Florida Cooperative Fish and Wildlife Research Unit

Annual Report
January – December 2010

2010 Annual Report Dedicated to Dr. Micheal S. Allen

We dedicate this Annual Report to Dr. Mike Allen a teacher, scholar, fisherman, and friend to the Florida Unit. Dr. Allen arrived at the University of Florida in 1997 after completing his PhD in the Mississippi Cooperative Fish and Wildlife Research Unit. In spite of, or because of, this previous experience with the Units program, shortly after his arrival Mike began what has evolved into an extremely productive relationship with all aspects of the Florida Unit.

Even though the Florida Unit does not have an official fisheries person, fisheries are important to the Florida Cooperative Fish and Wildlife Unit. Mike has been key in helping meet this need. He is quick to help any student, with any need, serving on numerous graduate committees and always offering advice and encouragement. Mike's research program focuses primarily on management of sportfish in Florida's lakes. Mike works closely with FWC to help evaluate how fish populations respond to management actions such as harvest policies and habitat manipulations. Mike's work in Lake Okeechobee and the Kissimmee chain of lakes is highly complementary to Wiley's ongoing work with snail kites in these same systems. Jointly, Mike and Wiley are able to help highlight the challenges and management tradeoffs faced by FWC, USFWS, ACOE, and other partners in developing effective lake management policies in these complicated ecosystems. These research collaborations have recently grown to include cooperative projects on climate change and hydrilla management.

While at UF Mike has advised more than 20 graduate students and co-authored more than 70 peer reviewed journal articles. Mike also teaches all or parts of several courses including Field Ecology, Ecological Statistics and Design, and Fisheries Population Dynamics. Mike also regularly teaches workshops on statistical methods for agency biologists and other interested participants. For these and other efforts, Mike was recognized with the 2010 Award of Excellence from the Fish Management Section of the American Fisheries Society.

Mike's outside interests also match well with the Florida Unit. As a Texas native his barbeque taste originally leaned toward brisket but now include both food groups. As an avid angler, Mike also routinely tests lakes and coastlines across the southeast as a courtesy to regulatory agencies to evaluate their management policies. At least, that is what he reports to be doing…. We thank Mike Allen for his contributions to managing aquatic resources in Florida and to the research and education missions of the Florida Unit. Well done!

Written by Bill Pine

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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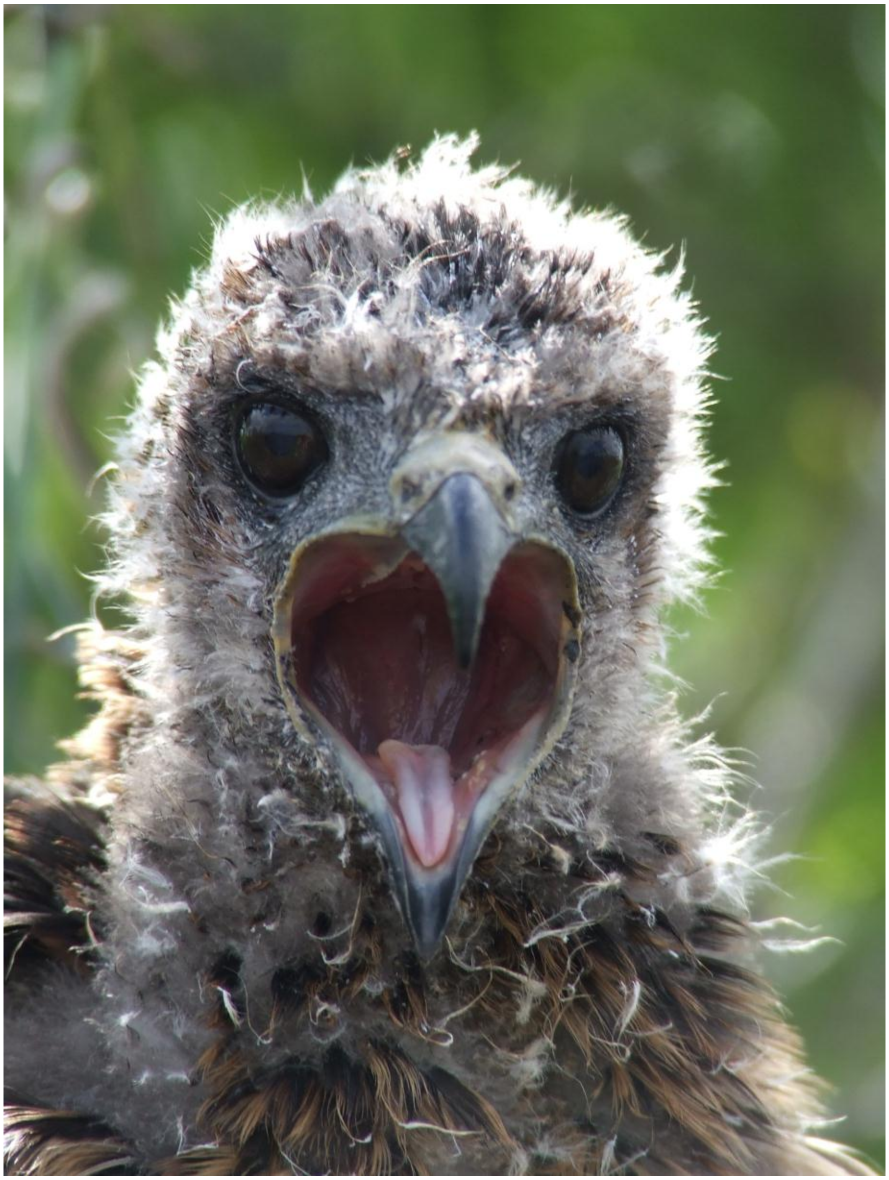
FLORIDA COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT INTRODUCTION

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



2009 Photo Contest Winner, Kyle E. Pias, FL CRU – Nestling snail kite taken at a nest in Everglades National Park.

"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

Jack Payne - 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 aerial 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 – Associate Unit Leader, Ecologist, Courtesy Professor, Department of Wildlife Ecology and Conservation and College of Natural Resources and the Environment at the University of Florida. 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 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, Southeastern Ecological Science Center, U.S. Geological Survey. His principal interest is in the application of decision science to problems in natural resource management. Such applications require a multi-disciplinary approach to engage stakeholders in the decision-making process, to predict the responses of ecological systems to controlled and uncontrolled drivers, to elicit societal values regarding the consequences of management policy, and to develop monitoring programs to compare predicted and realized system behaviors. He is particularly active in migratory bird management, with experience in problems of recreational and subsistence harvest, pest control, and habitat management. His scientific expertise is mostly in the areas of population ecology, statistical inference, dynamic systems modeling, and optimal decision making.

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

M. Gay Hale, 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.

Janet Fay– Student Assistant, Florida Cooperative Fish and Wildlife Research Unit. She is primarily responsible for visa card processes within the University financial system, and the tracking and recording of spent funds on all grants and state funds. She also maintains the database and helps with general office procedures.

Alexis Martin – Student Assistant, Florida Cooperative Fish and Wildlife Research Unit. She is primarily responsible for maintaining federal and state vehicle logs while maintaining DOI "Vroom" database for Florida Coop-Unit. Also works on manuscript processing, copying, filing, organizing of publications and data entry.

Amanda Burnett – Student Assistant, Florida Cooperative Fish and Wildlife Research Unit. She is primarily responsible for office management and for purchase order requests. She manages property and invoices. She left the unit in late 2010 to go to graduate school in Environmental Education at the School of Forest Resources and Conservation.

COOPERATORS

University of Florida:

A-mr Abd-Elraham
Michael S. Allen
Karen A. Bjorndal
Alan B. Bolten
Mary Christman
Mark Clark
Matthew J. Cohen
Robert M. Cubert
Bon A. Dewitt
Nancy Denslow
Robert Fletcher
Peter C. Frederick
Bill Guiliano
Aaron Higer
Jeff Hostetler
Mark Hostetler
Peter G. Ifju
Elliott R. Jacobson
Steven Johnson
Michael Kane
Paul A. Klein
Leda Kobziar
Ramon Littel
Frank Mazzotti
Ahmed Mohamed
Madan Oli
Todd Osborne
William (Bill) Pine
Carrie Reinhart-Adams
Carlos H. Romero
J. Perran Ross
Scot E. Smith
Marilyn G. Spalding
Linda Young

Florida Fish and Wildlife Conservation Commission:

Joe Benedict
Joan Berish
Tim Breault
Arnold Brunell
Janell Brush
Larry Campbell
Dwayne A. Carbonneau
Cameron Carter
Patrick Delaney
Harry J. Dutton
Jim Estes
Rebeca Hayman
Ron Hight
Linsay Hord
Richard Kiltie
Paul Kubilis
Julien Martin
Henry Norris
Tim O'Meara
Stephen W. Rockwood
Scott Sanders
Lawson Snyder
Rio Throm
Zach Welch
Nick Wiley
Blair Witherington
Allan R. Woodward

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
Jeff Keay
William L. Kendall
Catherine Langtimm
Lynn W. Lefebvre
Cynthia S. Loftin
Elizabeth Martin
Kelly McDonald
Clinton Moore
James D. Nichols
Kenneth G. Rice
Michael Runge
John Sauer
J. Michael Scott
Daniel Slone
James Williams
Pamela Telis
Kenneth Williams

U.S. Fish and Wildlife Service:

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

U.S. Army Corps of Engineers

Kristin A. Farmer
Michael T. Hensch
John K.Kilpatrick
Jon S. Lane
Jon M. Morton
Gina Ralph
Glenn G. Rhett
David J. Robar
Adam N. Tarplee
Larry Taylor
Robert M. Wallace
Damon A. Wolfe
William C. Zattau

St. Johns Water Management District:

Roxanne Conrow
James Peterson
Steven Miller
Mike Coveney

U.S. Parks Service

Leonard Pearlstine
Bob Miller

U.S. Air Force

Bruce Hagedorn

Wofford College

Clarence L. Abercrombie

Idaho Fish and Game

Pete Zager

University of Central Florida

Llewellyn M. Ehrhart
Dean Bagley

University of West Florida

Phillip C. Darby

Innovative Health Applications LLC

Eric D. Stolen
David Breininger

Environmental Project:

Ritchie H. Moretti
Sue A. Schaf

Others:

Tommy C. Hines
Lovett E. Williams
Howard K. Suzuki

RESEARCH PERSONNEL

Ikuko Fujisaki, PhD
Position: Statistician
Research: Analyzes data for the American Alligator monitoring and assessment program (MAP), IFAS, Fort Lauderdale Research and Education Center

Margaret Lamont, PhD
Position: Post Doctoral Associate
Research: Examining how coastal species, such as sea turtles and shorebirds, are affected by natural and anthropogenic dynamics of barrier island systems and oil spill effects on sea turtles.

Virginia Rolland, PhD
Position: Post Doctoral Associate
Research: Adaptive Strategy for managing bobwhites on the Babcock-Webb Wildlife Management Area

Christa Zweig, PhD
Position: Post Doctoral Associate
Research: Climate change research in coastal wetlands in the Big Bend area of Florida and snail kite habitat changes and how they affect population.

Matthew Burgess, MS
Position: Wildlife Ecologist/UAS Program Coordinator
Research: Unmanned Aircraft Systems research project

Jemeema Carrigan, MS
Position: 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)

Mike Cherkiss, MS
Position: Wildlife Biologist
Research: American alligator and crocodile monitoring and assessment program, (MAP). IFAS, Fort Lauderdale Research and Education Center

Melissa Ann DeSa, MS
Position: Project Coordinator
Research: Climate change in the northern Gulf of Mexico: impacts on coastal plant and small mammal communities

Wellington Guzman, MS
Position: Wildlife Biologist
Research: American alligator monitoring and assessment program (MAP), IFAS, Fort Lauderdale Research and Education Center

Brian Jeffrey, MS
Position: Wildlife Biologist
Research: American alligator and crocodile monitoring and assessment program, (MAP). IFAS, Fort Lauderdale Research and Education Center

Patrick McElhone, MS
Position: Wildlife Biologist
Research:

Matthew Walters, MS
Position: Wildlife Biologist
Research: Habitat conservation for the Florida scrub-jay and Climate Change in the northern Gulf of Mexico

GRADUATE STUDENTS

Chris E. Cattau
Degree sought: PhD, Wildlife Ecology and Conservation
Graduation Date: December 2012
Research: Demography and movement of the Snail Kite
Advisor: Wiley Kitchens

Kathryn Garland
Degree sought: PhD, Wildlife Ecology and Conservation- Human Dimensions focus
Graduation Date: May 2011
Research: Consumptive use and conservation of marine turtles in Pearl Lagoon, Nicaragua. Implications of historic taste preferences, cultural norms and local attitudes for the human dimensions of conservation.
Advisor: Ray Carthy

Jame McCray
Degree sought: PhD, Wildlife Ecology and Conservation
Graduation Date: May 2013
Research: Wildlife legislation and management in Florida: Sea turtles, a test case for creating effective policy
Advisor: Madan Oli and Ray Carthy

John H. Perry
Degree sought: PhD, Geomatics, School of Forest Resources and Conservation (NSF Fellow)
Graduation Date: May 2012
Research: Remote sensing research associated with UAS project
Advisor: Bon E. Dewitt

Brian E. Reichert
Degree sought: PhD, Wildlife Ecology and Conservation
Graduation Date: December 2010
Research: Snail kit monitoring of population demographics; exploring senescence and other aspects of survival.
Advisor: Wiley Kitchens

Zoltan Szantoi
Degree sought: PhD, Geomatics, School of Forest Resources and Conservation
Graduation Date: December 2012
Research: Pattern recognition and texture analysis of invasive plants from remote imagery.
Advisor: Scot E. Smith

Adam C. Watts
Degree sought: PhD, School of Forest Resources and Conservation
Graduation Date: December 2012
Research: Fire ecology in cypress domes in Big Cypress National Preserve
Advisor: Leda Kobziar

Danielle Watts
Degree sought: PhD, School of Natural Resources and Conservation
Graduation Date: December 2012
Research: Mechanisms of ridge slough maintenance and degradation across the greater everglades
Advisor: Matt Cohen

Benjamin E. Wilkinson
Degree sought: PhD, Geomatics, School of Forest Resources and Conservation
Graduation Date: December 2012
Research: Remote sensing from UAS platform
Advisor: Bon E. Dewitt

J. Patrick Delaney
Degree sought: M.S., School of Natural Resources and Environment
Graduation Date: December 2011
Research: Using GIS to assess nest site selection and nest abundance by American alligators
Advisor: Kenneth E. Rice and H. Franklin Percival

Lara K. Drizd
Degree sought: M.S. Wildlife Ecology and Conservation
Graduation Date: August 2011
Research: S. Florida vegetation (hydrilla) by apple snails in Lake Toho
Advisor: Wiley Kitchens

Brandon Evers
Degree sought: M.S. Aeronautical Engineering
Graduation Date: December 2011
Research: Airframe optimization of the Nova 2.1 UAS
Advisor: Peter G. Ifju

R. Blair Hayman
Degree sought: M.S., Wildlife Ecology and Conservation
Graduation Date: May 2010
Research : 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.
Advisor: Frank Mazzotti

Jean M. Olbert
Degree sought: M.S., Wildlife Ecology and Conservation
Graduation Date: December 2011
Research: Nest predation analysis of snail kites.
Advisor: Wiley Kitchens

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.
Advisor: Wiley Kitchens

Sarah Reintjes-Tolen
Degree sought: M.S., Wildlife Ecology and Conservation
Graduation Date: December 2012
Research: Chytrid fungus and amphibian populations in Florida.
Advisor: Kenneth Krysko and Ray Carthy

Thomas J. Rambo
Degree sought: M.S. Aeronautical Engineering
Graduation Date: December 2011
Research: Airframe construction techniques for the Nova 2.1 UAS
Advisor: Peter G. Ifju

Thomas W. Reed
Degree sought: M.S. Aeronautical Engineering
Graduation Date: December 2012
Research: Airframe construction techniques for the Nova 2.1 UAS.
Advisor: Peter G. Ifju

Amy C. Schwarzer
Degree sought: M.S., School of Natural Resources and Conservation
Graduation Date: May 2011
Research: Body condition and pray selection of wintering and migratory Red Knots in Florida.
Advisor: Jaime Collazo and H. Franklin Percival

Rio W. Throm
Degree sought: M.S. School of Natural Resources and Conservation
Graduation Date: December 2011
Research: Juvenile alligator movements in Lake Apopka, FL
Advisor: Kenneth G. Rice and H. Franklin Percival

Natalie Williams
Degree sought: M.S., Wildlife Ecology
Graduation Date: December 2011
Research: Juvenile alligator movements in Lake Apopka, FL
Advisor: Kenneth G. Rice and H. Franklin Percival

TECHNICIANS

Global Climate Change

Simon Fitz-Willaims	Rodney Hunt
Spencer Ingley	
Brandon Miller	

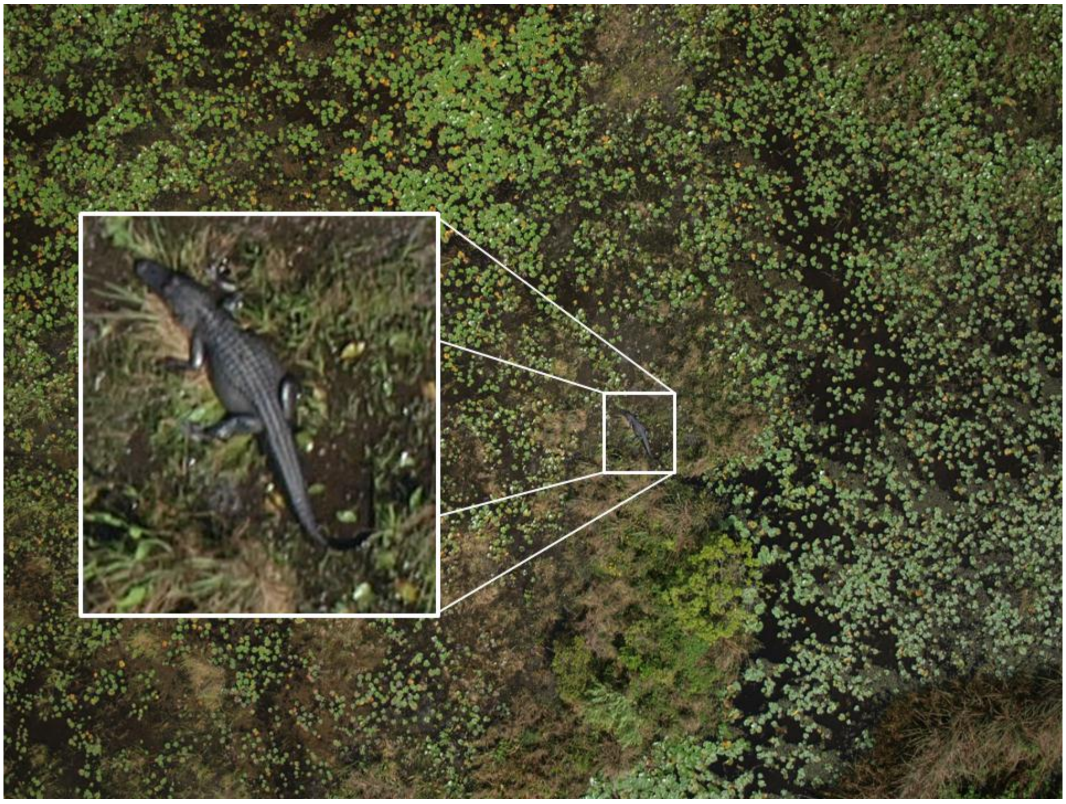
Snail Kite surveys, reproductive success and banding

Kristin Aaltonen	Emily Butler
Daniel Cavanaugh	Chris Hansen
Sanders Ho	Ashley Holmes
Cori Indelicato	Katherine Montgomery
Juan Pagan	Shrey Sangel

Sea turtle research and monitoring

Joseph Dirodio	Seth Farris
Kathryn Frey	Jessica McKenzie
Hope Ronco	Brail Stephens
Penny Weining	Natalie Williams

CURRENT PROJECTS
COOPERATIVE RESEARCH



Surveys of Snail Kite Breeding and Habitat Use in the Upper St. Johns River Basin

Principal Investigator: **Wiley M Kitchens**
Funding Agency: St. Johns River Water Management District
Expected Completion: 2/28/2011 (PJ#71241)
Graduate Students: Jean Olbert, Kyle Pias
Field Technicians:

The snail kite (*Rostrhamus sociabilis*) is an endangered raptor whose distribution in the United States is restricted to the South Florida Eco-System including watersheds of the Everglades, Lake Okeechobee, Kissimmee River, and Upper St. Johns River. Because snail kites feed almost exclusively on one species of aquatic snail, their survival depends directly on the hydrologic functioning of the wetlands associated with these watersheds.

