T.C. Emmel; Personnel: K.A. Schwarz, R.A. Worth, N.D. Eliazar; Completion Date:: October 1995

112. Changes in Salinity & Vegetation Following Re-establishment of Natural Hydrology on the Lower Savannah River (RWO117). PI: W.M. Kitchens; Personnel: P.J. Latham, L.P. Peterson; Completion Date: March 1995

113. Follow-Up of a 14 Year Old Crested Wetland/Upland Landscape on Phosphate-Mined Land in Central Florida (RWO120) PI: G.R. Best, W.M. Kitchens; Completed: March 1995

114. Trends, Status & Aspects of Demography of The Red-Cockaded Woodpecker in The Sandhills of Florida's Panhandle (RWO124). PI: H.F. Percival; Personnel: J.L. Hardesty, R.J. Smith; Completion Date: March 1995

115. Status & Distribution of The Florida Scrub Jay on Cape Canaveral, Flordia (RWO127) PI: H.F. Percival; Personnel: J.L. Hardesty, D.B. McDonald; Completion Date: May 1995

116. Mercury Contamination in Great Egrets in Southern Florida (RWO132). PI: P.G. Frederick; Personnel: M.G. Spaulding, M.S. Sepulveda: Completed: September 1995

117. The Acute Toxicity of Malathon to Glochidia & Freshwater Mussels (RWO133) PI: E.J. Philips; Personnel: A.E. Keller; Completion Date: March 1995

118. The Role of Environmental Contaminants in The Prevalence of Fish Infected With A Wading Bird Parasite (RWO134). PI: D.J. Forrester; M.G. Spaulding; Personnel: D. Morrison; Completion Date: September 1995

119. Development of an Ecologically Stable Cost Efficient Biological Water Treatment system & Technology Tranfer System (RWO135) PI: J.V. Shireman; Personnel: N.A. Furnicelli; Completion Date: September 1995

120. Status & Distribution of the Florida Scrub Jay on Cape Canaveral, FL (RWO136) PI: H.F. Percival; Personnel: D.B. McDonald, J.L. Hardesty; Completed: October 1995

121. Disruption of Endocrine Function & Reproductive Potential By Environmental Contaminants on Lake Apopka's Alligators & Other Taxa (RWO137) PI: H.F. Percival; Personnel: L.J. Guillette, T.S. Gross, K.G. Rice; Completed: October 1995

122. The Epidemiology of Upper Respiratory Tract Disease in Desert Tortoises at Three Sites in The California Deserts (RWO138) PI: M. Brown; Personnel: I.M. Schumacher, P.A. Klein; Completion Date: April 1995

123. The Relationships Between Host Plant & Habitat For The Distribution of Three Potentially Endangered S. Florida Butterfly Species (RWO145) PI: T.C. Emmel; Personnel: R.A. Worth; Completion Date: September 1995

124. Snail Kite Census PI: W.M. Kitchens; Completion Date: December 1995

125. Refinement of Population Estimation Techniques For Wild Turkeys YR 3. PI: G.W. Tanner; Completion Date: June 1995

126. Egg Viability, Sexual Development, Hatchling Viability & Growth in Alligators From Lake Apopka & Lake Beauchair. PI: H.F. Percival; Personnel: C.L. Abercrombie, A.R. Woodword, K.G. Rice; Completion Date: July 1995

127. Mineral Interactions Between embryo, Eggshell & Subtrate in Developing Sea Turtles (RWO92) PI: K.A. Bjorndal; Personnel: A.B. Bolten, R.R. Carthy; Completion Date: August 1996

128. Ecological Correlates of Red-cock Woodpecker Foraging Preference, Habitat Use, & Home Range Area on Eglin Air Force Base, Florida (RWO99) PI: H.F. Percival; Personnel: R.J. Smith, J.L. Hardesty; Completion Date: March 1996

129. Understory Response to Longleaf Pine-Sandhill Restoration Techniques (RWO111) PI: G.W. Tanner; Personnel: J.L. Hardesty, Completion Date: March 1996

130. Habitat Associations, Reproduction, and Foraging Ecology of Audubon's Crested Caracara in South-Central Florida (RWO114). PI: S.R. Humphrey; Personnel: J.L. Morrison, S.M. McGehee; Completion Date: May 1996

131. Landscape Dynamics of Scrub Lizard on Avon Park Air Force Range (RWO122) PI: L.C. Branch; Personnel: D.G. Hokit, B.M. Stith; Completion Date: September 1996

132. Post Hurricane Density & Recovery Status of the Key Largo Woodrat and Cotton Mouse (RWO123) PI: H.F. Percival; Personnel: K. Miller, B.W. Keith; Completion Date: August 1996

