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## **Restoration of the South Florida Ecosystem**



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“Learning from Regions: A Comparative Appraisal of  
Climate, Water, and Human Interactions in the Colorado and  
Columbia River Systems”

# **Restoration of the South Florida Ecosystem**

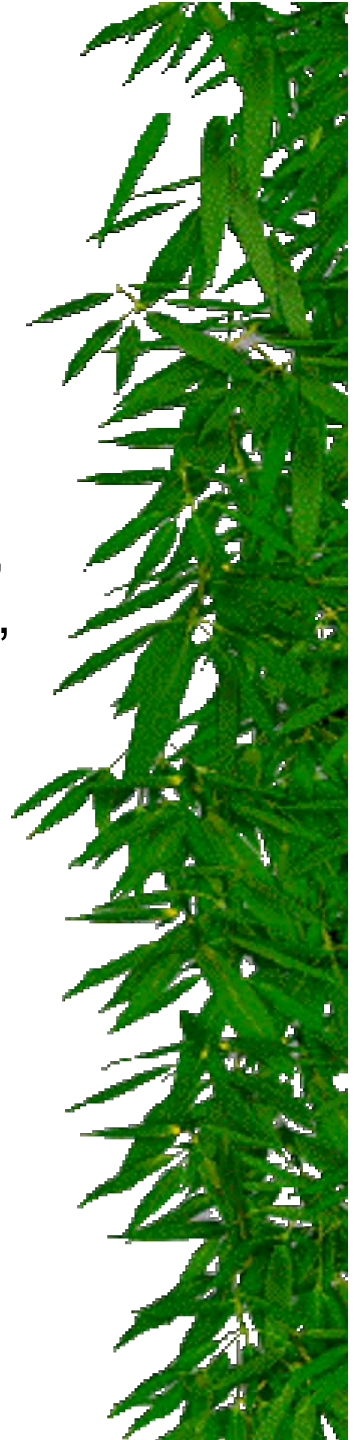
Coordination of Science and  
Adaptive Management



## **Background**

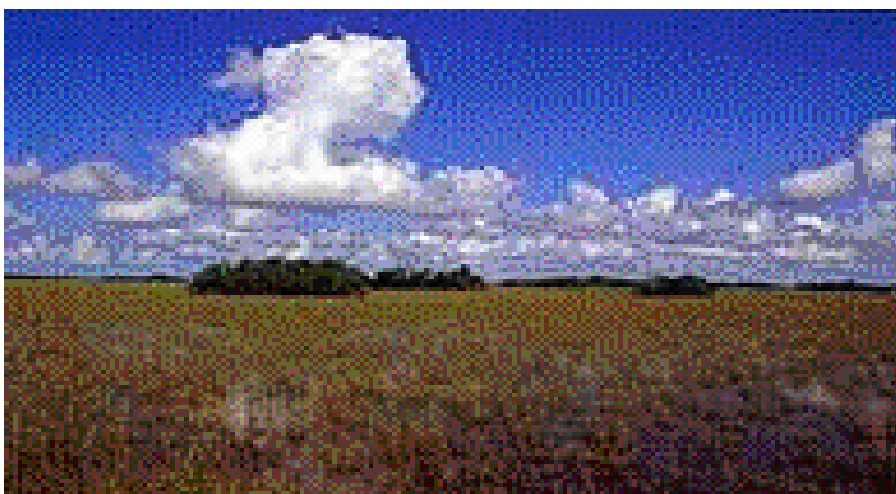
What is the South Florida ecosystem?

- Natural areas include Chain of Lakes, Lake Okeechobee, Kissimmee River, coastal areas, Everglades, Florida Bay, Biscayne Bay.
- Built areas include Miami and whole east coast, agricultural areas, Key West, etc.
- Subtropical area with rainy and dry seasons, palm trees, palmetto.
- Porous, flat limestone “sponge” that creates large expanses of wetlands, including the Everglades but also Big Cypress—a hardbottom wetland.













## **Background**

What is restoration?

- Returning the ecosystem to some prior state.
- Rehabilitating damaged or lost areas to regain ecosystem functions.