The purpose of this project is to document snail kite usage and reproduction within the Blue Cypress Marsh Complex (BCMC) during 2008, 2009, and 2010. Since the snail kite population in Florida is best viewed as a single population, we also report additional demographic data at the scale of the whole population.

Fourteen surveys of BCMC were conducted in 2010, with at least one survey occurring in each month of the year. During 2008, 2009, and 2010 the maximum number of snail kites observed during any one survey was 26, 25, and 28 respectively. The highest numbers of birds were detected during the months of April and May. Similar to most years, more snail kites were typically observed in the eastern section of BCMC than in the western section. The number of kites using BCMC has been considerably greater during 2008-2010 compared to 2007. Nearly all surface water was released from the BCMC in 2007 in an attempt to rejuvenate emergent foraging habitats, and as a result of the intense drawdown, snail kites temporarily left the area. Although water levels were back to normal during 2008-2010, the number of snail kites observed in BCMC remained low relative to recent years (i.e. 2001-2006). A total of four nests were initiated in the BCMC during the 2008 and 2009 breeding season, with all four nests failing before eggs hatched. Thus, no young were fledged from the BCMC during the 2008 and 2009 breeding season. Fourteen active nests were found in the BCMC in 2010, but only one was successful, fledging one young. The slow recovery of the snail kite population in the BCMC may reflect a lag time in the recovery of the apple snail populations from the effects of the 2007 drawdown. There is evidence that BCMC is critical to kites persistence especially when other wetlands experience droughts or drawdowns; however its potential as a source of recruitment is less certain.

Our recent demographic studies demonstrate alarming negative trends in the snail kite population. Kite numbers have drastically declined since 1999, with the population essentially halving from 2000 to 2002 and again from 2006 to 2008. A number of factors have likely contributed to the observed population decline; including effects on survival and reproduction from both short-term natural disturbances (e.g. droughts) and long-term habitat degradations (e.g. the conversion of wet prairies to sloughs in WCA3A). There has been a notable decline in snail kite production from two critical snail kite habitats, Lake Okeechobee and WCA3A. Lake Okeechobee, which from 1985 to 1995 was a productive breeding site, has been only a minor contributing unit (in terms of reproduction) since 1996. Snail kite production from WCA3A declined sharply after 1998, and no kites were fledged there in 2001, 2005, 2007, 2008, or 2010.

This loss of Lake Okeechobee and WCA3A as productive kite habitats has left the population heavily concentrated in and dependent upon the Kissimmee Chain of Lakes (KCOL), particularly Lake Tohopekaliga (Toho), which accounted for 52, 12, 89, 72, 61, and 33 percent of the successful nesting attempts range-wide from

2005-2010, respectively. This strong shift in kite nesting toward Toho raises concerns because the survival of juveniles that fledge there may be significantly suppressed due to their inefficiency at handling the exotic apple snail (*Pomacea insularum*).

A population viability analysis conducted in 2006 predicts very high extinction probabilities in the next 50 years, and the estimate of population size for 2010 (i.e. 826 individuals) suggests that the extinction risk may be even greater than previously estimated. Eighty percent of the reduction in the stochastic population growth rate is attributable to a decline in adult fertility (i.e. a product of (1) the number of young fledged per adult and (2) juvenile survival). Therefore, we are particularly concerned about the continuing lack of kite production in Lake Okeechobee and WCA3A and potential reductions to juvenile survival due to water management and/or exotic snails because these two demographic parameters are currently limiting population growth.

OBJECTIVES:
The purpose of this project is to document snail kite usage and reproduction within the Blue Cypress Marsh Complex (BCMC) during 2008, 2009, and 2010.

PROGRESS:
Fourteen surveys of BCMC were conducted in 2010, with at least one survey occurring in each month of the year. During 2008, 2009, and 2010 the maximum number of snail kites observed during any one survey was 26, 25, and 28 respectively. The highest numbers of birds were detected during the months of April and May. Similar to most years, more snail kites were typically observed in the eastern section of BCMC than in the western section. The number of kites using BCMC has been considerably greater during 2008-2010 compared to 2007.

In 2010 a total of 26 snail kite nests were observed in BCMC, but only 14 were active. During 2010, snail kite nests that occurred in BCMC accounted for 8% of the nests that were initiated range-wide. Only one of the active nests in BCMC was successful (nest success = 0.07, SE = 0.06), fledging only one young. Therefore, BCMC only contributed minimally to the number of successful nests or young fledged range-wide in 2010.

In 2010, 258 nests were located range-wide. Of this total, 190 nests were observed in an active state (i.e., containing eggs or nestlings). Fifty percent of the active nests occurred in the KCOL, with the majority occurring on Toho, which alone accounted for 34% of the range-wide nesting effort. An unprecedented number of active nests were located in Stormwater treatment Area 5 (STA5) in 2010, and this area accounted for 12% of the range-wide nesting effort.

Thirty-four percent of all successful nests range-wide in 2010 occurred on Toho, where nest success was 0.29 (SE = 0.06). In 2010, range-wide nest success averaged 0.28 (SE = 0.03). Estimates of annual range-wide nest success and BCMC-specific nest success from 1992 to 2010 are presented in Figure 2.

We were able to determine the fate of 186 of the 190 active nests located. From active nests of known fate, 93 young were confirmed to have fledged. We banded 96 nestlings during the pre-fledging stage. However, some nests were depredated after nestling(s) were banded but before fledging; therefore, not all of the nestlings that we banded actually fledged. Also note that we were not able to band all of the young that were confirmed to have fledged; therefore, the total number of young fledged includes banded and non-banded individuals that were known to reach fledging age.

The total number of young fledged throughout the entire state dropped substantially after 1998. Historically, the majority of annual kite production came from the Water Conservation Areas, principally WCA3A; however, in 2001, 2005, 2007, 2008, and 2010 no young were fledged out of WCA3A. In 2010, Toho produced 39% of the young that were fledged statewide. There is an increasing trend in the relative contribution of the KCOL, and of Toho in particular, to the annual number of young fledged range-wide.

Adult survival dropped significantly from 2000 through 2002, and again from 2006 through 2008. These historically low survival estimates correspond temporally to significant declines in the population and to region-wide droughts. Adult survival decreased by 16% from 2000 to 2002 (Martin et al. 2006), and by approximately 22% from 2006 to 2008. Juvenile survival has varied widely over time but reached a record low in 2000. Evidence shows that juvenile survival significantly decreased in the years 2004 to 2006 and rebounded in 2007. Although Florida also experienced severe drought conditions in 2007, there was no corresponding decrease in juvenile survival. This disjunction is likely due to the fact that the majority of young fledged in 2007 came from the KCOL. Lake levels in the KCOL have historically been less affected by adverse drought conditions (Bennetts and Kitchens 1997).

The snail kite population in Florida progressively and dramatically decreased between 1999 and 2002 from approximately 3400 to 1700 birds. Population size estimates of abundance between 2002 and 2006 suggested a possible stabilization at approximately 1500-1600 birds. The population estimate for 2007 was significantly less than the estimates for both 2006 and 2005. Furthermore, the population estimates for 2008 and 2009 were significantly less than the 2007 estimate and suggest that the snail kite population halved again between 2006 and 2008. The 2010 population size estimate (826, SE = 49) is larger than the 2008 and 2009 estimates, but it does not differ significantly and cannot be interpreted as a rebound.

SUMMARY:
BCMC is clearly a critical part of the network of wetlands used by kites, as it is consistently utilized by a portion of the kite population (Martin et al. 2006) and may also serve as a refugia habitat particularly when other wetlands are experiencing drought conditions. Since the snail kite population is at risk of extinction and because adult fertility plays such an overwhelming role in the population growth rate, it is critical to monitor essential regions such as the BCMC and to identify and attempt to remedy all factors that negatively affect snail kite production and juvenile survival.

Demographic, Movement, and Habitat of the Endangered Snail Kite in Response to Operational Plans in Water Conservation Area 3 A.

Principal Investigator: Wiley M. Kitchens
Funding Agency: USGS/Army Corps of Engineers
Expected Completion: 4/30/2011 (UFPJ#00088028)
Graduate Students: B. Reichert, C. Cattau, K. Pias, J. Olbert

This report concentrates on demographic data collected in 2010, but also incorporates data collected since 1992. Recent demographic results reveal alarming trends concerning the snail kite population in Florida. First we found that kite abundance has drastically and steadily declined since 1999, with the population essentially halving from 2000 to 2002 and again from 2006 to 2008. Each of these two periods of population decline coincided, in part, with a severe regional drought throughout the southern portion of the kites' range. The 2001 drought significantly, yet temporarily, affected adult survival, especially for kites within the Everglades region; however, the nesting patterns and lack of recruitment that have been observed since that time give us special concern about the recovery of the snail kite population. A life table response experiment (LTRE) shows that 80% of the reduction in the stochastic population growth rate is attributable to adult fertility (i.e., the product of (1) young fledged per adult and (2) juvenile survival). A population viability analysis (PVA) conducted in 2006 predicts very high extinction probabilities in the next 50 years, and the estimate of population size for 2008 (i.e., 685 individuals) suggests that the extinction risk may be even greater than previously estimated.

Multiple factors may be limiting the reproductive ability of the kites and reducing the carrying capacity of several of the wetland units throughout the state, and the reasons for this severe decline in population viability are probably tied to both short-term natural disturbances (e.g., drought) and long-term habitat degradations (e.g., the conversion of wet prairies to sloughs in WCA3A). Of particular concern is the lack of snail kite production from the Everglades region, as no kites were observed fledging out of the Water Conservations Areas during the breeding seasons of 2005, 2007, or 2008. In this report we detail new findings related to snail kite demography, movement, foraging, and genetics. We also make specific recommendations that may help guide management decisions aimed at increasing snail kite population growth.

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, and the population in 2008 was estimated to be half that in 2003. 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". .

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).

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 radiotelemetry, 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 in their oldest ages

All young fledged and radioed in the Kissimmee Chain of Lakes(KCOL) in 2008, stayed in the KCOL through the entire year.

SUMMARY:

Very little is known about the extent of a numerical versus behavioral response of the snail kite to a disturbance event (such as a drought). Radio telemetry is the only way to assess the ability for the bird to resist a regional drying event. Further, it enables determination of the factors which are generating movement patterns such as patch size, distance between patches, and the carrying capacity of a specific wetland. This is particularly interesting when considering the effect of fragmentation on the dispersal abilities of the kites, as fragmentation typically reduce patch size and increases the linear distance between patches.

Nesting Habitat & Nest Failures of Everglade Snail Kite on Kissimmee Lakes
And
Nesting, Recruiting and Foraging Ecology of the Florida Snail Kite in Lake Tohopekaliga

Principal Investigator: **Wiley M Kitchens**
Funding Agency: FWS and FWC
Expected Completion: 3/30/2013 (PJ#84066, #89466)
Graduate Students: Jean Olbert, Kyle Pias
Field Technicians:

The Snail Kite is a federally endangered raptor whose population in Florida has recently undergone precipitous declines. The remaining population remains heavily dependent upon the Kissimmee Chain of Lakes (KCOL), a group of lakes in central-Florida that is subject to many anthropogenic influences, including water and vegetation management. It is therefore crucial to gain an understanding of how the habitat on these lakes influences kite reproduction as well as determining reasons for nesting failure and success. We studied the role that habitat on the KCOL plays in reproductive success by radio-tagging and observing adult breeding Snail Kites by airboat. We calculated 90% home ranges using a kernel density estimator and quantified foraging effectiveness through time activity budgets. Additionally we studied the role that nest patch structure, local avian assemblages and predation plays in nesting success by setting up professional research cameras and performing regular avian point counts at nest locations as well as quantifying aspects of the selected nest patch structure.

OBJECTIVES:
This study has two main components. One is to examine the relationships between habitat use, foraging ecology, and nesting success. The other is to determine the major source of egg/nestling mortality and nesting failure.

The primary objectives of the habitat use study are to quantify the areas of and vegetative communities composing the home ranges of breeding snail kites and determine how vegetation composition, search time, and apple snail capture rate relate to home range size of breeding kites. These relationships will provide information pertaining to habitat selection, habitat quality, and ultimately carrying capacity. This will be done through the use of radio-transmitters that will allow specific birds to be followed over time and information on foraging and habitat use will be collected via behavioral observations and GPS/GIS techniques.

The primary objectives of the nest predation study is to examine reasons for snail kite nesting failure by looking at the vegetative communities that supply nesting substrate, presence of predators, and the role that interspecific avian assemblages play on the success rate of the nests. Snail kites often nest in cattail (*Typha spp.*) or bulrush (*Scirpus* validus) stands or patches of varying sizes and densities, especially during times of low water levels (Rodgers et al. 2001). By looking at aspects of the local avian community within the nest patch we hope to determine if there is a relationship between breeding Icterids, which may defend patches from predators, and snail kites with regard to nest predation, nest abandonment and decreased kite feeding due to harassment. Further, we will be able to determine whether snail provisioning rates relate to fledgling health and nest success. This research will provide managers with the critical information needed to manage for the survival of this endangered species.

PROGRESS:
The habitat use study is currently collecting data on three radioed nesting kites on Lake Tohopekaliga. A further two breeding radioed kites have been identified for observation on Lake Hatchineha, and one breeding radioed bird has been identified on Lake Okeechobee. Observations will continue on these birds every 3-4 days until the nest has finished. Further radioed birds will continue to be chosen for observation throughout the nesting season, and additional birds will be trapped and affixed with radio-transmitters.

For the nest predation portion of the project, new tripods are being built and equipment is being purchased in preparation for the breeding season. Currently there are 8 active snail kite nest cameras deployed on Lake Tohopekaliga. The majority of the nests are in the incubation stage with eggs while 2 of the nests with cameras have nestlings present. Point counts occur weekly at each nest patch.

SUMMARY:
This proposed study will provide critical information regarding reasons for snail kite nesting failure, by looking at the vegetative communities that supply nesting substrate, presence of predators, and the role that interspecific avian assemblages play on the success rate of the nests.

Linking Snail Kite Foraging Activity, Habitat Quality, and Critical Demographic Parameters to Guide Effective Conservation

Principal Investigator: **Wiley M Kitchens**
Co-Principal Investigator: R. Fletcher, C. Zweig
Funding Agency: U.S. Geological Survey
Expected Completion: 6/07/2012 (RWO 269, PJ#88726)
Graduate Students: Jean Olbert, Kyle Pias
Field Technicians: Dan Cavanaugh, Juan Andres Pagan

Recent demographic studies reveal alarming trends in the snail kite population in Florida. Kite numbers have drastically declined since 1999, with the population essentially halving from 2000 to 2002 and again from 2006 to 2008. Concurrent with the population decline is a corresponding decline in nesting attempts, nest success and the number of young fledged. A number of factors have likely contributed to these observed declines, including short-term natural disturbances (e.g., drought) and long-term habitat degradations (e.g., the conversion of wet prairies to sloughs in WCA3A). In relation to maintaining the long-term stability of the snail kite population, WCA3A is commonly recognized as stronghold for kite reproduction. However, snail kite reproduction in WCA3A sharply decreased after 1998. Given that reproduction may be largely limiting snail kite population growth and recovery, it is critical to understand the factors affecting reproduction in WCA3A. Natural resource managers currently lack a fully integrative approach to managing hydrology and vegetative communities with respect to the apple snail and snail kite populations. This report presents the status of our progress on (1) the integrated data synthesis effort, linking existing snail kite and apple snail data, and (2) the targeted field research being conducted to fill critical information gaps in our understanding of the interactions between/among hydrology, vegetation, snails and kites.

OBJECTIVES:
The endangered snail kite (*Rostrhamus sociabilis*) is a wetland-dependent species feeding almost exclusively on a single species of aquatic snail, the Florida apple snail (*Pomacea paludosa*). The viability of the kite population is therefore dependent on the hydrologic conditions (both short-term and long-term) that (1) maintain sufficient abundances and densities of apple snails, and (2) provide suitable conditions for snail kite foraging and nesting, which include specific vegetative community compositions. Many wetlands comprising the range of the snail kite are no longer sustained by the natural processes under which they evolved (USFWS 1999, RECOVER 2005), and hence, are not necessarily characteristic of the historical ecosystems that once supported the kite population (Bennetts & Kitchens 1999, Martin et al. 2008). In addition, natural resource managers currently lack a fully integrative approach to managing hydrology and vegetative communities with respect to the apple snail and snail kite populations.

Given the critically endangered status of the snail kite and the dependence of the population growth rate on adult fertility (Martin et al. 2008), it is imperative that we improve our understanding of how hydrological conditions effect kite reproduction and recruitment. In relation to maintaining the long-term stability of the snail kite population, WCA3A is commonly recognized as one of the ‘most critical’ wetlands comprising the range of the kite in Florida (see Bennetts & Kitchens 1997, Mooij et al. 2002, Martin et al. 2006, 2008). However, snail kite reproduction in WCA3A sharply decreased after 1998 (Martin et al. 2008), and alarmingly, no kites were fledged there in 2001, 2005, 2007, or 2008. Furthermore, Bowling (2008) found that juvenile movement probabilities away (emigrating) from WCA3A were significantly higher for the few kites that did fledge there in recent years (i.e. 2003, 2004, 2006) compared to those that fledged there in the 1990s. The paucity of reproduction in and the high probability of juveniles emigrating from WCA3A are likely indicative of habitat degradation (Bowling 2008, Martin et al. 2008), which may stem, at least in part, from a shift in water management regimes (Zweig & Kitchens 2008).