133. Evaluation of Sampling and Analytical Protocols for Manatee Capture-Recapture and Telemetry Data (RWO125) PI: H.F. Percival; Personnel: L.W. Lefebvre: Completed: July 1996

134. Community Response to Restoration Techniques in Degraded Florida Sandhill Systems (RWO 128) PI: G.W. Tanner; Personnel: D.R. Gordon, H.F. Percival; Completion Date: March 1996

135. Marine Turtle Nesting Biology & Assessment of Anthropogenic Disturbances to Hatchling Orientation at Eglin Air Force Base (RWO129) PI: H.F. Percival; Personnel L.G. Pearlstine, Completion Date: April 1996

135. Necropsies of Ill and Dying Desert Tortoises From California and Elsewhere in The Southwestern United States (RWO131) PI: B.L. Homer; Personnel: E.R. Jacobson, K.H. Berry; Completed:March 1996

137. Potential Effects of Endocrine Disrupting Contaminants (RWO140) PI: T.S. Gross; Personnel: H.F. Percival, K.G. Rice, A.R. Woodward; Completed: June 1996

138. Interactions Among Cavity Dependent Species in Longleaf Pine Forests: The Roles of Snags and Red-Cockaded Woodpecker Cavities (RWO143) PI: J.D. Harris; Personnel: R. Costa, J.J.

Kappes, Jr.; Completion Date: August 1996

139. Habitat Assessment in a Landscape Context: Analysis of The Factors Affecting The Distribution & Abundance of Florida Scrub Lizard (RWO156) PI: L.C. Branch; Personnel: D.G. Hokit, Completion Date: April 1996

140. Estimation & Environmental Correlates of Survival & Dispersal of Snail Kites in Florida. PI: W.M. Kitchens; Personnel: P.C. Darby; Completion Date: February 1996

141. Egg Viability & Population Trends of Lake Apopka Alligators: Relation Ships Among Populations & Biographical Parameters. PI: H.F. Percival; Personnel: K.G. Rice; Completed: July 1996

142. Evaluation of S.R.46 Wildlife Crossing. PI: H.F. Percival; Personnel: J.C. Roof, J.B. Wooding; Completion Date: May 1996

143. An Ecosystem Approach To Public Education & Information at Eglin Air Force Base (RWO107) PI: S.K. Jacobson; Personnel: S.B. Marynowski; Completion Date: September 1997

144. Genetic Analysis of Sea Turtle Populations in The Western Atlantic Ocean With Emphasis on The Southeast United States (RWO115) PI: B.W. Bowen, A.B. Bolten; Completion Date: June 1997

145. Cape San Blas Ecological Study (RWO126) PI: W.M. Kitchens, H.F. Percival, R.R. Carthy; Completion Date: August 1997

146. Enhancement & Evaluation of a Designated Watchable Wildlife Site (RWO130) PI: J.M. Schaefer, S.K. Jacobson; Completion Date: January 1997

147. Research Objectives to Support The S. Florida Ecosystem Initiative-Water Conservation Areas, Lake Okeechobee & The East-West Waterways (RWO139) PI: W.M. Kitchens; Completed: September 1997

148. Trends, Status and Aspects of Demography of The Red=Cockaded Woodpecker in the Sandhills of Florida's Panhandle, PartII (RWO146) PI: H.F. Percival, J.L. Hardesty; Personnel: K.E. Gault, L.F. Phillips; Completion Date: March 1997

149. Use of Unionid Mussels as Bioindicators of Water Quality in Escambia Conecuh River System (RWO149) PI: E.Philps; Personnel: A. Keller; Completion Date: June 1997

150. Captive Propagation & Experimental Reintroduction of Florid's Schaus Swallowtail (RWO151) PI: T.C. Emmel; Personnel: J.P. Hall, K.M. Wilmott, J.C. Daniels; Completed: December 1997

151. Testing & Implementation of Selected Aquatic ecosystem Indicators in The Mississippi River System, 1995: Potential Effects of Endocrine Disrupting Contaminants (RWO153) PI: T.S. Gross; Completion Date: September 1997

152. Wading Bird Population Monitoring, Environmental Correlates of Adult Foraging Success & Measurement of Nesting Energetic Needs in The Everglades: Part I (RWO158) PI: P.C. Frederick; Personnel: J.Surkick, J.Salantas; Completion Date: April 1997

153. Marine Turtle Conservation on The Caribbean Coast of Nicaragua (RWO171) PI: L.J. Guillette, Jr.; Personnel: C.L. Campbell; Completed: December 1997