## **Background**

### Why is restoration needed?

- Development of swamplands in Florida has caused the loss of 1.7 million gallons of water per day from the ecosystem.
- With this loss of water has come the loss of wetlands, wildlife, and water quality.
- Early on, Floridians wanted to save the “Everglades,” for example, Marjory Stoneman Douglas wrote about the River of Grass. In the 1940s, the population pushed to save Everglades National Park. In the 1960s, the population pushed to save Big Cypress National Preserve.





## **Background**

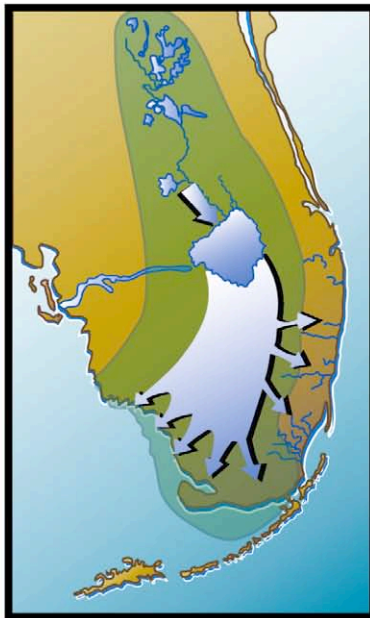
- ★ Interest in restoration has been ongoing in various ways for 20 years.
- ★ State legislation has emphasized land acquisition and water quality.
- ★ Federal legislation established an intergovernmental Task Force in 1996 and passed the Comprehensive Everglades Restoration Plan in 2000.



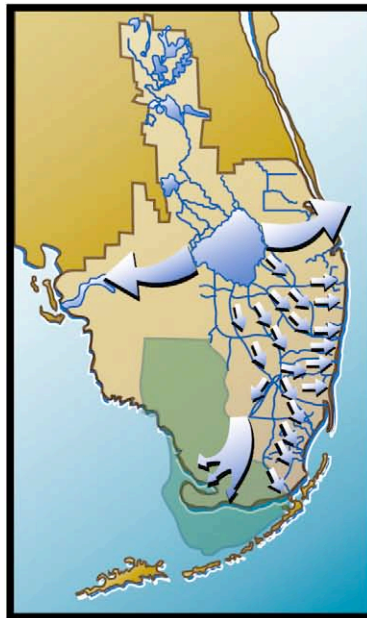
# Past, Present, and Future Flow of Water in South Florida



