



INTEGRATING CURRENT RESEARCH INTO MANAGEMENT DECISIONS AT THE ARTHUR R. MARSHALL LOXAHATCHEE NATIONAL WILDLIFE REFUGE

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Research...on a Refuge?

- ✿ A science-based approach fosters expert knowledge to aid in management decisions.
- ✿ The Refuge would like to help universities and other researchers develop projects that answer specific management questions.

Research

Management Decisions

- * Combination of focused monitoring, modeling & experimentation leads to successful adaptive management.
- * Mechanisms for conducting research:
 - * Special Use Permits (SUP)
 - * Conduct research with independent funding.
 - * Refuge biologists determine if projects are appropriate to answer management questions.
 - * Cooperative Agreements
 - * Collaboration between the Refuge and researchers.
 - * CESU agreements with UF, FIU, and FAU.

Using Scientific Research in Management Decisions?

- ❁ Water Regulation Schedule (WRS)
 - ❁ Benefits Anticipated from the 1995 WRS for Refuge
 - ❁ Completed in 2006 by Laura Brandt.
 - ❁ Assessed all ecological and hydrological research projects at the Refuge to determine if the current WRS had an increase in ecological benefits and what benefits were expected.
- ❁ Comprehensive Conservation Planning (CCP)
- ❁ Habitat Management Plans (HMP)
- ❁ Inventory, Monitoring and Research Plan (IMR)



Alligator

Specific Management Needs



How does water management effect this keystone species?

- ✧ Direct effects

- ✧ Nesting success, distribution, abundance, health, and body condition.

- ✧ Indirect effects

- ✧ Relationships between hydrology and nesting effort.

How would a managed alligator hunt effect the population on the Refuge?



Alligator

Research Projects



- ❁ Long term monitoring since 1998 (Laura Brandt and Frank Mazzotti, UF).
- ❁ Marsh and canal surveys and captures as part of the **RECOVER** Monitoring and Assessment Plan (MAP).
 - ❁ Determine patterns of relative abundance of alligators in marsh and canal habitats in relation to water levels and season.
 - ❁ Body condition assessed through captures.
- ❁ Provide long term monitoring for evaluation of Refuge conditions and effects of the Comprehensive Everglades Restoration Plan (CERP).
- ❁ Nest surveys 2000-2004 (5 years of data).

Apple Snails

Specific Management Needs

- ✿ What is the distribution, production, and abundance?
- ✿ What was the historic distribution of this species?
- ✿ What are the relationships between apple snails, periphyton compositions, and changes in water quality?





Apple Snails

Research Projects

- ✿ Apple snail density within the Refuge (Phil Darby, UWF).
- ✿ Predator prey dynamics (Joel Trexler, FIU).
- ✿ Growth and survival in a water quality gradient (Rebekah Gibble, USFWS).
- ✿ Analysis of the relationship between copper-based herbicides and natural populations of the Florida apple snail (Shannon Ladd and Matt Harwell, USF, Thesis 2010).

Exotics

Specific Management Needs



- ✿ What biocontrols are effective for those exotics species?
- ✿ What are the effects of hydrology and fire on priority exotic species?
 - ✿ Melaleuca (*Melaleuca quinquenervia*)
 - ✿ Old World Climbing Fern (*Lygodium microphyllum*)
- ✿ Create monitoring program for exotic fauna?





Exotics Control

Research Projects



* USDA-ARS Invasive Plant Research

- * Biocontrol agents for exotics (Dr. Anthony Boughton, Dr. Robert Pemberton).
- * Water lettuce population dynamics in Florida (Phillip Tipping).

* Herbicide trials for control of *Lygodium* (Jeff Hutchinson, UF).

- * Native and exotic recovery post treatment
- * Determine if burning tree islands results in greater native or exotic coverage.

* Monitoring program for invasive amphibians and reptiles (Mazzotti, UF).

- * Determine status and spread of existing population, and occurrence of new populations of invasive reptiles and amphibians in ECISMA lands.



Fire Research

Specific Management Needs



- ✿ What was the historic role and pattern of fire throughout the Everglades ecosystem?
- ✿ What are the main differences and effects of peat vs. surface fires?



Fire

Research Projects

- ✿ Evaluate the effects of prescribed marsh burns on water quality, especially the release of sequestered phosphorous (Todd Osborne, UF).
 - ✿ Evaluate the potential for exotic and invasive species control, through prescribed burns.
- ✿ Effects of herbicide and prescribed fire on *Lygodium* (Jeff Hutchinson).
 - ✿ Evaluate effects of fire on reducing *Lygodium* and increasing native plant cover that have been treated with herbicide.
 - ✿ Determine if fire and a reduction of *Lygodium* rachis mats result in greater native plant cover or an increase in *Lygodium*.



Tree Islands

Specific Management Needs



- * What are impacts of hydrology to:
 - * Tree islands diversity
 - * Elevation relative to slough
 - * Historic vs. current conditions
- * How can tree islands be maintained in the absence of historic sheet flow?
- * What will Laurel Wilt do to overall species composition of the tree islands.