154. Evaluating The Ecological Role of Alligator Holes In The Everglades Landscapes. PI: E.J. Mazzotti, H.F. Percival; Personnel: L.A. Brandt; Completion Date: December 1997

155. Two GIS & Land Use Analysis of Freshwater Mussels in The Apalachicola River Drainage (RWO164) PI: J. Mossa; Personnel: J. Howard; Completion Date: July 1997

156. Egg Viability & Population Trends of Lake Apopka Alligators. PI: H.F. Percival; Personnel: K.G. Rice; Completion Date: July 1997

157. Effect of Marine Pollution on Juvenile Pelagic Sea Turtles (RWO66) and Biology of and the Effects of Marine Debris (RWO118) PI: K.A. Bjorndal; A.B. Bolten; Completed: June 1998

158. Enhancement of Natural Dune building & Re-vegetation Processes on Santa Rosa Island (RWO159) PI: D.L. Miller, Mack Thetford; Completion Date: August 1998

159. Pathogenic, Molecular, and Immunological Properties of Herpersvirus Associated with Green Turtle Fibropapillomatossis: Phase I Virus Isolation & Transmission (RWO161) PI: P.A. Klein; Completion Date: June 1998

160. Migrations & Habitat Use of Sea Turtles in The Bahamas (RWO166). PI: K.A. Bjornal, A.A. Bolten: Completion Date: September 1998

161. Population Genetic Structure of Marine Turtles In The Southeastern United States and Adjacent Caribbean Region (RWO167) PI: B.W. Bowen, A.L. Bass; Completed: June 1998

162. Distribution and Abundance of Sensitive Wildlife at Avon Park Air Force Base Range (RWO169) PI: R. Franz; Completed: December 1998

163. Red-Cockaded Woodpecker Cavities & Snags in Longleaf Pine Forest: Cavity Nester Use & Nesting Success (RWO170) PI: K.E. Sieving; Completion Date: September 1998

164. Plant & Invertebrate Community Responses to Restoration Techniques In Degraded Florida Sandhills: YR3 Post-Treatment (RWO174) PI: G.W. Tanner, D.R. Gordon; Completed: July 1998

165. Demographics, Genetic Relationships & Impacts From Rd Imported Fire Ants on The Florida Grasshopper Sparrow (RWO175A) PI: H.F. Percival; Completion Date: March 1998

166. Red Imported Fire Ants on The Endangered Florida Grasshopper Sparrow (RWO175B) PI: H.F. Percival, Completion Date: June 1998

167. Wading Bird Population Monitoring, Environmental, Correlates of Adult Foraging Success & Measurements of Nestling Energetic Needs in The Everglades Phase II (RWO176) PI: P.C. Frederick; Completion Date: April 1998

168. Population characterization of Kemp's Ridley Sea Turtles in The Big Bend Area, Gulf of Mexico, Florida Monitor, Assess, and Predict Status of Impacts to Protected Species & Their Ecosystems (RWO177) PI: R.R. Carthy; Completion Date: September 1998

169. Breeding & Reintroduction of The Endangered Schaus Swallowtail (RWO179) PI: T.C. Emmel; Completion Date: July 1998

170. Estimating Survival & Movements in Snail Kite Population (RWO183) PI: W.M. Kitchens, R.E. Bennetts; Completion Date: July 1998

171. Tree Island Biological Inventory: Landscape Level Assess and Determination of Island Aream Shape & Vegetation Zones (RWO184) PI: W.M. Kitchens, L.A. Brandt; Completion Date: September 1998

172. Biological Diversity in Florida: And Evaluation of Potential Species in Relation to Habitat and Existing Reserves (RWO 98) PI: W.M. Kitchens, L.G. Pearlstine, S.E. Smith, J.L. Hardy; Completion Date: September 1998

173. Improving Survey Methods and Assessing Impoundment Effects on Waterfowl Ecology at the Merritt Island National Wildlife Refuge (RWO 186) PI: R.R. Carthy; Completion Date: June 1999

174. Effects of Prescribed Fire on Soil Nutrients, Forage Quality and Plant Community Composition and on Breeding Bird Communities on the Florida Panther NWR (RWO 168) PI: M.B. Main; Completion Date: July 1999

175. Florida Gap Analysis (RWO 187) PI: L.G. Pearlstine, S.E. Smith; Completion Date: December 1999

176. Modeling and Simulation Support for ATLSS (RWO 154a) PI: P.A. Fishwick; Completion Date: December 1999

177. The Effect of Everglades Food Items (Prey) on Crocodilian Growth Development and Fertility (RWO 154b) PI: P.T. Cardielhac; Completion Date: December 1999