Location of the restoration initiative



Past flow



Present flow



Future flow



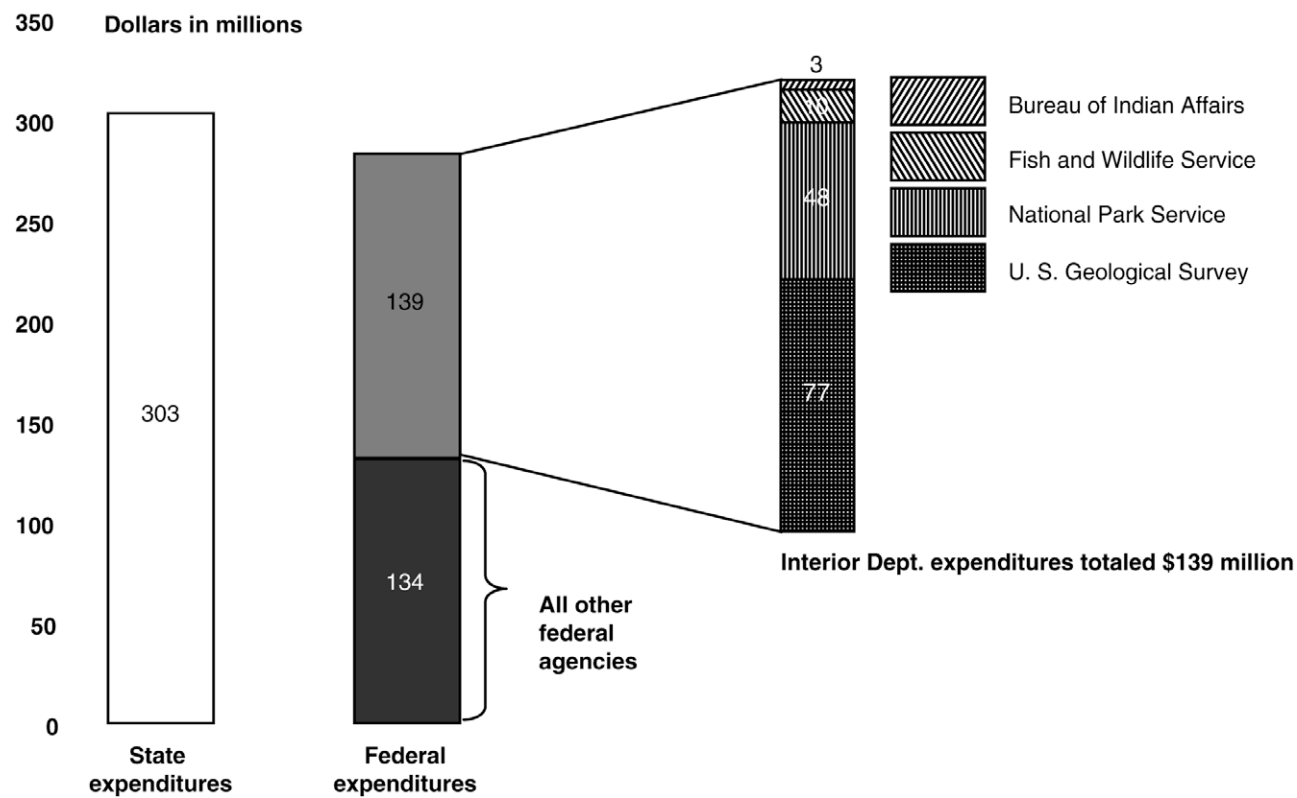
## **Funding for Science in Restoration Efforts**

A substantial investment has been made to develop scientific information from fiscal year 1993 through 2002:

- In total, \$576 million was spent by eight federal and one state agency.
- Federal agencies spent \$273 million and the state spent \$303 million.



## Funding for Science



Source: Federal agencies and the South Florida Water Management District (data), GAO (analysis).  
Note: Numbers may not add to total due to rounding.





## **Role of Scientists in Restoration**

- ★ Scientists have been involved from the beginning in “diagnosing” the need for restoration and in identifying a “cure”:
  - Water amount and quality
  - Spatial extent
  - Loss of species and invasive species
- ★ Task Force adapted 3 overall restoration goals:
  - “Get the water right”
  - Protect, preserve, and restore the natural system
  - Foster the compatibility with built and natural systems