Given the recent demographic trends in snail kite population, the need for a comprehensive conservation strategy is imperative; however, information gaps (Fig. 1) currently preclude our ability to simultaneously manage the hydrology in WCA3A with respect to vegetation, snails, and kites. While there have been significant efforts in filling critical information gaps regarding snail kite demography (e.g., Martin et al. 2008) and variation in apple snail density to water management issues (e.g., Darby et al. 2002, Karunaratne et al. 2006, Darby et al. 2008), there is surprisingly very little information relevant for management that directly links variation in apple snail density with the demography and behavior of snail kites (but see Bennetts et al. 2006). The U.S. Fish and Wildlife Service (USFWS) and the Florida Fish and Wildlife Conservation Commission (FWC) have increasingly sought information pertaining to the potential effects of specific hydrological management regimes with respect to the apple snail and snail kite populations, as well as the vegetative communities that support them.

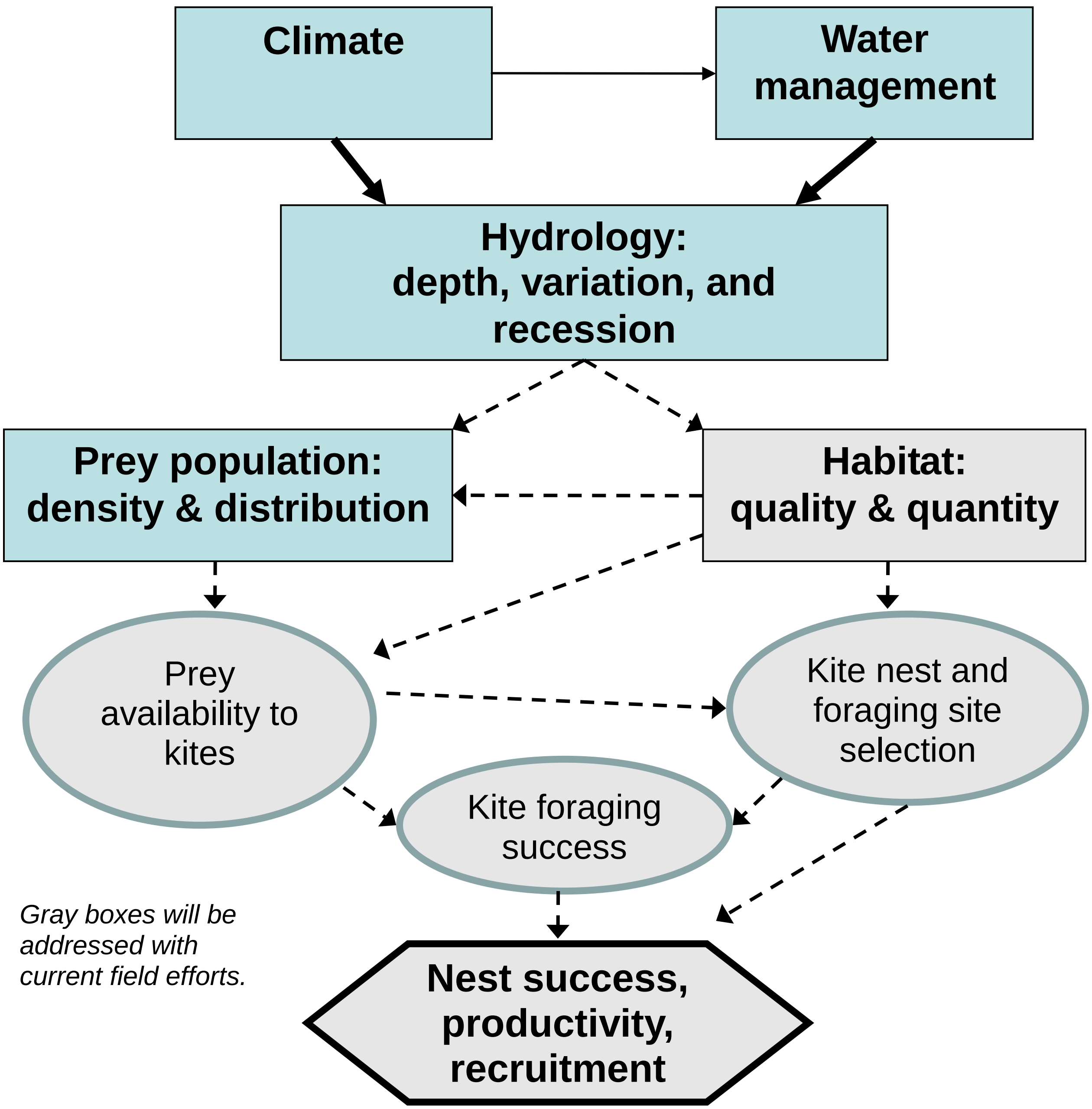


Figure 1. Conceptual model of environmental and biological variables affecting key demographic parameters of the snail kite population

The following objectives of the proposed work are meant to directly address the gaps in knowledge that are identified in Figure 1:

1. To determine how hydrology, habitat quality, and prey density affect snail availability for foraging and nesting snail kites.
2. To determine how snail availability affects kite foraging success, and nest and foraging site selection.
3. To determine how snail availability affects nest success and recruitment.
4. To determine the role of kite foraging success and nest and foraging site selection on nest success and recruitment.
5. To determine kite foraging habitat quality within foraging polygons and determine its relationship to hydrology and vegetation communities.

PROGRESS:

This study is complementary to the demographic study entitled "Continued Studies of the Demography, Movement, Population Growth and Extinction Parameters of the Snail Kite in Florida". In order to address Objectives 1-3 (above), we are currently integrating historic snail kite and apple snail data that share spatial and temporal overlap. We are also incorporating pertinent data related to hydrology and vegetation. These combined data will be comprehensively analyzed over the course of the study in order to elucidate environmental and biological variables affecting key demographic parameters of the snail kite population. We are also conducting further field research on snail kite habitat use, foraging activity, survival and reproduction that is necessary to fill the critical information gaps identified in Figure 1.

Integrated Synthesis of Existing Data

The Florida Cooperative Fish and Wildlife Research Unit (Coop) has monitored the snail kite population since 1992 and has a wealth of demographic and behavioral data. We have had several discussions (including a recent meeting held Dec 6th, 2010 in Gainesville, FL) with Dr. Darby from the University of West Florida, and we received a firm commitment from him to provide data (e.g., snail densities, snail sizes, vegetation metrics) relevant to this effort to synthesize existing information on snail kites and apple snails. We have started a prioritized research strategy in collaboration with Dr. Darby; anticipated research products appear in Table 1.

We have also begun preliminary analyses using some of the overlapping kite and snail data that we have synthesized into our database. We tested the effect of apple snail density on the number of snail kite nests initiated in WCA3A using a generalized linear model (GLM) with quasi-poisson error and a log link, and we found a significant positive relationship (d.f.= 4, t=4.93, p=0.008; Figure 2). We also tested the effect of snail density on apparent nest success in WCA3A using a GLM with quasi-binomial error and a logit link, and we found a positive trend (Figure 3), but it was not quite statistically significant (d.f.=5, t=2.488, p=0.055).

In both preliminary analyses, we used the maximum snail density measured in WCA3A during the breeding season of each year (2002-2009; except for 2008 because we had no snail data from that year, and we excluded 2006 from our analysis of initiated nests because it was an extreme outlier) as the independent variable. Our rationale for using the maximum density measured, as opposed to the density measured closest to each nest, was as follows: Since WCA3A covers a vast heterogeneous landscape, and since snail sampling took place on a limited spatial scale, it is likely that many unsampled areas may have also had high snail densities. Kites likely sample prey availabilities before selecting nest sites, and an underlying assumption of this approach is that all kites that established nests in WCA3A in a given year had encountered snail densities that were at least equal to the maximum sampled density and then selected nest sites in close proximity to habitats supporting high snail densities. The area used by a nesting kite will likely encompass multiple habitats with varying snail densities. Therefore, if the snail density estimate derived from the sample site closest to a kite nest is low, that does not preclude the existence of a habitat in close proximity to the nest that supports a higher snail density.

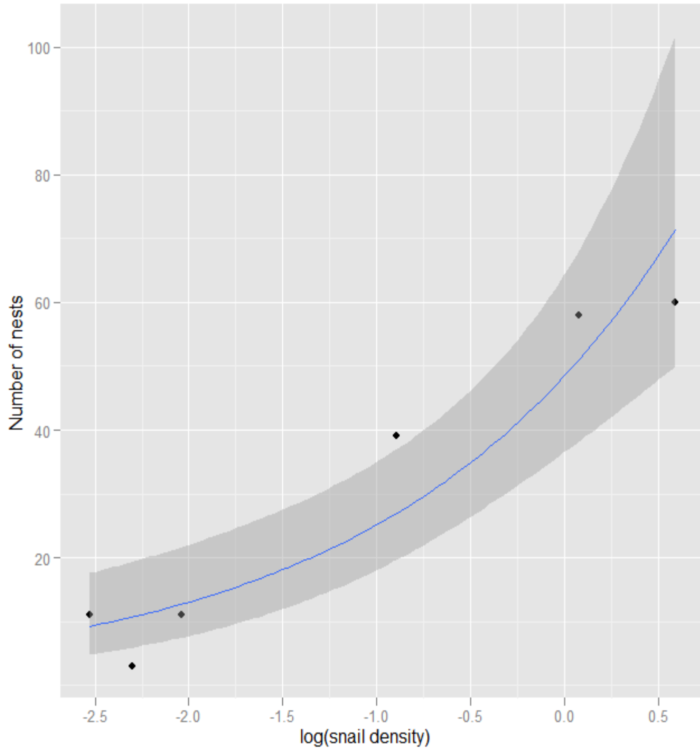


Figure 2. Number of active snail kite nests observed in WCA3A as a function of the maximum snail density measured (log-transformed) during the breading season of each year (2002, 2003, 2004, 2005, 2007, 2009). Points represent actual number of nests observed. Predicted mean (blue line) and 95% confidence interval (grey shaded area) are projected from a GLM with quasi-poisson error using a log link.

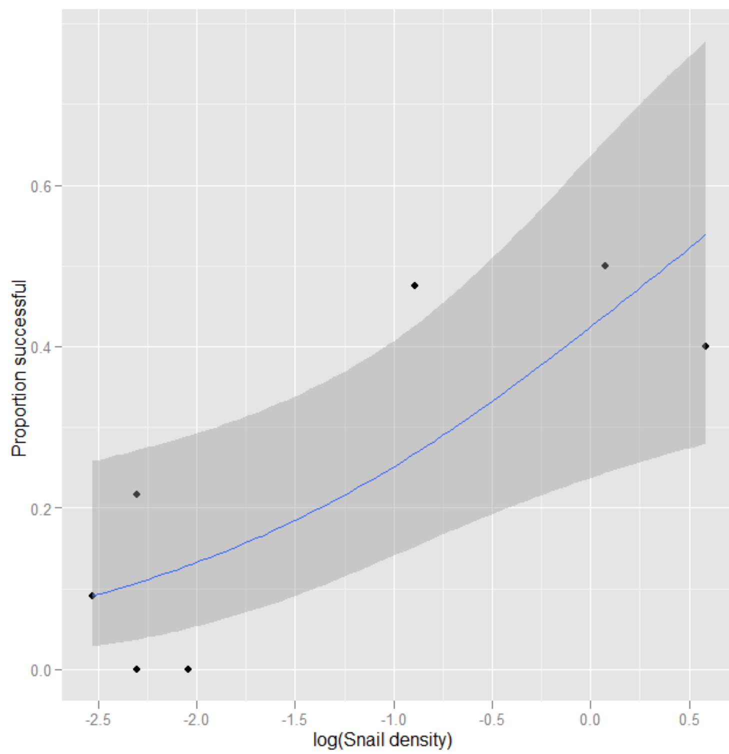


Figure 3. Apparent nest success in WCA3A as a function of the maximum snail density measured (log-transformed) during the breading season of each year (2002-2007, 2009). Points represent observed proportion of nests successful. Predicted mean (blue line) and 95% confidence interval (grey shaded area) are projected from a GLM with quasi-binomial error using a logit link.

Caution should be used when interpreting these preliminary results, as they (1) are based on the overlapping kite and snail data that we have so far, which is still incomplete, (2) suffer from small sample sizes, and (3) lack important environmental variables (e.g. hydrology). However, as soon as additional snail data are made available, we will have greater sample sizes and will be better able to deal with spatiotemporal variation in snail densities. Our effective sample size for nest success will also increase as soon as we finish restructuring our database so that we can model daily survival rates (DSR) in place of apparent nest success. Our next modeling efforts will also incorporate pertinent vegetation and hydrology data.

There is also uncertainty as to whether maximum snail density measured was truly representative of the highest density available during each year, which, if not true may bias our preliminary analyses. To deal with this last issue, we plan use the species distribution modeling package BIOMOD, which is implemented through Program R and can produce maps through ArcGis, to predict snail densities on a spatially explicit scale (30x30m grid) across WCA3A using hydrological and vegetation data. Density estimates from the existing dataset will be randomly selected for use as either model training or model validation data. Once we create a reliable predictor of snail density distributions, we will incorporate it into spatially explicit models of snail kite nest occurrence, success, and productivity. This next step in the modeling effort is essential for optimizing management decisions. Additionally, data generated from this study will be to evaluate the relative influence of various environmental factors on the dynamics and persistence of the kite population. Information generated from such PVAs will contribute substantially to an adaptive management strategy.

Determining the survival, movement probabilities, foraging polygons, snail capture rates, and nesting home ranges of kites

Two technicians, Dan Cavanaugh and Juan Andres Pagan have been hired for this project. They are currently stationed at the Oasis Visitor Center in Big Cypress National Preserve. They have both completed the Department of the Interiors Motorboat Operation Certification Course, Wilderness First Aid Training, and the Institutional Animal Care and Use Committee training. They have been trained in airboat maintenance and operation both on the Kissimmee Chain of Lakes (KCOL) and in the Everglades.

While on the KCOL, they were trained to search for snail kites, recognize breeding and foraging behavior, and to conduct nest checks and foraging observations. These foraging observations consist of both a spatial sampling of the kites' locations, which will be used to create foraging polygons, as well as a time activity budget, which will be used as a metric of the habitat quality of that polygon. Currently the technicians are employing this protocol wherever kites can be found within Water Conservation Area (WCA) 3A, WCA3B, Everglades National Park, and Big Cypress National Preserve.

The technicians are currently being trained to trap, handle, process, and affix radio-transmitters to kites. They are also being trained to construct noosed kite traps and radio-transmitter harnesses. The technicians will attempt to trap birds prior to and during the 2011breeding season so that individual breeding birds may be followed for observations. If trapping is unsuccessful, observations will be carried out on unmarked breeding birds.

The technicians participated in vegetation sampling this fall on both the KCOL and the Everglades. They will also be working closely with Dr. Phil Darby to tie snail sampling efforts to the delineated foraging areas.

Preliminary Results

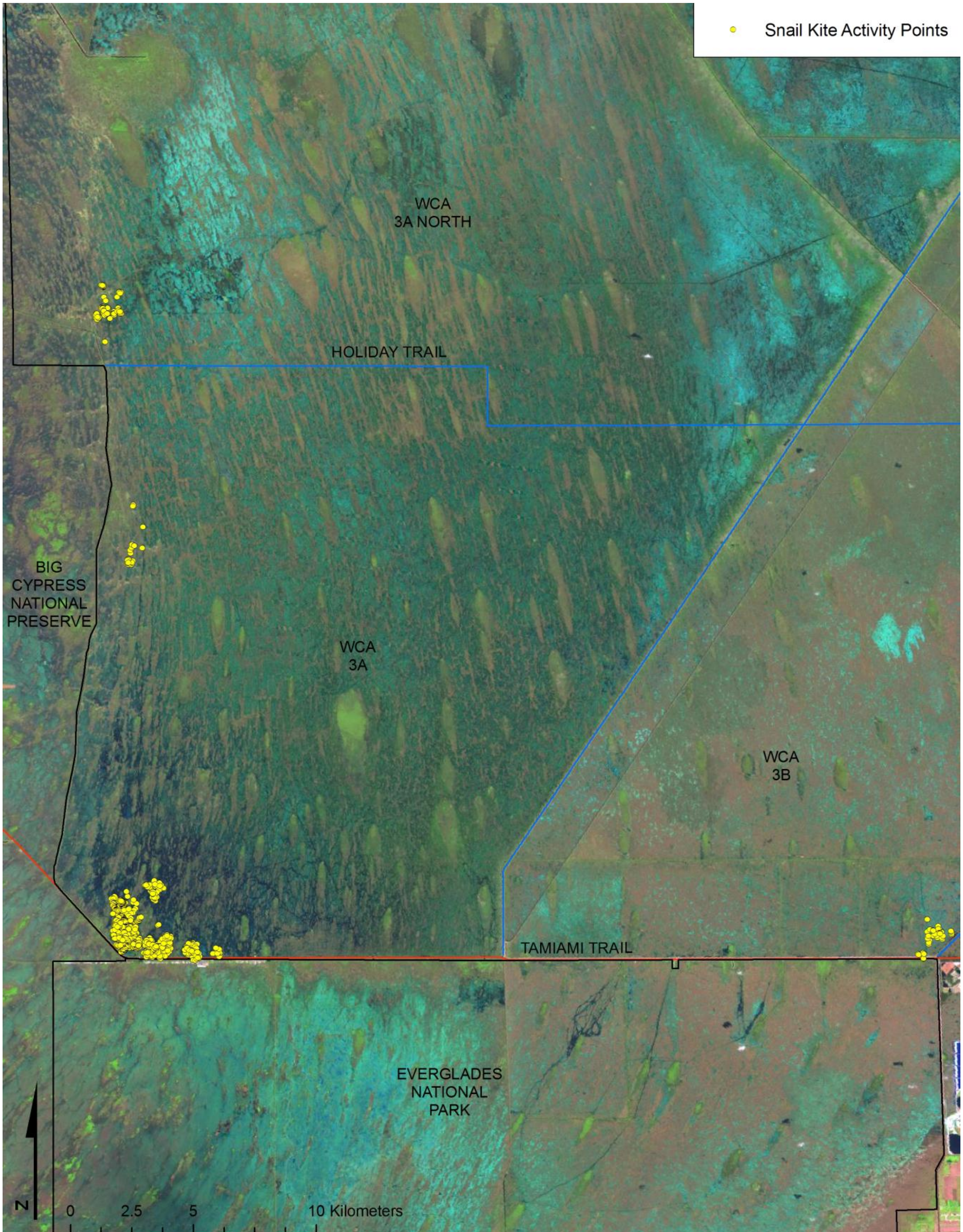
Between July 13th, 2010 and Dec 16th 2010, 144 hours of foraging observations have been obtained, and 2135 spatial locations of kite activity points (Figure 4) have been collected. These data represent 84 observation periods on an estimated 67 individual birds; the exact number may be smaller due to difficulties in distinguishing unmarked individuals. Observations were performed only in WCA 3A and WCA 3B as birds were not located in any other areas. In WCA 3A, birds were primarily located along the southern and western edges of the area.

Capture rates were calculated as the number of snails captured per minute of foraging effort. The average capture rate was 2.72$\pm$1.04 snails/minute (n=66 observations). This number is inflated by a single bird with a capture rate of 68 snails/minute. This was due to the bird primarily perch hunting, and therefore catching snails with no associated search time. With this individual excluded, the average capture rate is 1.72$\pm$0.26 snails/minute (n=65 observations). Foraging success was calculated as the number of successful captures/total number of attempts. The average foraging success rate was 0.93$\pm$0.01(n=73 observations).