178. American Alligator Distribution, Thermoregulation and Biotic Potential Relative to Hydroperiod in the Everglades National Park (RWO 154c) PI: H.F. Percival, K.G. Rice; Completion Date: December 1999

179. Nesting, Growth and Survival of American Crocodiles in Northeastern Florida Bay, Everglades National Park- Phase I (RWO 178) PI: F.J. Mazzotti, L.A. Brandt; Completion Date: April 2000

180. Creation of Upland Cover Map of Florida PI: L.G. Pearlstine, W.M. Kitchens; Completion Date: August 1999

181. Orientation of Digital Aerial Images and Protocol Development PI: L.G. Pearlstine, S.E. Smith; Completion Date: April 1999

182. Produce a Manual of Sea Turtle Research and Conversation Techniques PI: K.A. Bjorndal, A.B. Bolten; Completion Date: July 1999

183. Wildlife Refuge Waterfowl Survey Database (RWO 202) PI: R.R. Carthy, E. McMichael, R. Subramaniya; Completion Date: December 2000

184. Movements, Spatial Use Patterns and Habitat Utilization of Radio-Tagged West Indian Manatees (*Trichechus Manatus*) Along the Atlantic Coast of Florida and Georgia (RWO 163) PI: H.F. Percival, B.J. Deutsch, L.W. Lefebvre; Completion Date: July 2000

185. Pathogenic, Molecular and Immunological Properties of a Virus Associated with Sea Turtle Fibropapillomatosis, Phase II: Viral Pathogenesis and Development of Diagnostic Assays (RWO 180) PI: P.A. Klein, E.R. Jacobson, D.R. Brown, S.S. Coberly, D. Bagley; Completion Date: June 2000

186. Dry Down Tolerance of Florida Apple Snail (*Pomacea Paludosa*): Effects of Age and Season (RWO 182) PI: H.F. Percival, P.C. Darby, Z.C. Welch; Completion Date: August 2000

187. Effects of Coastal Erosion on Nesting sea Turtles Along the Florida Panhandle (RWO 185) PI: R.R. Carthy, M.M. Lamont; Completion Date: May 2000

188. A Comparison Between the Population of the Potential Tumor-Promoting Dinoflagellate, Prorocentrum SPP and the Incidence of Fibropapillomatosis in Green Turtles (*Chelonia Mydas*)

in Florida and Hawaii PI: R.R. Carthy, Y.C. Anderson; Completion Date: December 1999

189. Incubation Temperatures and Sex Ratios of Loggerhead Sea Turtles (*Caretta Caretta*) Hatched on Northwest Florida Beaches (RWO 197a) PI: R.R. Carthy, M.L. Maglothin; Completion Date: Aug. 2000

190. Biology of Nesting Sea Turtles Along the Florida Panhandle (RWO 197b) PI: R.R. Carthy, M.M. Lamont; Completion Date: August 2000

191. A Comparison Between Hawaii and Florida: The Potential Link Between the Tumor-Promoting Dinoflagellate, Prorocentrum SPP and the Prevalence of Fibropapillomatosis in Green Turtles (RWO 210) PI: R.R. Carthy, Y.C. Anderson; Completion Date: December 2000

192. Feeding Ecology and Habitat Affinities of Kemp's Ridley Sea Turtles in the Big Bend, Florida (RWO 189) PI: R.R. Carthy, J.S. Staiger; Completion Date: August 2001

193. Time Lapse Landscape Ecology: Merritt Island National Wildlife Refuge (MINWR) (RWO 189) PI: R.R. Carthy, J.B. Wooding, W.J. Barichivich; Completion Date: December 2001

194. Application of the Species at Risk Conservation for the Florida Army National Guard at Camp Blanding Training Site, Clay County, Florida (RWO 201) PI: R.R. Carthy, C.J. Gregory, A.J. Gruschke, L.G. Pearlstine; Completion Date: August 2001

195. Hydrological Characterization of the White River Basin (RWO 203) PI: W.M. Kitchens; Personnel: M.A. Craig, M.R. Wise; Completion Date: September 2000

196. A Multimodel Implementation Supporting ATLSS: Across Trophic Level System Simulation (RWO 204) PI: P.A. Fishwick; Personnel: R.M. Cubert, L.K. Dance; Completion Date: December 2001

197. Relations of Environmental Contaminants, Algal Toxins and Diet with the Reproductive Success of American Alligators on Florida Lakes (RWO 193) PI: H.F. Percival, T.S. Gross; Personnel: B. Bradford; Completion Date: August 2001