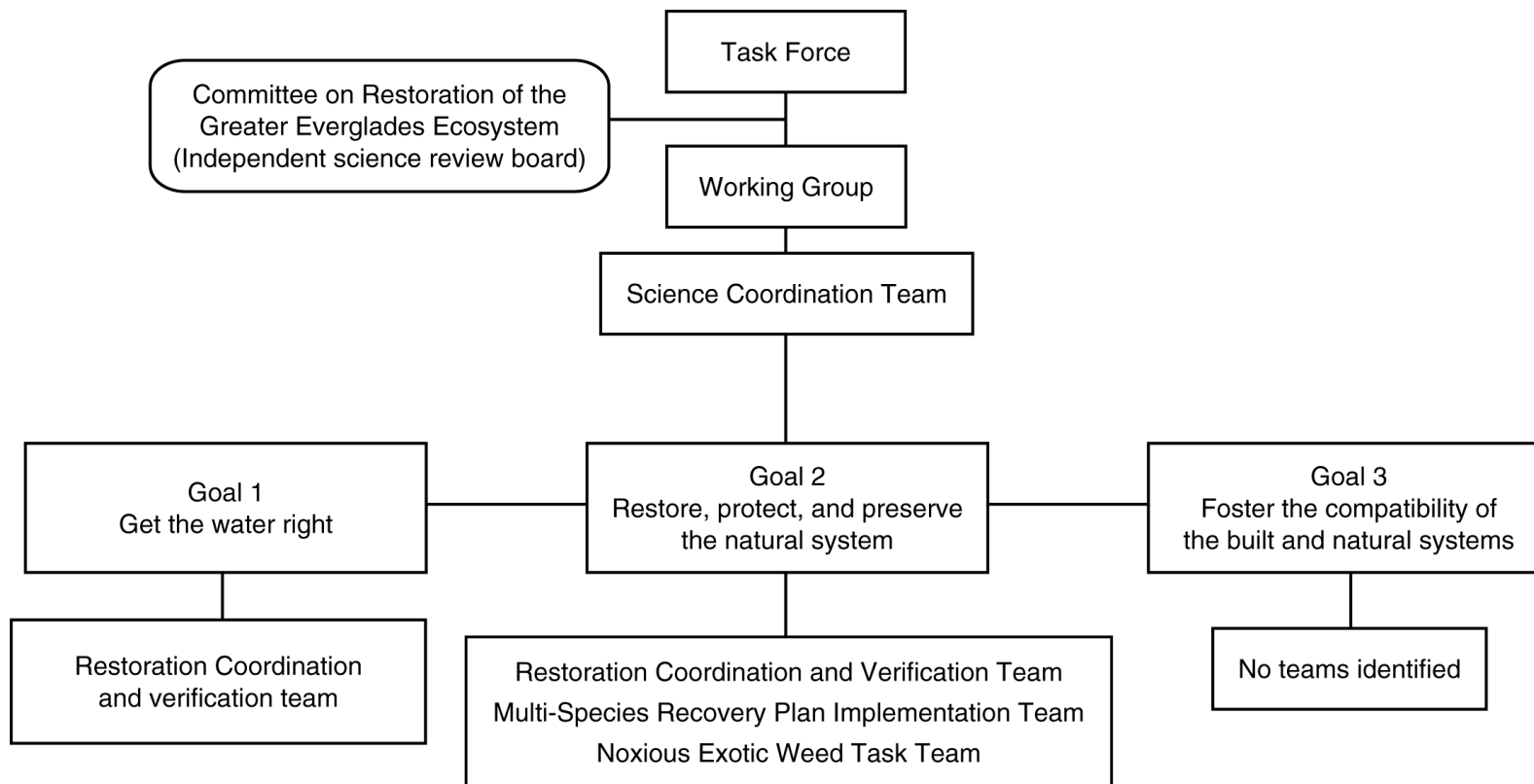


## **Role of Scientists in Restoration**

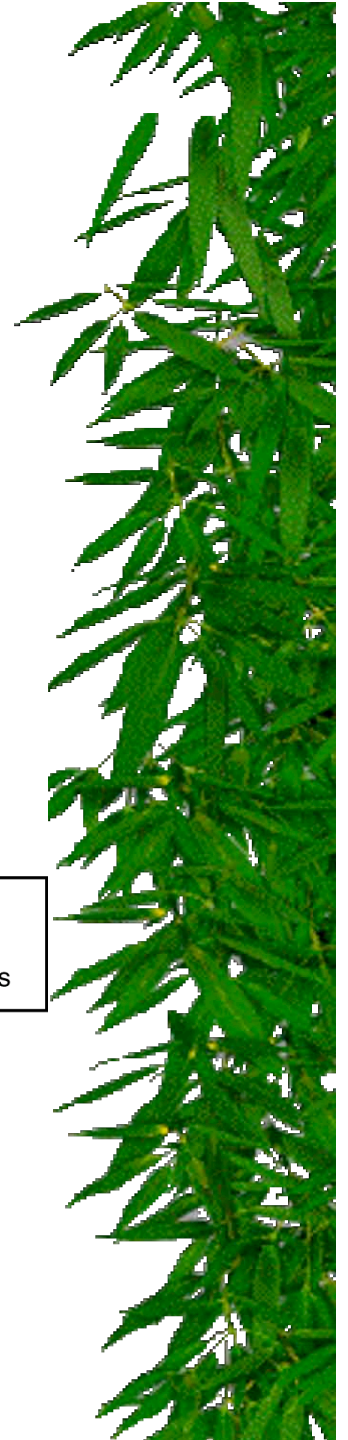
- ★ Multiple agencies conduct scientific activities.
- ★ Several groups exist to coordinate science for the restoration.
- ★ Only the Science Coordination Team has role that will help the Task Force coordinate science for all three restoration goals (see graph).