90% kernels were estimated using the reference smoothing parameter in Home Range Tools within ArcGIS (Figure 5), for all observation periods in which more than 10 spatial locations were collected, resulting in a total of 61 foraging polygons (60 in WCA 3A and 1 in WCA 3B). The average foraging area in WCA 3A was 20.3$\pm$3.3 ha (n=60).

SUMMARY:

Information gaps (identified in Figure 1) currently preclude our ability to simultaneously manage hydrology with respect to vegetation, snails and kites in WCA3A. Synthesizing and analyzing available overlapping datasets, as well as collecting additional targeted data, will help elucidate key components in this system's dynamics, which will aid management decisions for WCA3A and improve recovery planning efforts for the endangered snail kite.



GFigure 4. **Locations of snail kite activity collected in WCA 3A and WCA 3B between July 13th 2010 and Dec 16th 2010**

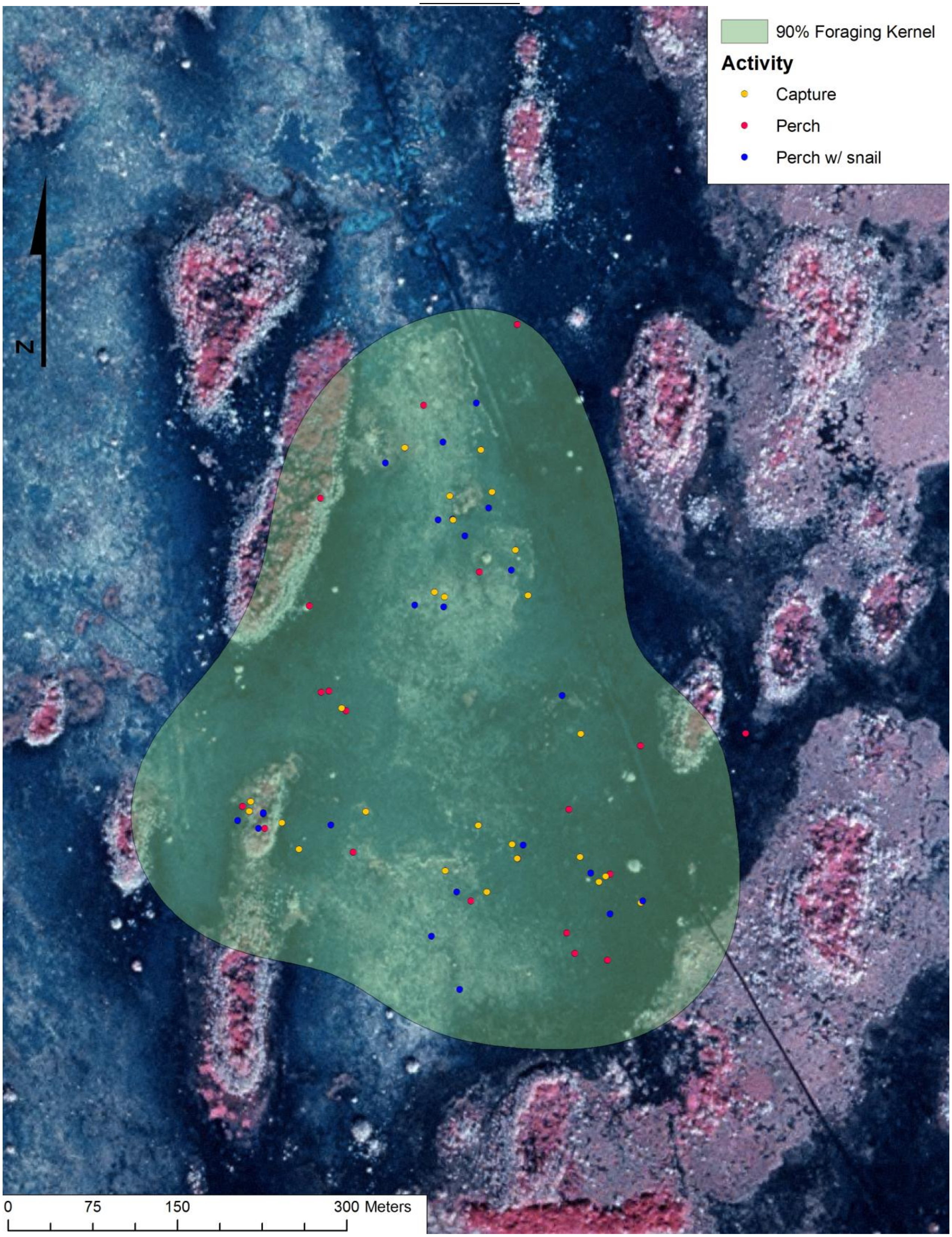


Figure 5. Example of a 90% foraging kernel calculated from locations obtained during a single observation period of a female snail kite in WCA 3A.

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


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

Principal Investigator: H. Franklin Percival
Co-Principal Investigator: Fred Johnson
Funding Agancy: U.S. Geological Survey

Expected Completion: 12/31/11 (PJ#81315)

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. 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.

PROGRESS:
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. Monte Carlo simulations suggested that either burning or 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.

Until recently, the lack of empirical information for estimating transition probabilities of scrub classes under various management regimes was an impediment to more informed management. That has changed, however, with the acquisition of five consecutive years (2004-2009) of high-resolution aerial photography from Brevard County. This imagery was recently classified by project partner Innovative Health Applications, LLC, and we are in the process of estimating scrub-class transitions in the presence or absence of fire, and with or without sandy openings in the scrub. These data will give us the most detailed look yet at how scrub on MINWR responds to various management actions, and will allow us to derive a scrub-management strategy in which we can have confidence.

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

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: 12/31/2011 (PJ#89837)

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 losely with scientists and managers of cooperating organizations to solve problems of natural resource management.

Photo by:* *Matthew Burgess, FL CRU *- UF/USACE team hand launches the Nova 2.1 UAS from an airboat on Lake Okeechobee*

Collection of Digital Serial Imagery in Support of Aquatic Invasive Species Program And CERP

Principal: H. Franklin Percival
Co-Principal Investigator: Peter Ifju,
Funding Agency: U.S.Army Corp of Engineers
pected Completion: 05/15/2011 (PJ#88394)
Biological Scientist: Matthew Burgess

In its 10th year, 2010 was a landmark year for the UF/USACE UAS Program. The team now has developed a very reliable, waterproof platform (Nova 2.1) which is totally autonomous including takeoff (hand tossed) and landing. The FAA requirement to fly within 1 nautical mile line of sight required land and water landings in the extensive Everglades and Lake Okeechobee. The payload includes an Olympus 420E digital SLR with a 25 mm pancake lens® delivering images with 2.5 cm resolution and <0.5 m positional accuracy at 100 m altitude. The Nova 2.1 performed 40+ individual flights without incident in 2010.

PROGRESS:
Significant progress was made in more effective mission planning and post-processing of data. Research in 2011 will involve additional biological applications, optimized flight planning and airframe design, potential sensor improvement and post-processing capabilities. The US Army Corps of Engineers will assume operational use of the UAS with orientation and collaboration from the UF UAS team. Examples of missions follow:
Indian Prairie:

The invasive aquatic vegetation studies over Lake Okeechobee consisted of flying the Nova UAS over areas of floating aquatic vegetation just prior to, and a short time after being sprayed with herbicides. Invasive vegetation species of interest included but were not limited to water lettuce (*Pistia stratiotes*) and water hyacinth

(*Eichornia crassipes*). Aerial imagery of 2,700 ha of treated vegetation showed distinctive patterns where herbicide was effectively applied, as well as areas that were missed. Armed with these data, ground-based herbicide crews were able to go back and treat areas that were missed during the initial aerial treatments. Additionally, because treated areas were re-flown at regular intervals, changes over time analyses were able to be performed helping to assess the effectiveness of invasive species herbicide treatments over time. It is anticipated that flights over the sprayed areas one year later may indicate that native vegetation will have replaced areas previously choked with invasive vegetation species.

Loxahatchee:

Autonomous flights using the Nova UAS were executed over several nesting wading bird colonies in the Loxahatchee National Wildlife Refuge on May 7, 2010. These studies were conducted to assess the population abundance and distribution of nesting birds amongst tree islands in the Refuge. It was hoped that routine flights over the same nesting colonies would indicate rates of change over time, however, problems with the Nova UAS payload prevented these time-series analyses. The UF team was however able to gather good snapshot data of nesting birds in tree islands at several locations. Comparison of these data with data collected on the ground during this calendar year helped indicate that 2010 was a particularly poor year for nesting birds in the Refuge.

Hoover Dike / L-6 Levee:

On May 6, 2010, a flight was made along the Hoover Dike to evaluate the ability of the Nova UAS to execute long linear flights along a dike. We found that the aircraft did a remarkable job of holding its position over the dike at both 150 and 300 m altitudes. On May 20, 2010, the team flew four optical flights recording a total of 1,232 images over the L-6 levee. Unfortunately, technical issues were encountered during the first two flights, limiting the utility of the imagery captured during those flights. A 6 km linear segment of levee was successfully photographed during the third flight, and an additional 6 km segment of levee was photographed during the fourth flight. Imagery from the final two flights appears to possess adequate clarity and overlap for mosaicing. Again, the Nova UAS did an outstanding job of covering the area of interest, and provided some excellent imagery for data analysis. Critical features such as water culverts under the levee were well documented; illustrating significant water flow from one side of the levee to the other.

Picayune Strand:

The goals of this Nova 2.1 mission at Picayune Strand were to: 1) fly an area of land that is undergoing road degradation in preparation for invasive vegetation removal and restoration of hydrologic sheet flow; 2) fly an active construction site at multiple altitudes where a water pump station is being constructed; and 3) fly plots of land that are known to contain several species of invasive vegetation with both a visible-spectrum color camera as well as a color infrared camera.

On July 7, 2010, an RGB payload flight was conducted at 300 m altitude over a road degradation site recording a total of 556 images. The site was littered with lots of heavy equipment that was being used to pile limestone rock, and cleared vegetation into brush piles to be subsequently burned. The forested areas between the cleared regions were dense. It is believed that once the roads have been degraded, crews will be able to enter the dense forest and remove invasive vegetation, as well restore hydrologic sheet flow across the area. Later that afternoon, a second RGB flight was conducted over an active water pump construction site recording 527 images. This flight was unique in that it was conducted at four separate altitudes (100, 150, 200, and 300 m ASL) while executing the same flight path. Imagery collected from this flight can be used to compare image resolution differences at the various altitudes. Because the construction site had extensive dirt mounds as well as deep pits, this imagery will also be used to test the ability of computer software to adapt to targeted landscapes with substantial changes in relief.

On July 8, 2010, the team flew two flights recording a total of 1,628 images over plots of land known to contain several species of invasive vegetation. The first flight was conducted with a visible-spectrum color camera at 200 m altitude. This flight revealed areas of forest as well as grasslands. The second flight of the day was conducted with a color infrared camera utilizing the exact same flight path and altitude as the previous flight, and a second airframe. As this was the first attempt at using the color infrared camera in a Nova 2.1, we learned a lot about the utility of this payload. Certain plant species, especially Brazilian Pepper (*Schinus terebinthifolius*) stood out well using the infrared camera. Imagery from all flights appears to possess adequate clarity and overlap for mosaicing during post processing.

Fisheating Bay:

On August 18, 2010, the Nova sUAS was flown with an RGB imager over a 500m x 500m square target area of Fisheating Bay known to contain several species of exotic vegetation. The area was scheduled for immediate herbicide treatment, so the flight on the 18th was to collect baseline imagery data for temporal change analyses later in the year. After the flight was executed, the field crew went to ten randomly-selected locations within the square target to document the vegetation communities at each location. This data would be used in conjunction with the color imagery to create maps of specific vegetation types based on spectral signatures. These maps were created based on seven major classification types: open water, submerged vegetation, Lotus, cupscale grass, *Luziola*, water hyacinth, and water lettuce. Spectral separation of these classification types was found to be effective for all categories except for differentiation of exotic *Luziola* from native cupscale grass.

On September 30, 2010, the Nova sUAS was re-flown three times over the same 500m x 500m square target area of Fisheating Bay initially flown on August 18th. The first two flights were conducted with the RGB imaging sensor, and the last flight with the color infrared sensor in an attempt to assist in the differentiation of *Luziola* from cupscale grass. Visual observation of the area indicated that the herbicide treatments had been very effective as much of the vegetation, both native and exotic, had been killed. Post-processing of the imagery back in the laboratory showed significant temporal change. The square target area initially contained very small amounts of open-water habitat, whereas the post-treatment RGB imagery indicated vast areas of open-water habitat as a result of the treatment. The color infrared imagery did not assist in the differentiation of *Luziola* from cupscale grass at the given flight altitude of 200m. It is thought that perhaps at a lower altitude, the infrared signature may be more useful.

Photo by: Matthew Burgess, FL CRU *- The Nova 2.1 is one of only a few amphibious landing UAS in the world.*

Adaptive Management of Gulf Coast Salt Marshes Considering Sea Level Rise And Recovery of the Endangered Florida Salt Marsh Vole

Principal: H. Franklin Percival
Co-Principal Investigator: Wiley Kitchens, Althea Hotaling, John Kasbohm, Christa Zweig
Funding Agency: U.S. Geological Survey
Expected Completion: 09/30/2010 (RWO#258, PJ#82190)

The Big Bend region in north Florida is perhaps the most pristine yet unprotected estuarine ecosystem in the state and is habitat for the endangered Florida salt marsh vole (*Microtus pennyslvanicus dukecampbelli*).The life history of this federally endangered animal remains largely unknown due to its relatively recent discovery, rarity and difficulty in trapping. Only 43 individuals have been captured since the first specimen was discovered in 1979. The main goal was document the persistence of *M. p. dukecampbelli*, which was successful, as two individuals were captured. One sub-adult and one adult male were found on Long Cabbage Key in the Lower Suwannee National Wildlife Refuge (LSNWR). In the summer of 2010, a stakeholder meeting connecting various agencies interested in ecological work in the Big Bend region was facilitated by FCFWRU. Seventeen stakeholders interested in coastal impacts in this area discussed current research and collaborative opportunities.

This study paved the way for continued efforts to study *M. p. dukecampbelli* as well as other coastal salt marsh species and vegetation. This new project is part of a larger collaborative, multi-agency project entitled “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 Scenarios in Combination with Ecological Modeling”. It is funded through USGS’s **National Climate Change and Wildlife Science Center.**

OBJECTIVES:

1. Document if *M. p. dukecampbelli* still persists in LSNWR.
2. Facilitate a stakeholder workshop connecting various agencies and organizations interested in ecological research in the Big Bend area.
3. Monitor marsh vegetative changes as a result of prescribed burns.

PROGRESS:

This project was completed in September 2010, although it has paved the way for continued work in the area looking at climate change effects on small mammal and marsh vegetation communities.

Small mammal trapping occurred in 9 different sites, which varied in size and shape but were chosen because they contained the largest extent of Saltgrass-dominated habitat thought to be the preferred habitat of the salt marsh vole. A total of 2675 trap nights occurred between January 20 and March 6, 2010. Of the 245 animals captured, most were Marsh Rice Rats (221), followed by Hispid Cotton Rats (19), Cotton Mice (3) and Salt Marsh Voles (2).

The July 22, 2010 workshop connected various research efforts in the Big Bend region. Future collaborations were encouraged and will be pursued so that concurrent data collection for oysters, birds and other topics of interest may be linked for a more complete understanding of this ecologically important region. Many of the participants felt that fresh water input will be an important determinant of the direction and amount of coastal changes resulting from sea level rise. It was suggested that hydrological models be shared among all stakeholders.

All agreed that LSNWR is a showcase refuge for examining and managing for coastal impacts of global climate change. Especially in the area of using down-scaled climate models to identify the physical components of climate change and sea level rise impacts and importantly, identifying the biological processes that will be impacted by physical changes. Concern for this system in combination with the breadth of on-going scientific research specifically geared to examine climate change impacts makes this refuge a key resource for addressing conservation and management of natural resources in the face of climate change. Future efforts should raise the visibility of the Big Bend as a prime resource deserving of more research and conservation

Prescribed burns did not occur as anticipated, thus the vegetation study which was to describe changes to the marsh vegetation post-burn also did not occur.

SUMMARY:

The endangered Florida salt marsh vole has successfully been found in the Lower Suwannee National Wildlife Refuge, documenting its continued persistence. Efforts were made to connect researchers working in the Big Bend region, highlighting the importance of collaboration and communication as the threats of climate change in this sensitive region are considered at many scales.

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

Principal Investigator: R.R. Carthy
Co-PI: M. Lamont
Funding Agency: USGS/Eglin Air Force Base
Expected Completion: 05/31/2012 (RWO#254, PJ# 00078317)
Research Staff:

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 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.

OBJECTIVES:
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 inter-nesting period
c. examining effects of erosion debris fields on nesting success
d. identification and GIS mapping of Coast Guard Station debris onshore and off-shore
e. statistical comparison of mean number of false crawls in debris areas versus non-debris areas
f. 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:
In 2010, we recorded 33 false crawls and 23 nests along Eglin AFB property on Cape San Blas for a total of 56 emergences. This represents a 41% nesting success, which is similar to the 15 year mean nesting success of 40% for this beach. Tagging success, site fidelity and tag returns are currently being analyzed. Towards the end of the nesting season, we saw a dramatic increase in coyote depredation of nests, with 4 nests depredated in 5 nights.

SUMMARY:
As the global climate changes it could have significant effects on coastal habitat and 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.

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 (UFPJ#00074216)
Research Staff: Frank Solis, Jennifer Solis

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.

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 also gathered spectral information and hatchling orientation data on the most popular lamps, including low pressure sodium and high pressure sodium lamps.

PROGRESS:

A complete set of lighting trials was conducted on July 23, 2009.

- Light intensity measurements (irradiance) were taken using an International Light IL 1700 research radiometer that was calibrated for wavelengths between 380nm and 740nm.
- Readings for each lamp were taken at 40nm increments between 380nm and 740nm, 15m from the light tower at ground level using 150W bulbs (90W for the LPS). LED fixtures were tested as supplied by the manufacturers.
- Experimental arena orientation trials were conducted at a single site along the eastern beach of Cape San Blas, Florida in September 2009, using 80 light-naive loggerhead hatchlings divided into 5 groups of 16 each (Control, HPS, LPS, Amber lens, Test Lamp).
- The center of the experimental arena was placed one-meter landward of Mean High Water. We used 100W lamps placed 45m from the experimental arena at a height of 24 feet: HPS, HPS with amber lens, Test lamp, 55W LPS, and control (no lamp).
- Orientation data were analyzed to:

1. Determine if groups of turtles were significantly oriented,
2 Assess whether groups of turtles were significantly oriented toward the most direct route to the sea (0°), and
3. Determine if orientation significantly differed between control and experimental treatment groups.

- Circular statistical methods were used to analyze these data. Exit angles for individual turtles were plotted in circular histograms for visual comparison among groups. Rayleigh's test was used to meet the first objective. A circular V-test was used to determine if groups of turtles were significantly oriented towards a pre-defined direction, in this case directly seaward (0°). Watson's U2 nonparametric test and

Watson-Williams F-tests (pair-wise comparisons) were used to determine whether significant differences existed among treatment and arena groups..