198. Further Strategies for Evaluating the Etiological Role of a Tumor-Associated Herpesvirus in Marine Turtle Fibropapillomatosis (RWO 194) PI: E.R. Jacobson, P.A. Klein; Personnel: D.A. Bagley, S.S. Coberly, R. Hirschman; Completion Date: September 2001

199. Evaluation of Desert Tortoises in and Around Fort Irwin for Exposure to a Tortoise Herpesvirus (RWO 196) PI: E.R. Jacobson, P.A. Klein; Personnel: F.C. Origgi, S. Tucker; Completion Date: April 2001

200. Response of Nesting Seat Turtles and Foraging Shorebirds to Barrier Island Dynamics (RWO 206) PI: P.C. Frederick; Personnel: J.D. Semones, R.A. Hylton, G.A. Babbitt, J.A. Heath; Completion Date: April 2002

201. Ecological Inventory of Moody Air Force Base and Surrounding Properties (Z 038) PI: W.M. Kitchens; Personnel: C.J. Gregory, M.M. Lamont; Completion Date: March 2003

202. Ecological Inventory of Moody Air Force Base and Surrounding Properties (Z 039) PI: R.R. Carthy; Personnel: C.J. Gregory; Completion Date: March 2003

203. Large Scale Habitat Monitoring for Migratory Birds: Digital Video Mosaics in Multi-Level Images (RWO 215) PI: B.D. Dewitt, L.G. Pearlstine; Personnel: G. Trull, S.R. Gonzales, G.P. Jones, IV; Completion Date: August 2003

204. Inventory and Monitoring of the Amphibians of Everglades National Park, Big Cypress National Preserve and Virgin Islands National Park (RWO 208) PI: H.F. Percival, K.G. Rice,

R.R. Carthy, J.D. Nichols; Personnel: C.D. Bugbee, M.E. Crockett, A.D. Dove, B. Jeffrey, A.J. Maskell, J.H. Waddle; Completion Date: December 2003

205. American Alligator Distribution, Thermoregulation and Biotic Potential Relative to Hydroperiod in the Everglades (RWO 199) PI: H.F. Percival, K.G. Rice; Personnel: M.D. Chopp, A.G. Finger, P. George, B. Jeffrey, M.T. Tuten; Completion Date: December 2003

206. Sereopidemiological Studies of Herpesvirus-Associated Diseases of Marine Turtles: Fibropapillomatosis and Lung-Eye-Trachea Disease (RWO 213) PI: R.R. Carthy, P.A. Klein, E.R. Jacobson; Personnel: D.A. Bagley, S.S. Coberly (Curry), R. Hirschman; Completion Date: December 2003

207. An Estimate of Population Age Structure for Gulf of Mexico Sturgeon, Acipenser O. Desotoi, on the Yellow River (RWO 214) PI: M.S. Allen; Personnel: J. Berg; Completion Date: December 2003

208. Contaminant Screening to Investigate Wildlife Mortality on Lakes in Central Florida (RWO 196) PI: H.F. Percival, J.P. Ross; Personnel: Y. Temsiripong; Completion Date: April 2003

209. Hibernation vs Migration Overwintering Strategies of Juvenile Sea Turtles in the Florida Panhandle (UF Project #00037385) PI: R.R. Carthy, E. McMichael; Personnel: R. Scarpino; Completion Date: August 2004

210. Estimation of Critical Demographic Parameters of the Florida Snail Kite During and After Drought Conditions (RWO 216) PI: W.M. Kitchens; Personnel: J. Martin, C. Cattau, C. Rich, D. Piotrowicz; Completion Date: December 2004

211. Demographic Movement and Habitat Studies of the Endangered Snail Kite in Response to Hydrological Changes (RWO 207) PI: W.M Kitchens; Personnel: J. Martin, C. Cattau, A. Bowling, D. Huser, M. Conners; Completion Date: March 2005

212. Monitoring of Wading Birds Nesting Activity in WCAS I, II and II of the Everglades and Study of Wood Stork Survival and Movements (RWO 218) PI: P.C. Frederick; Personnel: R. Hylton, J.D. Sermones, M. Bokach, J. Heath, J. Simon, K. Williams; Completion Date: March 2005

213. Evaluation of Sea Turtle Hatchling Disorientation and Assessment of Techniques for Minimizing Lighting Impacts at Tyndall AFB, Bay County Florida (RWO 217) PI: R.R. Carthy; Personnel: R. Scarpino; Completion Date: March 2005

214. Partnership in Case Studies for Training and Outreach (UF Project #00050944) PI: H.F. Percival, M. Monroe; Personnel: K. Bender; Completion Date: August 2005