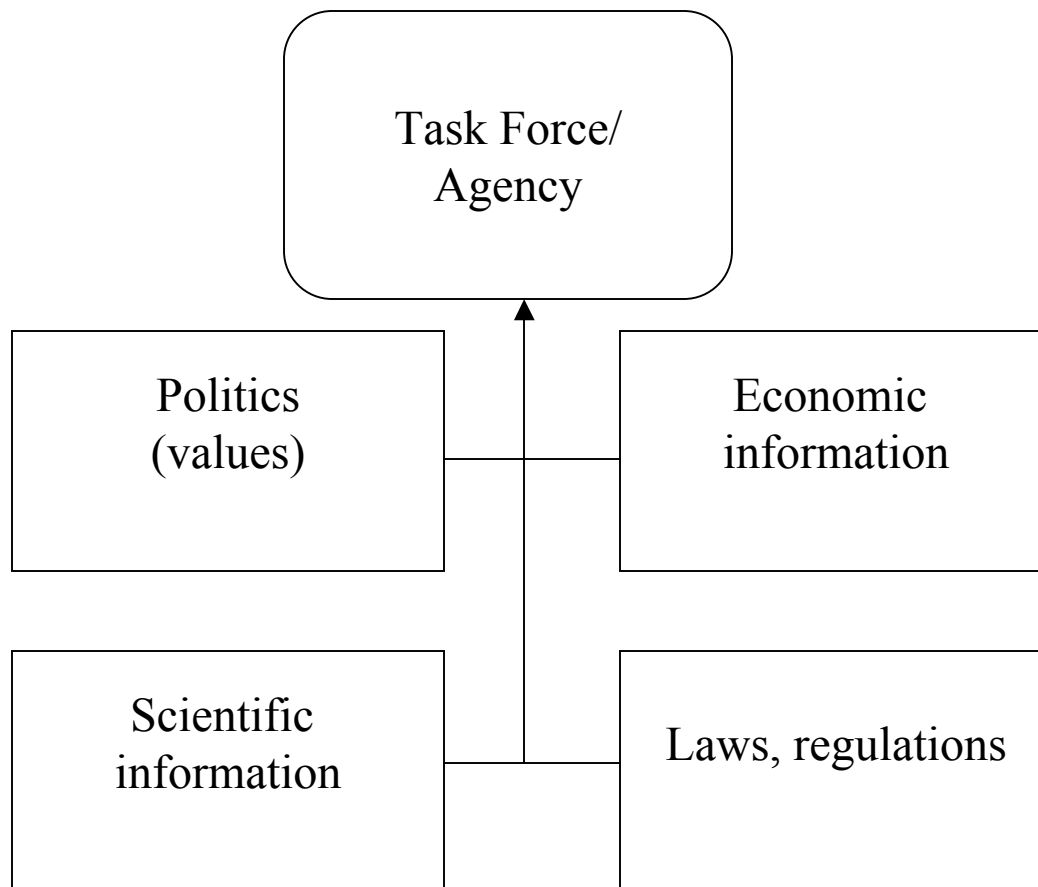
## Role of Scientists in Restoration



Source: Task Force (information), GAO (presentation).