Results:

- All lamps emitted light below 540nm and into the shortest UV wavelengths, including the LED fixtures.
- The LED lamps emitted the least amount of light below 540nm followed by LPS, HPS, Test, Amber lens and GE Evolve.
- In proportion to the total light emitted by each lamp, the Test lamp emitted the smallest percentage of light less than 540nm, followed by HPS, Beta LED, Beacon Amber LED, LPS, GE Evolve, and Amber lens
- Non-uniform distributions were observed for hatchlings released under each lamp (Fig 4. $p < 0.05$).
- There was no significant difference between the orientation of hatchlings released under the Test Lamp and those released under the LPS or Amber lens.
- All lamps showed significantly different orientation effects than the Control and HPS.
- The LED lamps were not included in hatchling orientation trials because they were not available at the time trials were conducted.
-

Results of this study provide important information regarding criteria for developing beachfront lighting that will reduce hatchling sea turtle misorientation:

1. Both LED and LPS lamps produce a peak of intensity at near UV wavelengths. The LPS lamps also resulted in significant misorientation of hatchlings as compared to a dark sky.
2. Wavelengths in the UV range may result in significant misorientation of sea turtle hatchlings. Criteria for evaluating acceptable beachfront lighting should include reduction of light in these wavelengths.
3. Hatchling orientation may be affected by factors such as dune profile and beach slope. Similar lighting sources may produce different light patterns on varying beaches. When developing criteria for wildlife-friendly lighting, an acceptable level of misorientation must first be established (a control). This level most likely differs among beaches. Perhaps beaches should be categorized by profile and level of human activity, and different criteria should be established for different beach categories.
4. Turtle vision appears complex with varied levels of response throughout the spectrum. The spectral profiles of lamps are also complex with all lamps in our study producing light throughout the spectrum. Therefore, it is not appropriate to simply assign one wavelength as a cut-off for acceptability. The entire spectrum of the lamp should be examined along with intensity at each wavelength. This can be accomplished using a research radiometer.

SUMMARY:

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.

Gopher Tortoise (gopherus polyphermus)Population Survey For St. Marks NWR-Line Transect Distance Sampling

Principal Investigator: **Raymond R. Carthy**
Co-PI: Margaret Lamont
Funding Agency: US Geological Survey
Expected Completion: 4/30/12 (RWO#265, UF PJ#00089566)
Research Staff:

The gopher tortoise (Gopherus polyphemus), unlisted range, is among the U.S. Fish and Wildlife Ecological Services 2008 priorities as a “preclude the need to list” species. This project furthers the Strategic Habitat Conservation process by providing critical information necessary for outcome-based monitoring, planning and management at St. Marks National Wildlife Refuge.

PROGRESS:

Line transect distance sampling (LTDS) is the recommended method to accurately estimate population density over a large area (Buckland et al., 2001), therefore the following steps have been implemented:

1. Pilot Survey (completed April, 2010 through August, 2010)

Following guidelines provided by Stober and Smith, 2010, Meyer et al. 2008,and Nomani et al. 2008; a sampling frame was created by analyzing suitable soil, elevation and habitat data as developed and determined by St. Marks NWR and Jones Center staff. The pilot survey was implemented by St. Marks NWR and determined the encounter rate of tortoises (per linear transect distance) within various strata. Within the most suitable soil types on the refuge, an encounter rate of between 1 tortoise per 0.5 Km and 1 tortoise per 1.5 Km was recorded.

2. Survey Design (completed January, 2011)

The encounter rate was used to determine the total line transect length needed to obtain an adequate sample size of 60 – 80 tortoises. Utilizing an equation (Smith and Stober, 2010, Meyer et al. 2008, Buckland et al. 2001) to determine total transect lengths to achieve a predefined coefficient of variation (15%), we determined that 132 Km of transects must be surveyed within 2,201 hectares that constitutes the sampling frame. A stratified sampling design was created in Program DISTANCE 6.0 and ArcGis 9.3 using Hawth's Analysis Tools to determine the placement of east-west oriented transects across the sampling frame at an interval of 160 m north-south. The result is a series of 328 unique transect lines with a mean length of 418 m and a combined length of 137.1 Km.

SUMMARY:

Survey (proposed timeframe: June 1, 2011 through July 31, 2011)

A three-person survey team will use a Trimble Nomad handheld computer running ArcPad 7.1.1 and a sub-meter real-time corrected GPS to navigate to each transect line and will locate all burrows along the central transect line and no less than 20 m perpendicular from the centerline. Burrow scoping will be done with a color camera system modified from http://www.amazingmachinery.com/videoecono- products.html.

Data collection will follow guidelines provided by Smith and Stober, 2010 including: start and end points; transect ID, distance of burrow from transect line, burrow diameter, burrow scoping status; occupants observed, burrow length, and burrow activity status. Both active and inactive burrows will be scoped when encountered to avoid biasing occupancy rates by time and space, and by season and time-of-day (Breininger et al. 1991, Nomani et al. 2008). All burrows will be classified as 1) "occupied", if a gopher tortoise is observed in the burrow; 2) "not occupied", if no tortoise is observed; 3) "abandoned", if the burrow is collapsed or extensively modified by armadillo use; or 4) "undetermined", if observers are unable to manipulate the camera scope to the end of the burrow.

All other occupants observed in gopher tortoise burrows will be documented and recorded in a comprehensive database including the date, time and location of each occupant observed. This data will likely prove useful for future conservation efforts of burrow occupants and will potentially provide some baseline data as to the presence / absence of such species (including imperiled tortoise burrow commensal species with historical refuge occurrence records such as Eastern Indigo Snake, Southern Hognose Snake, Florida Pine Snake and Gopher Frog) across the refuge.

Incubation temperatures of loggerhead turtle (caretta caretta) nests On NW Florida Beaches

Principal Investigator: **Raymond R. Carthy**
Co-PI: Margaret Lamont
Funding Agency: US Fish and Wildlife service
Expected Completion: 3/1/11 (RWO#266, UF PJ#00089694)
Research Staff:

The ratio of males to females in a population is an important feature of population structure. Sex ratio directly relates to reproductive rate and adaptive capability of a population (Ridley 1993) and is necessary for determining size, status, and dynamics of the population. For all species of sea turtles, basic knowledge of natural existing sex ratios has been missing until recently and is still not complete for most nesting groups. Sex determination of sea turtles is dependent upon the temperature at which the eggs are incubated (Yntema and Mrosovsky 1982). Several features of nesting beaches have been shown to impact incubation temperatures therefore understanding temperatures of the beach in which eggs incubate is critical to our knowledge of sex ratios.

Factors influencing temperatures of nesting beaches include beach orientation, position of the nest on the beach, weather conditions, and sand characteristics (Hays et al. 1995, Leslie et al. 1996, Ackerman 1997). Northwest Florida provides reproductive habitat for a small but genetically distinct group of loggerhead turtles. This area is higher in latitude than the more productive nesting beaches on Florida’s east coast and generally has whiter, finer grain sand beaches than the east coast. It is unknown whether these characteristics influence incubation temperatures, and thereby sex ratios of sea turtle nests in Northwest Florida.

OBJECTIVES:

The objectives of this study are to:

1. Determine sand temperatures and loggerhead nest incubation temperatures in Northwest Florida
2. Determine the relationship between sand temperatures and incubation temperatures
3. Examine variations in incubation rates, sand temperatures, and incubation temperatures at several nesting beaches throughout Northwest Florida.

PROGRESS:

All transect data have been converted from Boxcar Pro to Excel and monthly means calculated. Means were generated for 9 beaches across the FL Panhandle, including St. George Island, St. Vincent Island, St. Joseph Peninsula, St. Joseph State Park, Tyndall AFB, Panama City Beach, Santa Rosa Island, Walton County Beaches and Perdido Key. Data for sand transects are currently being analyzed to determine trends. Year 2000 temperatures have been compiled and indicate sand temperatures on eastern beaches are warmer than those on western beaches. Mean temperatures for St. George Island are 29.4 C° whereas those for Walton County Beaches are 27.9 C°. We will continue analyzing sand temperatures at all sites for comparison. In addition, data from loggers placed inside turtle nests will be converted and analyzed.

Incubation data from all beaches has been collected and compiled. These data indicate incubation times on beaches east of the Cape San Blas spit (60.9 days) are significantly shorter than those west of the Cape San Blas spit (65.1 days). This supports sand temperature data suggesting that beaches east of the Cape San Blas spit are warmer (resulting in shorter incubation periods). As sand temperature data are analyzed, comparisons with incubation lengths will continue.

SUMMARY:

Sex determination of sea turtles is dependent upon the temperature at which the eggs are incubated (Yntema and Mrosovsky 1982). Several features of nesting beaches have been shown to impact incubation temperatures therefore understanding temperatures of the beach in which eggs incubate is critical to our knowledge of sex ratios.

Pre-assessment Plan to Determine Potential Exposure and Injuries of Nesting and Hatching Loggerhead Sea Turtles

Some nesting loggerhead turtles are satellite tagged in order to monitor inter-nesting behavior, as well as foraging movements and reproductive migrations where they may face anthropogenic impacts.

Principal Investigator: **Raymond R. Carthy**
Co-PI: Margaret Lamont
Funding Agency: US Fish and Wildlife service
Expected Completion: 3/1/11 (UF PJ#00090003)

The Mississippi Canyon 252 (MC 252) incident is unparalleled in the scope of its potential geographic impact. Marine and estuarine ecosystems from Texas to Florida are in immediate danger. Potential impacts of oil and dispersants on loggerhead turtles range from mortality to sub-lethal stress and chronic impairment, including potential deleterious effects on reproduction and recruitment. Response and cleanup efforts may also cause loggerhead turtle loss and impairment.

The purpose of this plan is to determine and quantify exposure and injuries to the nesting adult loggerhead sea turtles that reside in and nest along the shores of the Gulf of Mexico resulting from exposure to MS Canyon 252 oil (hereafter referred to as oil). This study is being conducted in partnership with a separate yet identical project to quantify exposure and injury to adult Kemp's ridley turtles that nest primarily along the Texas coast. Combined, these two studies will assess nesting turtle impacts along the entire Gulf coast of the United States.

OBJECTIVES:

The objectives of this study are to:
1. Nesting female physical condition, internesting movements and blood chemistry will be assessed as a function of pre-spill, concurrent-with-spill, and post-spill concentrations of oil and dispersants in and on nesting females and nesting substrate to determine the relationship between oil and dispersant exposure and magnitude of injury.

2. A toxicological and physiological baseline will be established in nesting females by comparing beaches in the Gulf of Mexico within the impact zone to beaches outside the impact zone.

These objectives will be met by conducting nesting female physical evaluations, satellite tracking nesting female inter-nesting and post-nesting movements, collecting blood from nesting females, collecting viable eggs, along beaches within the oil spill impact zone and beaches outside the oil spill impact zone. Samples will be analyzed for hydrocarbons and physiological parameters.

PROGRESS:

Four loggerhead turtles that nested along the St. Joseph Peninsula in NW Florida were fitted with satellite tags to track movements. In addition, the carapace of approximately 30 turtles on the St. Joseph Peninsula were swiped for potential oil residue, blood was collected from 4 turtles, and nest content samples were collected from approximately 5 nests. In the Dry Tortugas National Park, 7 nesting loggerhead turtles received satellite tags along with approximately 5 carapace swipes and 2 blood samples. Nest contents were collected from approximately 5 nests. Along Casey Key, 5 nesting turtles received satellite tags while approximately 20 carapace swipes were collected and no blood samples. Nest content samples were collected from approximately 20 nests. Nest content samples were also collected from almost every loggerhead nesting beach along the Gulf Coast of Florida and Alabama. These samples are being analyzed as part of the legal NRDA process and results are confidential.

SUMMARY:

The Mississippi Canyon 252 (MC 252) incident is unparalleled in the scope of its potential geographic impact. Marine and estuarine ecosystems from Texas to Florida are in immediate danger and the potential impacts of oil and dispersants on loggerhead turtles range from mortality to sub-lethal stress and chronic impairment, including potential deleterious effects on reproduction and recruitment.

American Alligator Distribution, Size, and Hole Occupancy and American 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: 03/31/2015
(RWO#268, Project #89747, #89760)

The Water Resources Development Act (WRDA) of 2000 authorized the Comprehensive Everglades Restoration Plan (CERP) as a framework for modifications and operational changes to the Central and Southern Florida Project needed to restore the South Florida ecosystem. Provisions within

WRDA 2000 provide for specific authorization for an adaptive assessment and monitoring program. A Monitoring and Assessment Plan (MAP) (RECOVER 2004, 2006) has been developed as the primary tool to assess the system-wide performance of the CERP by the REstoration, COordination and VERification (RECOVER) program. The MAP presents the monitoring and supporting research needed to measure the responses of the South Florida ecosystem to CERP implementation.
At all life stages, crocodilians integrate biological impacts of hydrologic conditions (Mazzotti and Brandt 1994, Mazzotti 1999, Mazzotti and Cherkiss 2003, Rice et al. 2005). Florida's two native species of crocodilians—the American alligator (*Alligator mississippiensis*) and the American crocodile (*Crocodylus acutus*)—are important indicators of health of the Everglades ecosystem because research has linked three key aspects of Everglades' ecology to them: (1) top predators such as crocodilians are directly dependent on prey density, especially aquatic and semi-aquatic organisms, and thus they provide a surrogate for status of many other species, (2) drier (nests) and wetter (trails and holes) conditions created by ecosystem engineers like alligators provide habitat for plants and animals that otherwise would not be able to survive. This increases diversity and productivity of Everglades marshes (Kushlan and Kushlan 1980, Palmer and Mazzotti 2004, Campbell and Mazzotti 2004) and, therefore, alligator monitoring can indicate overall health of the marsh (3) the distribution and abundance of crocodilians in estuaries is directly dependent on timing, amount, and location of freshwater flow (Dunson and Mazzotti 1989, Mazzotti and Dunson 1989); crocodiles and alligators exhibit an immediate response to changes in freshwater inputs into the estuaries.

RECOVER's conceptual ecological models (CEMs) for the Total System, Biscayne Bay, Southern Marl Prairies, Ridge and Slough, and Mangrove Estuarine ecosystems identify three major stressors to wetlands that are affecting populations of alligators and crocodiles: (1) water management practices (affecting hydrology); (2) agricultural and urban development (affecting habitat loss and hydrology); and (3) decreased freshwater flow to estuaries (affecting salinity regimes) (U.S. Army Corps of Engineers (USACE) 2004). Results of this proposed MAP project will increase certainty of CEM linkages hypothesizing population responses to the restoration of freshwater flow and salinity patterns in estuaries and the return of more natural hydropatterns in interior wetlands and alligator holes.

Restoration success or failure can 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, USACE 2004). Importantly, these data can be used in an analysis designed to distinguish between effects of CERP and those of non-CERP events such as hurricanes or droughts. The CERP and RECOVER MAP hypotheses and goals related to crocodilians are as follows:

Alligators

- Restoration of hydropatterns (depth, duration, distribution, and flow) in Southern Marl Prairies/Rocky Glades will expand the distribution and abundance of reproducing alligators and active alligator holes and will restore the keystone role of alligator holes as refugia for aquatic fauna.

- Restoration of estuarine salinity regimes will expand distribution and abundance of reproducing alligators into oligohaline portions of estuaries.

- Restoration of hydropatterns in ridge and slough landscape will sustain current populations of alligators and improve body condition of alligators in ridge and slough landscape.

Crocodiles

- Restoration of freshwater flows and salinity regimes to estuaries will increase growth and survival of crocodiles.

- Restoration of location of freshwater flow will result in an increase in relative density of crocodiles in areas of restored flow, such as Taylor Slough/C-111 drainage.

Concerns about these indicators relate primarily to their respective roles as top predator, keystone species, and ecosystem engineer (American alligator), and top predator, flagship species, estuarine dwelling, and federally threatened species (American crocodile). Reproduction, growth, and survival of crocodilians are dependent on food availability—birds, mammals, fish, and macroinvertebrates, which in turn are dependent on hydrologic conditions. Loss of flow and relatively dry hydrologic conditions resulting from water management practices over the past several decades, and loss of habitat (due partly to reduced areas of inundation, increased drydowns, and increased salinization) in portions of the Everglades have adversely affected alligators and crocodiles (Mazzotti and Brandt 1994, Mazzotti and Cherkiss 2003, Rice et al. 2005, Mazzotti et al. 2009). Loss of habitat in Southern Marl Prairies and Rocky Glades and reduction in depth and period of inundation in remaining Everglades wetlands have reduced abundance of alligators and alligator holes in these habitats (Craighead 1968). Other areas are impacted by ponding and altered timing of increased water depths, resulting in nest flooding (Kushlan and Jacobsen 1990) and reduced body condition (Dalrymple 1996). Reduced prey availability throughout the system as a result of hydrologic alterations corresponds with lower growth, survival, and reproduction of alligators (Mazzotti and Brandt 1994).

Both alligators and crocodiles have been affected by loss of freshwater flow to estuaries. This loss of flow corresponds with a reduction in distribution and abundance of alligators (Craighead 1968). Although there are higher numbers of crocodiles in more places today than when the species was declared endangered, virtually all of the increase is due to crocodiles occupying and nesting in man-made habitats such as the Turkey Point Power Plant site and along the East Cape Canal (Mazzotti and Cherkiss 2003, Mazzotti et al. 2007). The mangrove back-country of northeastern Florida Bay has consistently been considered core habitat of the American crocodile in Florida (Kushlan and Mazzotti 1989, Mazzotti 1999, Mazzotti et al. 2007). Today this physically unaltered area suffers from diversion of fresh water (McIvor et al. 1994). This area also has the lowest rates of growth and survival of crocodiles anywhere in Florida (Mazzotti and Cherkiss 2003, Mazzotti et al. 2007).

Because of its unique geographic location and subtropical climate, the Greater Everglades is the only place in the world where both alligators and crocodiles occur. The most important factors affecting regional distribution and abundance of these crocodilians are loss of habitat, changing hydroperiod, altered water depth, and changing salinity (Mazzotti and Brandt 1994, Mazzotti 1999, Mazzotti and Cherkiss 2003, Rice et al. 2005, Mazzotti et al. 2007). Water management has changed the pattern of water levels in the southern Everglades, causing unnatural flooding events and mortality of alligator nests (Kushlan and Jacobsen 1990). Increasing drought frequency and depth of drying have reduced the suitability of Southern Marl Prairie and Rocky Glades habitats and occupancy of alligator holes by alligators. Increasing drought frequency and depth of drying have also increased the time required for fish and macroinvertebrate populations to recover to levels considered representative of the historical Everglades (Trexler et al. 2003). When drying events occur repeatedly at less than a 3- to 8-year interval, fish and macroinvertebrate populations are continually recovering from past droughts and may fail to reach densities sufficient to sustain large predators such as alligators (Loftus and Eklund 1994, Turner et al. 1999, Trexler et al. 2005). Diminished prey density is correlated with lower growth and reproductive rates for alligators in the Everglades compared to other parts of their range (Mazzotti and Brandt 1994). Repeated drying events may also wipe out entire age classes, as alligators are forced to congregate in remaining bodies of water where they may suffer from predation and cannibalism.

Changes in water salinity patterns also affect populations of crocodilians (Dunson and Mazzotti 1989, Mazzotti and Dunson 1989). Although American crocodiles are more tolerant of saltwater than alligators, both species prefer fresh to brackish water (Mazzotti 1983). The distribution of alligators in estuaries has been affected by intrusion of saltwater (Craighead 1968, Mazzotti and Brandt 1994). In northeastern Florida Bay occurrence of alligators corresponds with presence of fresh water (Mazzotti 1983). Regionally, lack of fresh water has been correlated with lower growth and survival of crocodiles (Moler 1992, Mazzotti and Cherkiss 2003, Mazzotti et al. 2007).