215. Continued Vegetation Monitoring of the Savannah River Tidally Influenced Marshes PI: W.M. Kitchens; Personnel: K. Lindgren, Z. Welch; Completion Date: December 2005

216. Geomorphic Assessment of Channel Changes along a Modified Floodplain Pascagoula Basin, Mississippi PI: J. Mossa; Personnel: D. Coley, J. Rasmussen, R. Godfrey, A. Villegas; Completion Date: December 2005

217. Geomorphic Assessment of Channel Changes along a Modified Floodplain Pascagoula Basin, Mississippi PI: J. Mossa; Personnel: J. Williams; Completion Date: June 2006

218. Factors Affecting Population Density and Harvest of Northern Bobwhite (*Colinus Virginianus*) in Babcock/ Webb Wildlife Management Area, Charlotte County, Florida PI: H.F. Percival, R. Dimmick, M. Oli; Personnel: S. Dimmick, S. Brinkley, J. Hostetler, G. Coker, A. Brinkley, C. Jones; Completion Date: June 2006

219. Cost and Accuracy of Analysis of Gopher Tortoise Population Estimation Techniques PI: R.R.

Carthy, M. Oli; Personnel: E. Langan, J. Wooding, S. Nomani, E. Cantwell, K. Miller, M. Voight; Completion Date: July 2006

220. Surveys of Snail Kite Breeding and Habitat Use in the Upper St. John's River Basin PI: W.M. Kitchens; Personnel: J. Martin, C. Cattau, A. Bowling, S. Stocco, B. Reichert; Completion Date: February 2006

221. Qualitative Analysis Supporting Reptile and Amphibian Research in Florida's Everglades PI: H.F. Percival, F. Mazzotti; Personnel: M. Miller; Completion Date: August 2006

222. Sea Turtle Habitat Use and Interactions with Humans in the Coastal Zone PI: R.R. Carthy; Personnel: R. Scarpino; Completion Date: August 2006

223. Southeastern Adaptive Management Group (SEAMG) PI: H.F. Percival, R. Dorazio, F. Johnson; Completion Date: June 2006

224. Development of Unmanned Aerial Vehicles for Assessment Wildlife Populations and Habitats Phase 2 PI: H.F. Percival, B. Dewitt, P. Ifju, L. Pearlstine; Personnel: J. Duberstein, D. Grant; Completion Date: December 2006

225. Toho V-A Proposal to Document Floral and Faunal Succession Following Alternative Habitat in a Large Central Florida Lake PI: W.M. Kitchens; Personnel: J. Brush, M. Desa, C. Enloe, J. Reyes; Completion Date: June 2006

226. Population Structure of a Loggerhead Turtle (*Caretta Caretta*) Nesting Colony in Northwestern Florida as Determined Through Mitochondrial DNA Analysis PI: R.R. Carthy; Personnel: R. Scarpino; Completion Date: April 2006

227. Conservation, Ecology and Propagation of Florida *Orchidacea Eulophia Alta* (*Linnaeus*) FA WCWRR and RENDLE PI: M. Kane; Completion Date: December 2006

228. Rapid Delineation of Provenance for Florida Sea Oats Used for Beach and Dune Stabilization PI: M. Kane; Personnel: N. Philman, P. Sleszynksi, S. Stewart, D. Dutra; Completion Date: September 2006

229. Radio Telemetry and Mark Recapture Studies of Demographic, Movement and Population Dynamics of Endangered Snail Kites (RWO 221) PI: W.M. Kitchens; Completion Date: March 2006

230. Wading Bird Colony Local, Sizing, Timing, & Wood Stork Nesting Success Cost & Accuracy PI: P. Frederick; Completion Date: October 2006

231. Development of Unmanned Aerial Vehicles for Assessment of Wildlife Population and Habitat Phase 2 PI: H.F. Percival; Personnel: A. Watts, S. Bowman; Completion Date: December 2006

232. Assessing Belowground Consequences of Forest Dieback and Climate Change in Coastal Cypress Swamps PI: H.F. Percival; Completion Date: July 2006

233. Vegetative Habitat Responses to Hydrological Regimes in Everglades Water Conservation Area 3A PI: W.M. Kitchens; Personnel: C. Zweig, E. Powers, T. Hotaling, S. Fitz-William; Completion Date: September 2006

234. Gopher Tortoise Population Estimation Techniques PI: R.R. Carthy; Personnel: E. Langan, J. Wooding, S. Nomani; Completion Date: May 2006