Tree Islands

Research Projects



- ✿ Vegetational and geochemical history of tree islands based on soil cores (Debra Willard and William Orem, USGS).
- ✿ Fire on tree islands following *Lygodium* treatment (Jeff Hutchinson, UF).
- ✿ Assess hurricane damage to tree islands and recovery (Hongjun Chen, UF).
- ✿ Determine nutrient availability in tree islands spatially with seasonal hydro-dynamics (Pam Sullivan, FIU).
- ✿ Determine how hydrologic conditions and shallow groundwater chemistry differ in tree islands containing peat versus limestone cores (Pam Sullivan, FIU).



Tree Islands

Research Projects

Laurel Wilt

- ✿ Laurel wilt, a disease that causes mortality in bay trees, was confirmed in the Refuge interior in January 2012.
- ✿ This disease is spread through the exotic beetle, *Xyloborus glabratus*, which introduces the fungal pathogen *Rafaellea lauricola*.
- ✿ It is possible that up to 30% of the bay trees will demonstrate resistance to the disease (Cameron et al. 2008).
- ✿ However, with the projected bay loss of 70% or more, the fundamental structure and function of the tree islands will be dramatically altered.
- ✿ Canopy gaps will create understory openings which previously did not exist.
 - ✿ To collect baseline data documenting plant community composition on tree islands within the Refuge.
 - ✿ To establish long-term monitoring sites for assessing tree island condition in terms of vegetation communities.
 - ✿ To establish protocol for monitoring impacts of laurel wilt in the Refuge.



Cypress Swamp



- ✿ Baseline data was collected in 2000 for a potential restoration project.
- ✿ Cypress Swamp has been dry for many years, and the risk of fire has increased.
- ✿ Data will be collected in summer 2012 to reassess species composition of the cypress swamp.

Trust Resources

Specific Management Needs

- ✿ How does hydrology and water quality effects migratory and other birds such as snail kites?
- ✿ What are the best recession rates for successful nesting and reproduction?



Trust Resources

Research Projects



- * Long term snail kite research (Wiley Kitchens, UF).
 - * Monitor survival, reproduction, and estimate population size.
- * Wood stork monitoring (SFWMD, UF).
- * Wading bird monitoring (SFWMD, UF).
- * Bald eagle nest checks (Refuge staff).
- * Secretive marsh bird monitoring (USFWS).



Photo credit, Charles Slavens



Photo credit, Charles Slavens

Wading Birds

Specific Management Needs

- ✿ What effects do water management have on nesting?
- ✿ What effects do hydrology have on prey?
- ✿ What are the anthropogenic causes of spatial patterns when nesting?





Wading Birds

Research Projects

- ✿ **SFWMD Wading Bird Report** (Mark Cook and Mac Kobza, SFWMD).
 - ✿ Weekly flights throughout Everglades system to provide yearly comprehensive report.
- ✿ **Wading bird nesting trends on the Refuge** (Peter Frederick, UF).
 - ✿ Monthly flights covering 100% of the Refuge.
- ✿ **Determine the availability of prey to wading birds during the dry season** (Dale Gawlik, FAU).
- ✿ **Relationship between landscape prey availability patterns and physiological conditions of adult great egret and white ibis** (Dale Gawlik, FAU).
- ✿ **Study of white ibis diet** (Robin Boyle and Nathan Dorn, FAU).

Water Quality

Specific Management Needs

- ✿ What are the effects of:
 - ✿ Hard water
 - ✿ Chloride
 - ✿ Sulfur
 - ✿ Phosphorus
 - ✿ Water intrusion





Water Quality Projects



- ✿ Enhanced Water Quality Network (LOXA flights) (Refuge).
 - ✿ Vegetation monitoring at each water quality site to document any changes over time.
- ✿ Ecological effects of canal water intrusion (Paul McCormick).
- ✿ Fire effects on Water Quality (Todd Osborne, UF).
- ✿ Spatial Patterns of Phosphorus Storage (Todd Osborne, UF).
- ✿ Weather station monitoring (Carolyn Price, USGS).
- ✿ Total Maximum Daily Loads for Refuge (Jason Storrs, FLDEP).
- ✿ Effects of conductivity on food-web structure (Joel Trexler, FIU).
- ✿ Long term fish mercury levels (Ted Lang, FWC and Nicole Niemeyer, SFWMD).
 - ✿ Part of an ongoing monitoring program to evaluate mercury trends in fisheries of the Everglades region.

Aquatic Fauna

Research Projects

- ❁ CERP aquatic fauna and periphyton (Joel Trexler, FIU).
 - ❁ Sample wetland fishes, crayfish, grass shrimp, amphibians and periphyton to obtain data for establishing pre-CERP reference conditions.
- ❁ Field research and monitoring for CERP and MAP (Sue Newman, SFWMD).
 - ❁ Sampled water quality, soil chemistry, and periphyton and invertebrate taxonomy.
- ❁ Crawfish and fish sampling (John Volin and Nathan Dorn, FAU).
- ❁ Hydroperiod influence on the occupancy rates of anuran species in the Refuge (Ryan Lynch and Laura Brandt, Thesis, UF).

Critical Needs

Still Missing...

* Climate

- * Implications of sea level rise, rising temperatures.

* Integration

- * Decision support tools.
- * Looking at water management effects at different spatial, temporal, and ecological scales.

* Model

- * Conceptual ecological model and hydrodynamic model.

* Communication/Education

- * To the general public and legislators.

* Public Support

- * Understanding current and future land and water use requirements.

Questions?