In a particularly encouraging finding, Mazzotti et al. (2007) reported that after Buttonwood and East Cape canals in Everglades National Park were plugged in the 1980s to reduce saltwater intrusion into interior areas of Whitewater Bay and Cape Sable, crocodiles responded positively by increasing local nesting effort and success. This clear result suggests that restoring historical salinity patterns in estuaries can have a positive effect on this indicator species and that long-term monitoring is effective at determining population-level responses. It also indicates that nesting phenology, effort, and success should be added to growth and survival as monitoring parameters.

OBJECTIVES:

1. Monitor changes in alligator populations resulting from restoration over short-term (body condition), medium-term (distribution, relative density, hole occupancy) and long-term (demography) temporal scales

2. Monitor changes in growth, survival, body condition, relative density, and nesting of crocodiles in response to CERP projects.

PROGRESS:

Alligator captures: A total of 183 (94 female and 89 male) alligators were captured in the spring at 15 areas (9 marsh, 2 canal, and 1 estuary; Figure 1). Of those captured, 153 were new individuals and 30 were recaptured individuals. Captured alligators ranged from 125.3 cm to 309.5 cm. A total of 156 (87 female and 71 male) alligators were captured in the fall. Of those captured, 122 were new individuals and 36 were recaptured individuals. Captured alligators ranged from 125.5 cm to 309.5 cm.

Alligator Surveys: Spring alligator surveys were conducted in 9 marsh, 7 canal, and 1 estuary areas. Alligator encounter rates ranged from 0.0/km to 6.6/km in the marsh/estuary and 0.3/km to 12.3/km in canals. Fall alligator surveys were conducted in 9 marsh and 1 estuary areas. Alligator encounter rates ranged from 0.0/km to 4.4/km.

Alligator Hole Occupancy: Spring alligator hole occupancy flights were conducted in 3 areas and ranged from 0.0% to 7.93% of hole observed had alligators present.

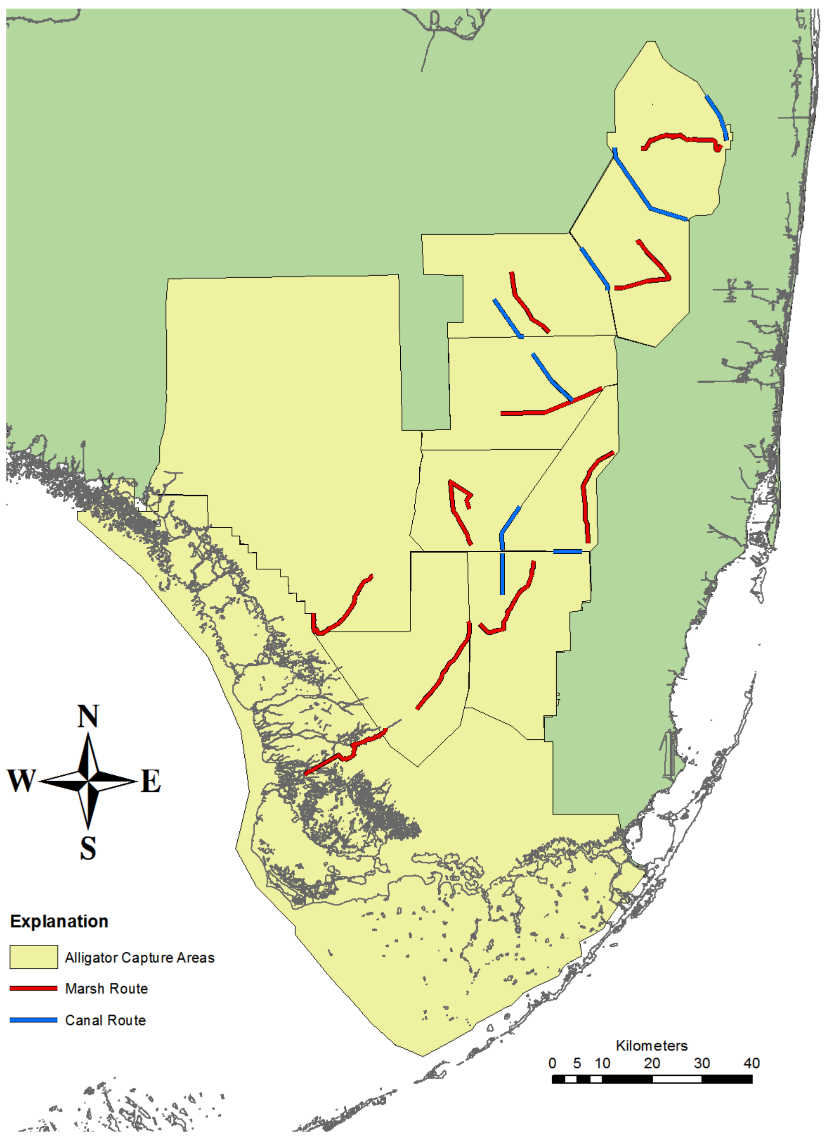


Figure 1. Alligator capture and survey locations.

Crocodile Surveys: Surveys performed from Biscayne Bay and Key Largo west along most of the accessible coastal and estuarine shoreline to Cape Sable in ENP resulted in 138 crocodile observations, 57 alligator observations and 184 indistinguishable eyeshines (Figure 2). Forty four crocodile captures were made, with 25 individuls being recaptures. Personnel at TP and FWC originally marked four and one of the recaptured crocodiles, and the University of Florida originally marked the remaining 20.

During January 2010 there was an extreme cold event, for which we performed surveys to assess crocodile deaths. Of the 150 total dead crocodiles observed, 46 (31%) were visited on the ground. We physically measured 78 individuals, whose size ranged from 46.8 – 409.5 cm TL (mean TL 249.10 cm, SD 76.84). There were an additional 65 were size was estimated (could not be measured) which ranged from 160.0 – 450.0 cm TL, (mean TL 296.0 cm, SD 64.0) and seven for which no size is available. Sex was determined for 38 animals (21 female and 17 males).

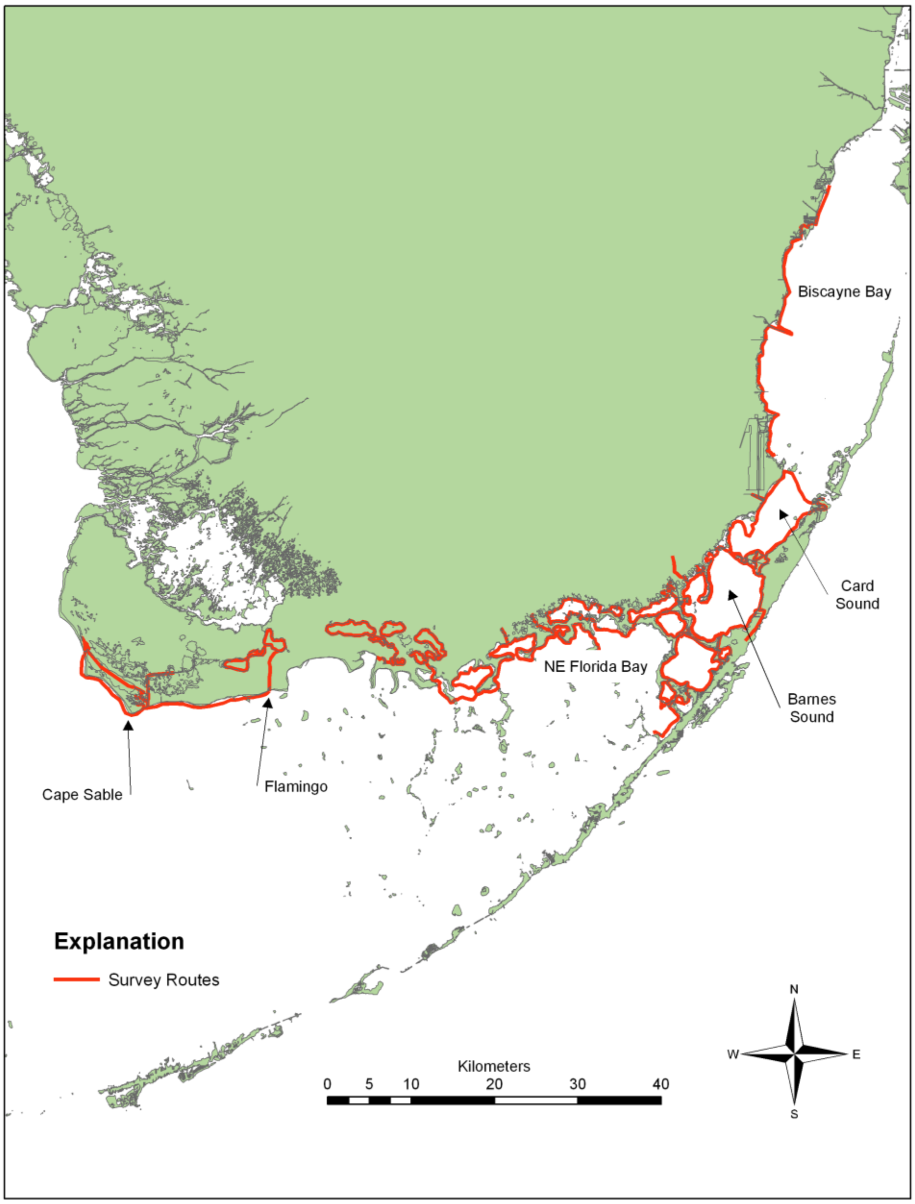


Figure 2. Crocodile survey routes.

Crocodile Nesting: Eighty-seven confirmed nests were located during the 2010 nesting season during University of Florida surveys, 85 within ENP, one depredated nest was located at Chapman Field in Miami, and one nest located in Deering Bay. For nests whose fate was known, eighty-seven percent (75) were successful, 6% (5) were depredated by raccoons and the remaining 7% (6) failed for unknown reasons. A total of 549 hatchlings were captured, from nests in ENP.

SUMMARY:

Hydrology influences alligator densities and body condition and crocodile juvenile growth and survival in the Everglades.

Monitoring of Wood Stork & Wading Bird Reproduction in WCAS 1, 2 & 3 of the Everglades

Principal Investigator: Peter Frederick
Funding Agency: U.S. Army Corps of Engineers
Expected Completion: 12/31/2010 (RWO 230 – UF#00054346)
Research Staff: John Simon, Chris Winchester, Louise Venne

The numbers of breeding pairs of wading birds in the Everglades and their reproductive success measures have been used for some time to reflect hydrological and biotic conditions in the Everglades, and there is compelling evidence that various aspects of wading bird reproduction and foraging ecology can be mechanistically linked with various aspects of the ecology and hydrology of south Florida wetlands. These relationships are strong enough that wading birds therefore have been chosen as important indicator species for the progress of Everglades restoration, and explicit predictions about specific species and their reproductive reactions have been expressed as a series of trophic hypotheses. This monitoring effort is specifically designed to document the annual reproductive responses of wading birds throughout the ecosystem, including Lake Okeechobee, central and southern Everglades, and Florida Bay. Here, we report on reproduction by wading birds in the 2010 breeding season.

PROGRESS:

The 2010 nesting season (November 2009 – July 2010) was exceptionally cold and had numerous rainfall events during the normally dry winter and spring, mostly the result of a strong El Nino event. This caused numerous reversals in the drying trend of water, and near-flat pool conditions in much of the WCAs until late March. The cold was both continuous and extreme, with deviations from normal temperatue being well below one standard deviation below the mean deviation in January, February and March of 2010. Cold temperatures probably strongly affected fish and invertebrate availability to birds, with daily low temperatures below thresholds for burrowing and hiding behavior in fishes on 62% of days, and daily mean temperatures below this on 23% of days. In addition, particularly cold snaps and continued cold temperatures may have caused extreme physiological stress on adult birds.

By comparison with the recent past, 2010 was an exceptionally low year in terms of numbers of nests and nesting success. We estimated a total of 12,432 wading bird nests were initiated at colonies within LNWR, WCA 2, and WCA 3. This was the lowest number of nests recorded in the WCAs since the current survey protocol was established in 2005, was one-third the average of the previous 10 years and less than one-quarter of the banner year in 2009. The most significant reduction was observed in WHIB initiations (6X reduction by comparison with 2009). There was no WOST nesting in the WCAS in 2010, and numbers of Roseate Spoonbills were the second smallest since nesting in the WCAS began in the early 2000's. Reductions in nesting was also true of species that typically do well under conditions that do not concentrate prey. By comparison with 2009, Great Blue Heron nests were decreased in 2010 by 48% and Tricolored Herons by 57%. By comparison with the 5-year average, Tricolored Heron nests were down by 72% and Little Blue Herons were down by 41%.

Generally, nest success was much depressed by comparison with most other estimates from the Everglades or reproductive statistics typical of the species. Wood Storks failed at all locations at which they initiated nesting this year. White Ibis nests had less than a 1% probability of fledging at least one young in 2010, while typical figures in good years exceed 50%. For Great Egrets, only 7% of nests fledged at least one young in 2010 and a more typical figure is 70% under good hydrological conditions. Snowy Egrets and Tricolored Herons managed somewhat better, with nest success at 46% and 54%, respectively. These species may have done better because they nested somewhat later and were able to fit their nesting cycle into a period of more consistent drying pattern. In general, brood sizes for nests that did survive were lower than typical for each species.

During 2010 there was some progress towards wading bird restoration indicator goals. Storks began nesting in late January, which is earlier than most years in the past, though still a far cry from the November initiations typical of the pre-drainage period. The proportion of nesting in the coastal ecotone was the highest it has been since the 1960s, though it is likely that this was the result of very poor hydrological conditions in the WCAs rather than markedly improved conditions in the coastal ecotone wetlands. The interval between exceptional ibis nesting years is only one since 2009 qualified as an exceptional nesting year (2010 did not). This puts this interval well within the 2-5 year interval typical of the pre-drainage period. The ratio of tactile (ibis + Wood Stork) to non-tactile (Great Egret) foragers was quite low in 2010 largely as a result of poor nesting by ibises, and no progress was made on that indicator.

SUMMARY:

In sum, the 2010 nesting year was extremely poor, though not unexpected given the hydrological and temperature conditions that prevailed. While the response by the birds may not be surprising, it is of great interest to know how frequently these conditions may occur in the future, especially under changing global weather patterns.

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

Foam alligators used by Brittany Burtner and Peter Frederick to investigate the relationship between alligators and wading bird nesting colonies in the Everglades.

Principal Investigator: Peter Frederick
Funding Agency: U.S. Army Corps of Engineers
Expected Completion: 12/31/2014 (RWO 254 – UF#00085805)
Research Staff: John Simon, Chris Winchester, Brittany Burtner

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.

OBJECTIVES:

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.

PROGRESS:

1. Aerial and ground surveys for January, February and March have been completed, with ground checks at all active colonies.
2. Monitoring of Wood Stork colonies has been done on a biweekly basis, both from targeted aerial surveys and from ground observations.
3. This season was a terrible year for nesting by wading bird of all species. Water levels did not declined appreciably in WCAs 1 and 3, and only marginally in ENP. This was a product of repeated rains during the winter and early spring that result from the El Nino weather pattern. In addition it has been an unusually and consistently cold winter – this has likely further exacerbated already poor foraging conditions for wading birds by causing prey animals to burrow and become inactive.

<u>*Nesting Effort:*</u> We estimated a total of 12,432 wading bird nests were initiated at colonies within LNWR, WCA 2, and WCA 3 (Tables 1 and 2). This was the lowest number of nests recorded in the WCAs since the current survey protocol was established in 2005. The total is approximately one-third the average of the previous 10 years and less than one-quarter of last year's value.

The most significant reduction was observed in WHIB initiations. This season's estimates are over 6 times smaller than the previous 5-year average of about 19,500. While LNWR hosted comparable numbers of WHIB nests this season, the WCAs (specifically Alley North, Hidden, and 6th Bridge) saw only a small fraction of their usual numbers. Like the 2007 and 2008 nesting seasons, this year saw no WOST nesting in our study area, a stark contrast from the 1433 nests found in 2009. As above, there was unusually high rainfall and very persistent cold temperatures during the January through April period. Both rainfall and cold temperatures are known to strongly affect availability of prey animals, and we suspect that the low prey availability was the strongest of the effects resulting in low numbers of initiations. In addition, there may have been unusual and direct effects of cold, wet weather on energy expenditure by wading birds this winter.
Reproductive Success. Nest starts were relatively late in the 2010 breeding season with most initiated in early- to mid-April. For Great Egrets this is at minimum 4 weeks later than usual for WCA 3. Nest success varied substantially by species at the five colonies in WCA 3 we monitored: Alley North, Hidden, Joule, L-67, and Cypress City. GREG nests predominated at Joule (N = 26), L-67 (N = 20), and Cypress City (N = 28). Combined with those we monitored at Alley North (N = 24), we calculated a very low success (at least one fledgling) rate of 27.6% at those nests where the fate could be determined. In the GREG nests that were successful, we found an average of 1.7 fledglings produced, or an average of 0.5 fledglings for all nest attempts.

Small herons (TRHE, LBHE, SNEG) appeared to have greater success. We monitored 20 TRHE nests at Hidden, 1 at L-67, and another 34 mixed small heron nests at Alley North. Combined we found a nest success rate of 74.5%, with 2.4 fledglings per successful nest or 1.8 for all nest attempts. We followed the fate of 30 WHIB nests at Hidden and 2 (plus 4 GLIB) at Alley North. They too had a relatively high success rate compared to GREGs with 75% producing at least one fledgling. We recorded an average of 1.4 fledglings per successful nest or 1.1 for all attempts.

The pattern therefore appears to be that early nesters like Great Egrets endured the majority of reversals and cold weather, and had extremely poor success, while the small numbers of later nesters (ibises and small herons) had considerably higher nest success, probably as a result of late nesting and avoidance of the majority of reversals.

SUMMARY:

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.

2010 was probably the worst nesting year in over 40 years that have been monitored in the region.

Determination of Population Diversity in the Florida Endangered Orchid Cytopodium punctatum

Daniela Dutra, graduate student, studying the reproductive biology of Cyrtopodium punctatum the cigar orchid.

Principal Investigator: Michael E. Kane

Funding Agencies: U.S. Department of Interior, USGS

Expected Completion: 9/30/2011 (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 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:

- 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:

Site visits to the FPNWR were previously made to collect newly developed leaves of *C. punctatum* for "clean" DNA extraction from the major of the individuals in the limited existing populations. With the guidance of Larry Richardson visits were made to various sites on the FPNWR to identify the locations for future reintroduction of *C. punctatum* plantlets. Plants are scheduled to be reintroduced to the FPNWR in late Spring 2011. The DNA extraction of all leaf samples was completed and samples were then submitted to the University of Florida Genetic Analysis Laboratory for ALFP marker analysis. After a delay due to technical issues, the raw AFLP marker data has been obtained and is being analyzed using GeneMarker®.

Flower of *Cyrtopodium punctatum*

SUMMARY:

This project is a continuation of Florida orchid conservation research efforts to insure that native orchids, such as *Cyrtopodium punctatum,* will continue to thrive in their natural habitats as independent organisms. Knowledge of the population genetic diversity is key to development of sound conservation plans for these native orchid species.