235. Floral and Faunal Succession Following Alternative Habitat Restoration Techniques in a Large Central Florida Lake (PJ50773) PI: W.M. Kitchens; Personnel: Melissa Desa, C. Enloe, B. Shoger,

A. Schwarzer; Completed: June 2007

236. American Alligator Distribution, size, and Hole Occupancy and American Crocodile Juvenile Growth and Survival (RWO225) PI: H.F. Percival, Frank Mazzotti; Personnel: M Cherkiss; Completion Date: April 2007

237 Radio Telemetry & Mark Recapture studies of Demography, Movement & Population Dynamics of The Endangered Snail Kite (53729) PI: W.M. Kitchens; Personnel: C.Cattau, A.Bowling: Completed December 2006

238. Continued Snail Kite Monitoring Studies: Population Growth, Extinction, and Movement Patterns. (RWO231) PI: W.M. Kitchens; Completion Date: November 2007

239. Status, Ecology, Propagation Science & Recovery of Imperiled FL Orchidaceous: Habenaria Distans. PI: M. Kane: Completed Date: November 2007

240. Update Marsh Succession Model & Provide Technical Assistance Savannah Harbor Expansion (60411) PI: W.M. Kitchens; Completion Date: April 2006

241. St. George Island Lighting Project. PI: R.R. Carthy; Completion Date: July 2006.

242. Vegetation Habitat Responses to Hydrologic Regimes In Everglades Water Conservation Area 3A PI: W.M. Kitchens, C. Zweig; Personnel: T. Hotaling, P. Wetzel, S. Fitz-Williams Completion Date: March 2008 (53972)

243. American Alligator Distribution, Size, and Hole Occupancy & American Crocodile Juvenile Growth and Survival. PI: H.F. Percival, F.J. Mazzotti; Completion Date: June 2007 (50174)

244. Conservation, Ecology & Propagation of Florida Orchidaceae-Eulophia alta and Cyrtopodium punctatum. PI: M. Kane; Personnel: T. Johnson, D. Dutra Completed: December 2007

2009 Publications:

Zweig, C. and W.M. Kitchens. 2009. Multi-state succession in wetlands: A novel use of state and transition models. Ecology. 90:1900-1909.

Zweig, C.L. and W.M. Kitchens. 2009. Defining the present before restoring the past: Everglades vegetation communities. Society of Wetland Scientists Online Brief Series. http://www.sws.org/researchbrief.

Martin, Julien, Wiley M. Kitchens, Madan K. Oli, Christopher E. Cattau. 2008. Exploring the importance of natural disturbances and habitat degradation on Snail Kite population dynamics. Endangered Species Research. 6: 25-39.

Zweig, C. and W.M. Kitchens. 2008. Effects of landscape gradients on wetland vegetation communities: Information for large-scale restoration. Wetlands. 28(4) 1086–1096.

Haas, Sara, Rebecca Kimball, Julien Martin, and Wiley Kitchens. 2008. Genetic divergence among Snail Kite subspecies: implications for the conservation of the endangered Florida Snail Kite. Ibis (Published on-line): Aug 11 2008 DOI: 10.1111/j.1474-919X.2008.00872.x

Hotaling Althea S., Julien Martin, W. M. Kitchens. 2009. Estimating Transition Probabilities among Everglades Wetland Communities using Multistate Models. Wetlands. In Press.

Zweig, C.L. and W.M. Kitchens. 2009. The Semiglades: the collision of restoration, social values, and the ecosystem concept. Restoration Ecology. In press

Cattau, Christopher E., Julien Martin, Wiley M. Kitchens. 2009. Effects of an exotic prey species on a native specialist: example of the Snail Kite. Biological Conservation. Provisionally accepted.

Loftin, C. S., T. J. McCloskey, W. M. Kitchens, and M. L. Dusek. Accepted. Changes in vegetation distribution in the lower Savannah River tidal marsh following removal of a tidal flap gate. Wetlands.

Miller, S. J., R. E. Bennetts, and W. M. Kitchens. Accepted. A simple technique for a standardized measure of local and regional drought. Wetlands.

McMichael, E., J. A. Seminoff and R. R. Carthy. Growth rates of wild green turtles, Chelonia mydas, at a temperate foraging habitat in the northern Gulf of Mexico: assessing short-term affects of cold stunning on growth. Journal of Natural History. (in press)

Waddle, A.R, J.M Kinsella, J.P. Ross, E. Rojas-Flores, H.F. Percival, D.J Forrester. 2009. Nematodes collected by gastric lavage from live American alligators, alligator mississippiensis, in Florida. Journal of Parasitology, 95(5) pp. 000-000. In Press

2009 Presentations:

Kitchens, W. and Z. Welch. Restoring Pattern without Process in Lake Restoration. September 2009. PhD Exit Seminar, Interdisciplinary Ecology, School of Natural Resources, Univ of Florida. (Invited Presentation)

Kitchens, W. and Z. Welch. Restoring Pattern without Process in Lake Restoration. August 2009. Ecological Society of America Annual Conference. Albuquerque NM. (Invited Presentation)

Kitchens, W. and Z. Welch. Effects of Habitat Enhancement Project on Lake Tohopekaliga. April 2009. Project Summary Report to FFWCC Management. Eustis, FL. (Invited Presentation)

Layton, J.E., T. Wibbels, A. Tucker, J. Wyneken, L. Ehrhart, R. Carthy, R.E. Martin, R. Ernest, M. Bresette, C. Johnson, S. Fournier, J. Schmid, B. Drye, K. Watson, and A. Bryant. 2009. Long-term evaluation of loggerhead sea turtle nesting beach temperatures in the southeastern United States: implications of global climate change on sea turtle conservation. Poster presentation at the 28th Annual International Symposium on Sea Turtle Biology and Conservation, Brisbane, Australia. (Invited Presentation)

McMichael, E., J. Seminoff, R. Carthy, and R. Scarpino. 2009. Kemp's ridley sea turtles in St. Joseph Bay, Florida, USA: results from an in-water study in the northeastern Gulf of Mexico. Poster presentation at the 28th Annual International Symposium on Sea Turtle Biology and Conservation, Brisbane, Australia. (Invited Poster)

Mota, M.J. and R.R. Carthy, 2009. The role of external calcium carbonate in Loggerhead turtle nest incubation. Oral presentation at the 28th Annual International Symposium on Sea Turtle Biology and Conservation, Brisbane, Australia. (Invited Presentation)

Senko, J., V. Koch, W. Megill, R. Carthy, R. Templeton, and W.J. Nichols. 2009, Fine-scale movement and activity patterns of the East Pacific green turtles at a coastal foraging area in Baja California Sur, Mexico. Poster presentation at the 28th Annual International Symposium on Sea Turtle Biology and Conservation, Brisbane, Australia. (Invited Poster)

Garland, K., R. Carthy, C. Wood, L. Gravelee, C. Campell, S. Jacobson, and P. Ross. 2009. Cultural antrhopology of taste in Pearl Lagoon: social and economic factors driving green turtle consumption in Caribbean Nicaragua. Poster presentation at the 28th Annual International Symposium on Sea Turtle Biology and Conservation, Brisbane, Australia. (Invited Poster)

Burgess, M.A., H.F. Percival, A.C. Watts, P.G. Ifju, K. Lee, J.A. Childs, B. Evers, T.J. Rambo, S.E. Smith, A. Mohamed, B.A. Dewitt, J.H. Perry, Z. Szantoi, P.C. Frederick, J.C. Simon, L.E. Taylor, and J.S. Lane. Use of a

small unmanned aircraft system for ecological research and habitat assessment. Poster presentation. AUVSI Unmanned Systems North America 2009, Washington D.C. August 2009. (Invited Poster)

Burgess, M.A., H.F. Percival, A.C. Watts, P.G. Ifju, K. Lee, J.A. Childs, B. Evers, T.J. Rambo, S.E. Smith, A. Mohamed, B.A. Dewitt, J.H. Perry, Z. Szantoi, P.C. Frederick, J.C. Simon, L.E. Taylor, and J.S. Lane. A small unmanned aircraft system for ecological research. Poster presentation. 3rd National Conference on Ecosystem Restoration, Los Angeles, California. July 2009. (Invited Poster)

Lamont, M.M. and R.R. Carthy. 2009. Beach nourishment monitoring for seat turtle conservation: Coastal engineers and wildlife biologists partner for success. Poster presentation at the 3rd National Conference on Ecosystem Restoration, Los Angeles, California. July 2009. (Invited Poster)

2009 Technical Reports:

Shoger, Brad, Adam Betuel, and Wiley M. Kitchens. 2009. Wildlife Usage and Habitat Development on Spoil Islands in Lake Tohopekaliga, FL. Final Report. U.S. Geological Survey, Florida Cooperative Fish and Wildlife Research Unit, University of Florida, Gainesville, FL.

Brush, Janell, Melissa DeSa, Zach Welch, Carolyn Enloe, and Wiley Kitchens. 2009. Monitoring Floral and Faunal Succession Following Lake Enhancement in the Littoral Reaches of Lake Tohopekaliga. Final Report. Florida Cooperative Fish and Wildlife Research Unit.