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

The ecology & reproductive biology of the native FL orchid species, Eulophia alta.

Principal Investigator: Michael Kane
Funding Agencies: U.S. Department of the Interior
Expected Completion: 9/30/2011 (UF69301)
Biological Scientist: Nancy Philman
Research Staff: Tim Johnson, Daniel Dutra, Philip Kauth,

North America possesses approximately 250 unique species of both epiphytic and terrestrial orchids with Florida having 118 of those species. Florida native orchids are faced with a constant on-slaught of habitat loss due to land conversion to agricultural uses or 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.

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.

Flower of Bletia purpurea, the pine-pink orchid

PROGRESS:

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.

Soil characterization and vegetation data has been completed for *Bletia purpurea*. Principle coordinate analysis of data is currently underway. Preliminary examination of the data indicates that Pistol Pond, McBride's Pond and Western Helipad sites where *B. purpurea* are located each have distinct vegetation and soils characteristics. This may result in different selection pressures at these 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. The results of this study indicate that storage of fresh seed at -10°C is detrimental to seed viability and that this effect is compounded when seeds are not stored with desiccant. Room temperature storage appears to be an acceptable alternative to cold storage. Seeds from various treatments are currently being examined using transmission electron microscopy to look for signs of freeze damage. An additional experiment is underway to examine the effect of moisture content on seed storage at -10°C. Statistical analysis and repetition of this experiment is currently ongoing. Following the identification of suitable storage conditions, viably seeds were once again co-cultured with a symbiotic fungus that had previously promoted germination of *E. alta*. In this experiment, the fungus was found to no longer support germination. It is possible that artificial selection in culture has led to this change.

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. From these experiments, it has been found that germination in darkness is dependent upon exogenous carbohydrates (sucrose, fructose, glucose and trehalose were all suitable for promoting germination and development). Seeds are able to germinate under illuminated conditions without a carbohydrate source, though sucrose enhances germination and development. Contrary to previous reports with other orchid species, *B. purpurea* is not able to utilize sugar alcohols. These findings have been accepted for published in Plant Growth Regulation (Johnson et al, in press). Production of seedlings is hampered by the inability of small seedlings to produce corms and substantial leaves. Experiments have been conducted to see if this is due to asymbiotic media, light environment or media depletion. However, the problem persists.

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. A living library of 126 plants from three FPNWR sites (Pistol Pond, McBride's Pond and Western Helipad) and Fakahatchee Strand State Preserve has been collected and is currently kept at UF-Gainesville. DNA extraction is underway.

As an accompaniment to this study, a three year investigation of the breeding system of *B. purpurea* on the FPNWR has also been completed. Results are that exclusion of pollinators did not limit capsule set, indicating that cleistogamy may be the dominant or exclusive mode of reproduction for this species. In light of these results, the genetic diversity and adaptability of *B. purpurea* populations on the FPNWR are expected to be very low. This may pose a considerable challenge to management and conservation of this species. An investigation of the genetic diversity of this species throughout its range in Florida may be needed.

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.

Bletia purpurea populations also persist on the FPNWR in diverse habitats. Pollen-limitation is not an issue since plants are cleistogamous and produce large quantities of seed each year. However, cleistogamy leads to homozygosity making genetic diversity a potential management challenge. 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 well with this species in the past and may be the most reliable method of propagation for future reintroductions. In addition to the direct conservation goals associate with this project, *B. purpurea* is emerging as an important model for understanding orchid seed germination and propagation.

SUMMARY:

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 propagation and conservation of these native orchid species will allow others to apply these same procedures to other orchid species throughout Florida.

Population Genetic Analysis and Assessment Of Hybridization between Calopogon tuberosus var. tuberosus and var. simpsonii

Principal Investigator: Michael E. Kane
Co-Principal Investigator*:* Philip Kauth
Funding Agencies: U.S. Department of Interior,USGS
Expected Completion: 9/30/2011 (RWO 262, UF#84877)

Calopogon tuberosus var. tuberosus

Calopogon tuberosus is a widespread terrestrial orchid of eastern North America. In Florida two varieties exist: var. *tuberosus* and var. *simpsonii*. Variety *tuberosus* is found as far south as Collier and Broward counties while var. *simpsonii* is found in puare stands in only extreme south Florida. Both varieties are found in the Florida Panther National Wildlife Refuge (FPNWR), making this one of the only locations where both varieties grow together. Using AFLP genetic analysis Goldman et al. (2004a) found that var. *simpsonii* formed a coherent group. This was also supported by distinct morphologically features between var. *tuberosus* and var. *simpsonii* (Goldman et al. 2004b). However, based on isozyme analysis, Trapnell et al. (2004) reported low genetic identity for var. *simpsonii*. They suggested that var. *simpsonii* has been reproductively isolated from var. *tuberosus* for a long period of time. On closer examination of the FPNWR population, many plants exhibit morphological similarities of both varieties. Hybridization between the two varieties may exist through gene flow in transitional habitats located from Naples to northward to Stuart, FL (Goldman et al., 2004b), which directly contrasts Trapnell's suggestion of reproductive isolation. As orchid populations are becoming threatened with extinction from habitat loss, identifying and investigating the genetics of populations and hybridization is necessary to assess their conservation status. In a possible hybrid zone, selecting donor plants for propagation purposes may be facilitated by differentiating hybrids from the species. The existence of both *Calopogon* varieties and possible hybrids at FPNWR, provides an opportunity to generate base line genetic analysis which will be critical for interpretation of future studies of the breeding systems and the pollination biology of the *C. tuberosus* varieties.

Calopogon tuberosus var. simpsonii

OBJECTIVES:

Determine the genetic composition of *C. tuberosus* var. *tuberosus* and var. *simpsonii* populations on the FPNWR and in pure stand populations outside of the FPNWR using AFLP-based genetic analysis.

Determine the existence and extent of hybridization occurring between the *C. tuberosus* varieties on the FPNWR.

Determine the genetic composition of *C. tuberosus* var. *tuberosus* and var. *simpsonii* in pure stand populations outside of the FPNWR using AFLP-based genetic analysis.

TASKS

- Plants from each variety and possible hybrids between var. tuberosus and var. simpsonii will be identified
- Plant morphometric data will be taken for each variety and hybrid plants
- Leaf samples from each variety and potential hybrid plants will be collected
- DNA will be extracted from leaf samples
- Isolated and purified DNA will be sent to the ICBR lab at the University of Florida for AFLP analysis

PROGRESS:

Forty leaf samples were collected in May 2010 from three populations at the Florida Panther National Wildlife Refuge and ten samples from a population at the Fakahatchee Strand Preserve. Morphometric analysis (including flower and whole plant measurements) was also performed on all plants from which leaf samples were collected. DNA was isolated over four months from June-September 2010. Good quality DNA was isolated and 51 samples were sent to the ICBR Lab at the University of Florida for AFLP analysis in October 2010. A sample from a population of *Calopogon tuberosus var. tuberosus* in north central Florida was also included as a true C. var. tuberosus sample. Unused leaf samples and DNA is being stored at -80 C at the University of Florida Environmental Horticulture Department.

SUMMARY:

Calopogon tuberosus is a widespread terrestrial orchid of eastern North America. In Florida two varieties exist: var. *tuberosus* and var. *simpsonii*. Both varieties are found in the Florida Panther National Wildlife Refuge (FPNWR), making this one of the only locations where both varieties grow together, and many plants exhibit morphological similarities of both varieties. In a possible hybrid zone, selecting donor plants for propagation purposes may be facilitated by differentiating hybrids from pure species. The existence of both *Calopogon* varieties and possible hybrids at FPNWR, provides an opportunity to generate base line genetic analysis which will be critical for interpretation of future studies.

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: 07/15/2010 (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.

PROGRESS:

We studied patterns of habitat selection by northern bobwhite quail on BWMA and evaluated factors influencing the sizes of their home ranges. Home range sizes were generally larger in winter than in summer. Home ranges sizes were smaller on average for birds with home ranges that intersected a food strip. This pattern was especially prominent in winter when food is more likely to be scarce. Bobwhite quail on BWMA appear to prefer habitat that includes dry prairie and food strips while avoiding wet prairies and roads. These patterns generally hold for both sexes. Additionally, the bobwhite quail telemetered for this study had home ranges significantly closer to food strips than would be expected by chance alone. These patterns seems to indicate that food may be a limiting resource on BWMA, especially in winter, and that the supplemental food strips may help mitigate this effect.

Nest site location represents another use of habitat by bobwhite quail. Bobwhite quail on BWMA primarily nested in dry prairie and pine palmetto habitats. The nests tended to be closer to food strips and farther from water than expected by chance. Avoidance of water was likely an attempt to reduce the chance of nest failure due to flooding. Nests also occurred more frequently in areas with high level of patch interconnectedness. This indicates a dependence of bobwhite quail on highly complex habitat for nesting. Therefore care should be taken that land management actions are implemented in small enough parcels that habitat complexity is not reduced. At BWMA habitat did not seem to affect nest success. However care should be taken in the interpretation of these results as the few nest locations in apparently suboptimal habitat may have been selected by nesting bobwhite quail based on criteria not considered in this study.
Clutch size and nest success were higher with first nest attempts than subsequent ones. Females were more successful at incubating nests than males. The rate of double nesting was low compared to that in the literature, but this may have been due to lower nest success and adult survival at BWMA than at other study sites described in the literature. Bobwhite quail at BWMA often did not have the opportunity to double nest because either the first nest failed, and they therefore renested instead, or they died before having the opportunity to attempt a second nest. Brood survival at BWMA was also lower than reported in the literature. There was no impact of food strip density on nest success or brood survival, perhaps because food resources are less limited during the reproductive season than at other times of year.

Survival of bobwhite quail at BWMA was relatively low when compared to other studies. Winter survival was relatively constant except in 2008, when harvest pressure was lower due to reduced hunting effort. Winter survival in 2008 was the highest measured for any winter during this study. Additionally, winter survival at the Field Trial

Course, where harvest pressure was lighter, was substantially higher than in other zones. This suggests that harvest mortality is at least partially additive during winter on BWMA. However, annual survival did not vary among areas with low and high harvest pressure. Juvenile survival at BMWA was lower than adult survival in summer but there is no evidence that they are different in winter, suggesting that harvest pressure had the same effect on juveniles as adults. There was no significant difference in survival between males and females in this population.

We used demographics collected during this study to parameterize a matrix population model. This model was used to estimate overall and year-specific population growth rates, to determine contribution of vital rates to annual changes in population growth rates, and to evaluate the role of harvest and weather conditions. The model indicated that a population at equilibrium would consist of 79.9% adults and 20.1% juveniles in the fall. This was likely due to low recruitment to the breeding population caused by low fledgling survival and low winter survival. Our estimated growth rate for the population was 0.136 with high inter-annual variation. Although this growth rate seems unrealistically low, it is corroborated by a low (albeit not as low) realized growth rate based on harvest age ratios and suggests that the bobwhite quail population at BWMA declined during the study period. Our model indicated that growth rate was sensitive to both winter survival and reproductive related to the first nesting attempt. In particular, winter survival was an important factor in population dynamics and should be of primary concern in designing management strategies. Weather patterns also had a synergistic effect with harvest. Above-average rainfall in winter enhanced the negative effect of harvest on survival.

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: 09/30/2010 (RWO#241, 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.

Mechanisms of Ridge-Slough Maintenance and Degradation
Across the Greater Everglades

Principal Investigator: **Matt Cohen**
Co-Principal Investigator: Todd Osborne, Mark Clark
Funding Agency: US ACOE, USGS MAP/RECOVER
Expected Completion: 08/15/2011 (RWO#267, PJ#89993&89994)
Graduate Student: Danielle Watts

This 5 year project focuses on the mechanisms of peat accretion and oxidation in the ridge-slough landscape of the central Everglades. We focus in particular in 4 elements of the peat accretion process that are essential to understanding how this landscape forms, and how it is and has been changing with hydrologic management over the last 50 years; the intent is to help inform restoration decision making to ensure the persistence of the patterned landscape. The first and primary element of the project is the quantification of net ecosystem carbon exchange fluxes. Using a combination of chamber based techniques we are quantifying the fluxes of carbon into and out of these marshes to test the hypothesis that, under the best conserved hydrologic conditions, ridges and sloughs represent alternative ecological configurations for achieving equal carbon balance (i.e., slight net accretion). At the same time, we are examining how the carbon balance changes with variation in hydrologic management from areas that are excessively dry to areas that are excessively wet. Our prediction is that the rapid loss of soil elevation bimodality observed in response to hydrologic modification occurs when one of these two configurations is no longer supported by extant hydrologic conditions. The second element of this work is an examination of the mechanisms that lead to phosphorus enrichment on ridges; the sentinel observation is that soil TP is linearly related to elevation in settings where soil elevation bimodality is conserved, and that this TP-elevation association disappears rapidly with changes that interrupt the ecosystem processes that maintain bimodality. Since phosphorus is very likely to influence patterns of primary production and respiration, understanding how such dramatic enrichment gradients can be sustained is of considerable importance. We articulate and test 3 hypotheses for this behavior across field sites spanning a gradient of hydrologic modification. The third research element is a detailed examination of the prevalence, incidence and causes of ridge senescence, a process via which the dominant primary producer community (sawgrass) episodically dies back. The implications for peat accretion on ridges is enormous because one year of typical ecosystem respiration without the addition of organic matter from primary production can set back the peat accretion process 20-30 years. The spatial extent, temporal dynamics and underlying mechanisms of the various forms of ridge senescence are proposed outcomes of our work. Finally, the fourth element of this work is coupling models of water stage and flow with models of peat accretion and landscape patch geometry to test the hypothesis that orientation and flow impedance at the landscape level impacts hydroperiod and therefore may be necessary and sufficient to explain patterning. Our work couples simple analytical models of landscape discharge capacity with similar models of peat accretion dynamics parameterized with data from research element #1 to explore the spatial and temporal pattern development dynamics. We also propose to integrate stochastic events that strongly affect soil elevation (ridge senescence and peat pop-ups) into the model to explore their role in configuring landscape pattern and flow paths.

OBJECTIVES:

A. Quantify carbon dynamics (primary production, respiration) of ridge and slough communities over time and across a gradient of hydrologic modification. We seek to test the hypothesis that ridges and sloughs are alternative configurations for achieving the same net peat accretion rate (i.e., P - R) under the best conserved hydrologic conditions; this will help explain the presence of bimodality in soil elevation distributions. By extension, we are also testing the hypothesis that hydrologic modification creates conditions where one of those configurations is no longer stable, leading to soil elevation conditions where only one mode is present. The restoration significance of the loss of bimodality is large because of presumed asymmetry between the loss of soil modes (which is rapid) and the regeneration of those modes (which is presumed to be slow).

B. Investigate mechanisms underlying the significant accumulation of phosphorus on ridge soils. We have observed strong associations between elevation and soil TP in areas where soil bimodality is conserved, but rapid decline in that association elsewhere. This suggests one of several mechanisms (lateral concentration, vertical concentration, legacy effects, atmospheric deposition capture) that we will test with measurements across a gradient of hydrologic conditions.

C. Quantify prevalence and incidence of ridge senescence events using historical imagery, and investigate mechanisms for that process based on experimental and correlative analyses. Ridge senescence is an overlooked feature of the ridge-slough system where primary producers (sawgrass) suddenly die-off and often take more than 5 years to recover; it is unknown whether the process has increased in regularity or severity, and more importantly what causes it. To animate the importance of this process, note that elevation differences between ridges and sloughs of 25 cm represent ca. 250 years of nominal landscape peat accretion; assuming a senescent ridge continues to respire after the primary producers die off (at ca. 2000 g C/m^2/yr), this elevation difference could be eliminated in less than 10 years. Understanding causes and consequences may be useful in helping to understand how the observed rapid loss of soil bimodality occurs.

D. Develop predictive and descriptive modeling tools that link landscape hydraulics (discharge capacity in response to changes in microtopography magnitude and orientation), peat accretion and development of spatial pattern. These models will allow us to test the hypothesis that landscape pattern emerges from hydraulic impedence effects of ridge patches, and their cumulative effect on landscape hydroperiod. In addition to exploring steady state effects in this model, we propose to integrate stochastic effects (ridge senescence and peat pop ups) into the model to explore how these impact the rate of pattern organization and its persistence with changing hydrology.

PROGRESS:

Research Elements

A. **Net Ecosystem Exchange:** We have selected 5 study blocks spanning a gradient of hydro-logic modification, and including a site that is in the footprint of the Decomp Physical Model on the L67 canal. At all but the last site we have completed 3 bi-monthly measurements of soil respiration in 16 locations within each block (8 in ridges, 8 in sloughs). We have completed construction and field testing of the net ecosystem exchange (NEE) chamber and will implement the first field measurements in February 2011. We have initialized a synthesis of the literature on peat accretion rates to parameterize a point-based peat accretion model that explores development of soil elevation bimodality and loss thereof with hydrologic modification.

B. **Soil TP gradients:** We have identified sites and methods to test explore TP enrichment. These include installation of shallow wells in adjacent ridge and slough sites in both drained and conserved landscape blocks. Each well is equipped with a continuous high resolution level recorder to detect lateral hydraulic gradients (specifically when ridges are exposed, but sloughs remain inundated) that is a mechanism for P transport. We have also developed a peat coring protocol to test the hypothesis that P enrichment of surface soils in ridges is a root-mining effect rather than a lateral transport effect. Finally, we have identified a technique based on recent published work using excitation emission measurements of dissolved organic matter for discriminating the source of organic matter in P enriched areas, specifically to test the hypothesis that lateral advection of particles (i.e., floc from sloughs) is responsible for P enrichment.

C. **Ridge senescence:** We have initiated several activities. First, we developed a typology of senescence to diagnose prevalence and incidence from DOQQs. Second, we have completed manual air photo interpretation from 2004 to determine prevalence of ridge senescence events across the study area, and have determined concordance with dry season water levels. Third, we have begun development of a remote sensing approach to incidence analysis of ridge senescence that may help uncover where and when the process is occurring. Finally, we are beginning implementation of a multi-part experiment to test competing hypotheses for why senescence occurs.

D. **Model development:** We have initiated 3 elements of the model. First, we have made progress on the use of the SFWMD Regional Simulation Model (RSM) to test hypotheses about how flow friction, microtopography and patch geometry affect regional water flows. Preliminary results suggest that orientation matters. Second, we have completed algorithm development on a point-based stochastic model of peat accretion that draws heavily on data from research element #1.

SUMMARY:

The central Everglades is at its core a peat accreting system comprised of a mosaic of habitat types. Surprisingly, our understanding of the peat accretion process is poor, particularly how the various elements of the landscape achieve the same long-term peat accretion rate. Our work seeks to fill that knowledge gap and provide basic information about how these ecosystems work under conserved conditions and how they respond to hydrologic modification that can help inform restoration planning.

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: 11/30/2011(RWO 237, PJ#66026)
Research Staff: Christine Wiese, Leah Cobb
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:

YEAR 1: 2007

- 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: 2008

- 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: 2009

- Continue treatments (including broadcast seeding) 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: 2010

- Continue treatments (including broadcast seeding) and data collection
- Implement follow-up herbicide treatments
- Collect response data
- Conduct annual coordination meeting

YEAR 5: 2011

- Create semi-final report, omitting the effect of broadcast seeding, reduced protocols, and Decision Tool User Manual
- Continue treatments (including broadcast seeding) and data collection
- Implement follow-up herbicide treatments
- Collect response data
- Create supplement to the final report, including the effect of broadcast seeding, reduced protocols, and Decision Tool User Manual

PROGRESS 2010: Regarding the modeling effort, two major accomplishments should be noted: 1) the state and transition model was developed along with supporting dynamic optimization, and 2) the framework for an automated, database-centered user interface (within Sharepoint, endorsed by USFWS) was built. RCG control treatments were implemented for a third year, which includes our first year of broadcast seeding treatments (the outcome of which will be observed in the 2011 response data). An annual coordination meeting in LaCrosse, WI provided guidance for the field on protocols and treatments, and gave the Science Team an opportunity to solicit feedback on model development. Overall project coordination transitioned smoothly from UF to USFWS, and UF staff were able to focus on data assimilation and analysis.

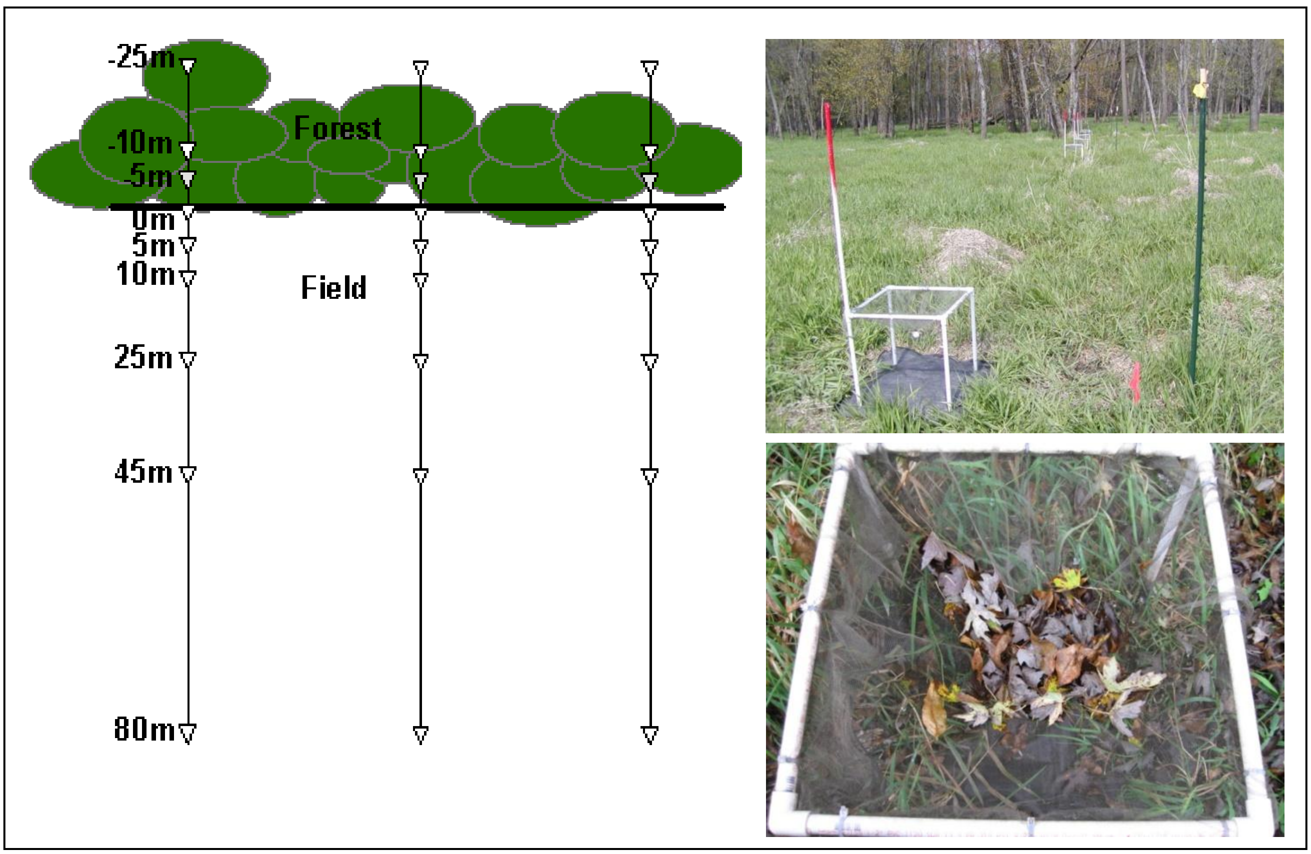
At the initial coordination meeting, participants from 10 National Wildlife Refuges collaborate to model current knowledge of RCG dominated systems using a frame based model; visits to the field sites selected enhance Science Team understanding of the decisions confronted by FWS biologists.

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: 07/31/2010
Research Staff: Leah Cobb, Dale Haskell

The decline of forest tree populations in forested floodplains is a major conservation concern in the Upper Mississippi River, especially the replacement of forest by the invasive reed canarygrass. Control with glyphosate limits RCG dominance, but natural seed rain may be insufficient to encourage natural recolonization of forest species in the face of RCG reinvasion. But how does proximity to a natural seed source affect the potential for forest species recolonization? We studied seed rain from intact forest floodplains into adjacent areas dominated by RCG.

PROGRESS 2010: Seed rain was measured by observing seeds in seed traps at 7 locations. Traps were initially placed prior to the 2008 field season, and were observed every two weeks during the growing season in 2008, 2009, and 2010. Samples were collected during the 2010 growing season, and results from previous years were confirmed. This includes the conclusion that seed rain was considerable up to 25 m from the edge, but insignificant beyond this. Despite seed rain, establishment of forest seedlings was minimal in 2010, even after 2 years of effective control of RCG. Surprising results from two sites in LaCrosse show that RCG control resulted in establishment of both wet meadow and emergent wetland vegetation, and despite annual midsummer recruitment of trees, survival of these seedlings was very poor. Previously, it was assumed that adequate RCG control would facilitate natural recruitment of the forest community; our results suggest that the transition is more complicated than anticipated.



Seed traps were placed at regular intervals from the forest edge to determine how seed rain is affected by proximity to the intact forest. Seed traps were underlain with landscape fabric to prevent vegetation from interfering with trap capacity, and netting collected all seeds and debris that fell at trap locations.

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. Sinter 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 Completion Date: December 2007

245. Snail Kite Population Studies: Demography, Population Trends, and Dispersal Relative to Environmental correlates, and Habitat Sudies PI: W.M. Kitchens. Completion Date: February 2008

246.Lake Apopka North Shore Restoration Area Alligator Monitoring Study. PI: H. Franklin Percival. Co-PI: R. Carthy. Personnel: R. Throm, E. Lamivee. Completion Date: February 2008.

247. Lake Apopka North Shore Restoration Area Amphibian Monitoring Study. PI: Raymond R.Carthy Co-PI:H.F. Percival. Personnel: R. Throm, E. Lamivee. Completion Date: February 2008.

248. Continued Snail Kite Monitoring Studies: Demographic, Population Growth, Extinction and Movement Parameters. PI: Wiley M. Kitchens. Personnel: B. Reichert, C. Cattau, A. Bowling. Completion Date: March 2008.

249. Status, Ecology, and Conseration of Rare and Endangered Florida Orchidaceae-Bletia purpurea. PI: M. Kane. Personnel: S. Stewart, T. Johnson, d. Dutra, P. Kauth. Completion Date: June 2008.

250. Radio Telemetry and Mark-Recapture Studies of Demographic, Movement and Population Dynamics of the Endangered Snail Kit. PI: W.M. Kitchens. Personnel: Br. Reichert, C. Cattau, A. Bowling. Completion Date: June 2008

251. Technical Assistance for Continuing Development of Content for Focal Species Website and Bird Conservation Node Website. PI: H. F. Percival. Personnel: E. Martin, A. Schwarzer. Completion Date: July 2008.

252. Evaluating Endocrine Disruption in Fish Exposed to Waters at Turkey Creek. PI: N. Denslow; Co-PI: N. Sazbo. Personnel: R. Weil, I. Knoebl. Completion Date: September 2008.

253. Assessment of Beach Compaction and Associated Effects on Loggerhead Sea Turtles (Caretta caretta) Nesting on Natural and Nourished Beaches in Northwest Florida. PI R. Carthy; Co-PI: M. Lamont; Personnel: Lori Brinn, J. Solis. Completion Date: September, 2008.

254. Effects of Environmental Mercury Exposure on Development and Reproduction in White Ibises. PI: P. Frederick; Personnel: N. Jayasena. E. Adams, L. Straub, B.J. Sampson. Completion Date: September 2008

255. ERDC Participation in 2008 USACE UAS Program. PI: H.F. Percival. Co-PI: P. Ifju, B. Dewitt, S. Smith. Personnel: A. Watts, J. Perry, W. Bowman, M. Morton. Completion Date: September 2008.

256. An Assessment of the Use of Unmanned Aerial Systems for Surveys of Wading Birds in the Everglades. PI: P. Frederick. Personnel: A. Watts, A Abd-Elrahman, A. Mohamed, B. Wilkinson, J. Perry, K. Lee, Y. Kaddoura. Completion Date: September 2008.

257. St. Joseph Peninsula Beach Restoration Project. PI: R. Carthy, Co-PI: M. Lamont. Personnel: F. Solis, J. Solis, M. Weisel, C. Warner. Completion Date: October 2008.

258. To Document Floral and Faunal Succession Following Alternative Habitat Restoration Techniques in a Large Central Florida Lake Tohopekaliga. PI: W.M. Kitchens; Personnel: Melissa DeSa, Zach Welch Carolyn Enloe, Brad Shoger, Amy Schwarzer. Completion Date: December 2008.

259. Adaptive Habitat Management for Florida Scrub-Jays at Merritt Island National Wildlife Refuge. PI: H. F. Percival; Co-PI: F. Johnson. Completion Date: December 2008.

260. Assessing the Effects of Coastline Alteration on Sea Turtle Nesting and Faunal Assemblages at Cape San Blas, Florida. PI: R. Carthy, Co-PI: M. Lamont, Personnel: R. Scarpino, C. Warner, J. Solis, F. Solis Michelle Weisel, L. Brinn. Completion date: March, 2009.

261. Development of a Sea Turtle Education Program for Gulf County, FL. PI: R. Carthy. Co-PI: M. Lamont. Completion Date: March 2009.

262. Regional Distribution of Soil Nutrients – hierarchical Soil Nutrient Mapping for Improved Ecosystem Change Detection. PI: T. Osborne. Co-PI: M. Cohen. Personnel: S. Lamsal, B. White. Completion Date: March 2009.

263. Monitoring of Wading bird Reproduction in WCAS 1, 2, and 3 of the Everglades – UAV. PI: H. F. Percival. Personnel: A. Watts, J. Perry, M. Burgess, S. Ingley. Completion Date: March 2009.

264. Science Fellowship for Assessment of Coastal Habitats and Listed Species. PI: Raymond R. Carthy Co-PI: M. Lamont. Completion Date: April 2009.

265. Historic Pond Restoration in the Florida Panther National Wildlife Refuge. PI: C. Reinhardt-Adams. Co-PI: M. Kane. Personnel: S. Stewart, D. Watts, N. Steigerwalt, C. Wiese, S. McCauley. Completion Date: May 2009.

266. Rapid Delineation of Provenance for Florida Sea Oats Used for Beach and Dune Stabiliation. PI: M. Kane. Personnel: N. Philman, P. Sleszynski, S. Stewart, D. Dutra. Completion Date: June 2009.

267. Ecology and Conservation of Snowy Plovers In the Florida Panhandle. PI: Steven Johnson. Completion Date: June 2009

268. Wildlife Usage and Habitat Development on Spoil Islands in Lake Tohopekaliga, Florida. PI: W. M. Kitchens Personnel: Melissa DeSa, Carolyn Enloe, Brad Shoger, Amy Schwarzer, Jonathan Chandler. Completion Date: August 2009.

269. Techniques for Field Establishment and Reintroduction of Calopogon tuberosus var. tuberosus. PI: M. Kane. Co-PI: P. Kauth. Completion Date: August 2009.

270. Conservation of South Florida's Orchids—Developing Reintroduction Methods for Eight Native Species Including the State Endangered Ghost Orchid (Dendrophylax lindenii). PI: M. Kane. Personnel: D. Dutra, P. Kauth, T. Johnson, N. Philman. Completeion Date: August 2009.

271. Wading Bird Colony Location, Size, Timing and Wood Stork Nesting Success. PI: P. Frederick. Personnel: J. Simon, K. Williams. Completion Date: September 2009.

272. Development of Unmanned Aerial vehicles for Assessment of Wildlife Populations and Habitats: Phase 3. PI: H.F. Percival; Co-PI: P. Ifju; Personnel: M. Burgess. Completion Date: December, 2009.

273. Experimental Evaluation of a Habitat Enhancement Project for Fish and Wildlife at Gant Lake, Florida. PI: W.M. Kitchens: Co-pi's: M. Allen, H.F. Percival. Completion Date: December, 2009.

274. Structured Decision Making, Ecological Thresholds and the Establishment of Management Trigger Points. PI: W.M. Kitchens. Research Staff: J. Martin. Completion Date: December 2009.

275. An Assessment of Gulf Sturgeon Population Status in the Gulf of Mexico. PI: W. Pine. Research Staff: H. Jared Flowers. Completion Date: December 2009.

Publications 2010

Garland, K.A. and R.R. Carthy. Changing Taste preferences, market demands and traditions I Pearl Lagoon, Nicaragua: a community reliant on Chelonia mydas for income and nutrition. Conservation and Society. (submitted to FSP)

Senko, J., V. Koch, W.M. Megill, R.R. Carthy, R.P. Templeton, W.J. Nichols. 2010. Fine scale daily movements and habitat use of East Pacific green turtles at a shallow coastal lagoon in Baja California Sur, Mexico. Journal of Experimental Marine Biology and Ecology. 391(2010): 92-100

Hotaling, Althea, H.F. Percival, W.M. Kitchens, J.W. Kasbohm. In Press. The persistence of the endangered Florida salt marsh vole in the salt marshes of the Central Florida gulf coast. Southeastern Naturalist. Southeastern Naturalist.

Watts, A. C., J. H. Perry, S. E. Smith, M.A. Burgess, B.E. Wilkinson, Z. Szantoi, P.G. Ifju, H. F. Percival. 2010. Small unmanned aircraft systems for low-altitude aerial surveys. Journal of Wildlife Management, 74(7):1614-1619.

Singh, TC Hines, HF Percival, MK Oli. Published. Does nest-site selection influence bobwhite nesting success in South Florida? Wildlife Research.37:489–496.

Rolland, V., J. Hostetler, T. Hines, H. F. Percival, and M. Oli. 2010. Impact of harvest on survival of a heavily hunted game bird population. Journal of Applied Ecology. Published Wildlife Research, 37, 392–400

Singh, A, T.C. Hines, J.A. Hostetler, H.F. Percival, M.K. Oli. 2010. Patterns of Space and Habitat Use by Northern Bobwhites in South Florida, USA. Eur J Wildl Res. DOI: DOI 10.1007/s10344-010-0393-x. 060310

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): 1237–1238.

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 143: 513-520.

Reichert, Brian,J. Martin, W.Kendall, C. Cattau, W. Kitchens. 2009. Interactive Effects of Senescence and Natural Disturbance on the Survival Probabilities of Snail Kites. Oikos. DOI: 10.111/j.1600-0706.2010. 18366.x

Zweig, C. L. and W. M. Kitchens. 2009. The Semiglades: The collision of restoration, social values, and the ecosystem concept. Restoration Ecology 18(2): 138–142.

Hotaling, A.S., J. Martin, W.M. Kitchens. 2009. Estimating Transition Probabilities Among Everglades Wetland Communities Using Multistate Models. Wetlands 20(4):1224-1233

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Reichert, B. and W. M. Kitchens. (2010) The Current Status of the Snail Kite Population in Florida. Southeast Partners in Flight Conference. Gainesville, FL. March, 10 2010. Available online, http://sepif.org/content/view/46/1/. (Invited Oral)

Smith, TJ III, M Allen, E Chassignet, H. Davie, D. DeAngelis, A Foster, T Green, W Kitchens, V Misra, P Nelson, F Percival, N Plant, D Slone, L Stefanova, B Stith, E Swain, D Summer, A Tihansky, G Tiling-Rangel, S Walls, C Zweig. 2010. Land of flowers on a latitude of deserts: aiding conservation and management of Florida's biodiversity by using predictions from downscaled AOGCM climate scenarios with ecological modeling. 3rd USGS Modeling Conference: Understanding and Predicting for a Changing World. 7-11 June 2010, Denver, CO. Poster presentation. (Contributed Poster)

Burtner, B. and P.C. Frederick. 2010. The Interaction Between Nesting Wading Birds and Alligators in the Everglades. Presented as a poster by B. Burtner at the Greater Everglades Ecosystem Conference, Naples Fl. July 2010.

Venne, L. and P.C. Frederick. 2010. Response of Wading Birds to Fire in the Central Everglades. Presented as a poster by LV at the Greater Everglades Ecosystem Conference, Naples Fl. July 2010.

Frederick, P.C. 2010. Wading bird nesting as a tool for understanding everglades ecology: a keystone integrator and generator of trophic hypotheses. Presented as a paper at the Greater Everglades Ecosystem Conference, Naples Fl. July 2010.

Burgess, M.A., J.H. Perry, B.S. Evers, T.J. Rambo, T.M. Reed, H.F. Percival, P.C. Frederick, J.C. Simon, P.G. Ifju, S.E. Smith, B.A. Dewitt, Z. Szantoi, L.E. Taylor, and J.S. Lane. A small unmanned aircraft system for ecological research and monitoring. Slide presentation. Third Annual Alaska UAS Interest Group Conference, Anchorage, Alaska. September 2010. (Invited Poster)

Smith, TJ III, M Allen, E Chassignet, H. Davie, D. DeAngelis, A Foster, T Green, W Kitchens, V Misra, P Nelson, F Percival, N Plant, D Slone, L Stefanova, B Stith, E Swain, D Summer, A Tihansky, G Tiling-Rangel, S Walls, C Zweig. 2010. Land of flowers on a latitude of deserts: aiding conservation and management of Florida's biodiversity by using predictions from downscaled AOGCM climate scenarios with ecological modeling. 3rd USGS Modeling Conference: Understanding and Predicting for a Changing World. 7-11 June 2010, Denver, CO. Poster presentation. (Contributed Poster)

Smith, TJ III, M Allen, E Chassignet, H. Davie, D. DeAngelis, A Foster, T Green, W Kitchens, V Misra, P Nelson, F Percival, N Plant, D Slone, L Stefanova, B Stith, E Swain, D Summer, A Tihansky, G Tiling-Rangel, S Walls, C Zweig. 2010. Land of flowers on a latitude of deserts: aiding conservation and management of Florida's biodiversity by using predictions from downscaled AOGCM climate scenarios with ecological modeling. USGS Climate Change Science: Understanding the Past, Informing Decisions for the Future, 9-11 March 2010, Denver, CO. Poster presentation. (Contributed Poster)

Dr. Jennifer Seavey, WEC Post-doctoral Associate, works with Drs. Rob Fletcher, Peter Frederick and Bill Pine on patterns of change related to climate change in Flrorida's Big Bend.

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