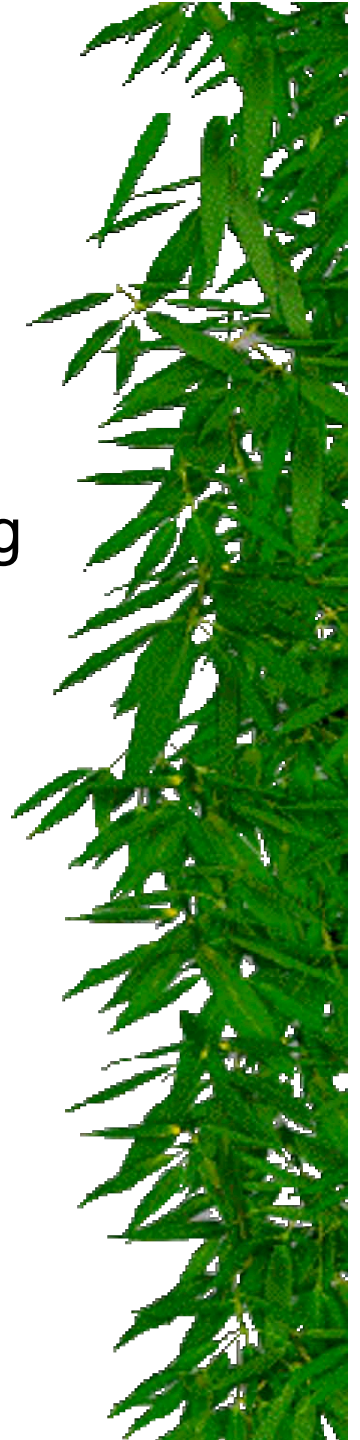
## Role of Decision Makers





## **Decision Process**

- ★ At any time, multiple, different decision processes are underway. They can be understood by thinking about:
  - Information that is being provided and gathered
  - How various positions and solutions are being advocated or promoted
  - The selected options—e.g., legislation
  - The policies that get developed from legislation (interpretation can vary from legislative intent)
  - Implementation of the policies—e.g., a program
  - Evaluation of the policy
  - Termination of the policy



## **Decision Process**

- So, for example, the State of Florida needs to set a water quality standard for phosphorus in the Everglades.
- Scientific work has been conducted on an ongoing basis, aiming to answer the question by 2003. Scientists answered the question of what the standard should be, but were not successful in developing the technology to get there.
- What is a decision maker to do? Set a standard that it cannot yet meet, or move the time frame?



## **Uncertainties Related to Restoration**

- ★ What does a “restored” ecosystem look like?
- ★ What amount, timing, distribution, and quality of water is needed to restore the ecosystem?
- ★ What spatial extent is needed to restore the ecosystem?
- ★ What level of development is compatible with a restored ecosystem—including contaminants discharged into water and development patterns?



## **Technical Uncertainties Related to Restoration**

- ★ Storage techniques for water are uncertain:
  - Aquifer storage and recover,
  - Seepage barriers,
  - Inground storage,
  - Water reuse—tertiary treatment,
  - Stormwater treatment areas, and
  - Future water need, demographics.





## **Use of Adaptive Management**

- ★ Task Force has specifically adopted the use of “adaptive management” to manage uncertainty of scientific information related to restoration.
- ★ Army Corps and the South Florida Water Management District, as well as other agencies, have developed the Restoration Coordination and Verification program with multiple teams to conduct modeling, monitoring, and assessment of progress.
- ★ National Academy of Sciences calls the program “passive” adaptive management.



## **Use of Adaptive Management**

Adaptive management involves:

- Conceptual models of stressors in the ecosystem and key ecological functions,
- Performance measures (indicators?) related to ecological functions that show “restoration,”
- Monitoring modules to track trends in ecological functions,
- Periodic assessment and reporting on trends and how projects are changing functions, and
- Research to fill holes in conceptual models.



## **Use of Adaptive Management**

- ★ Adaptive management program primarily focuses on wetlands—the areas affected by Corps projects.
- ★ Adaptive management has not yet been applied to other restoration goals—upland restoration, species restoration (associated with uplands), invasive species, spatial extent, and growth management.



## **Use of Adaptive Management**

- ★ Models of water amounts and distribution have been developed.
  - Water quality models have not been developed.
  - Marine models have not been developed.
- ★ Ecological models for some species have been developed.
  - Landscape vegetation models have not been developed.
  - Simpler models needed for use in assessing changes shown from hydrological modeling.



## **Use of Adaptive Management**

- ★ To develop information related to gaps in knowledge, Task Force set up Science Coordination Team.
  - Team has not developed a plan that identifies gaps and lays out a plan to fill gaps.
  - Team has not conducted synthesis of scientific information that is being developed.
  - Team is part-time with few resources.





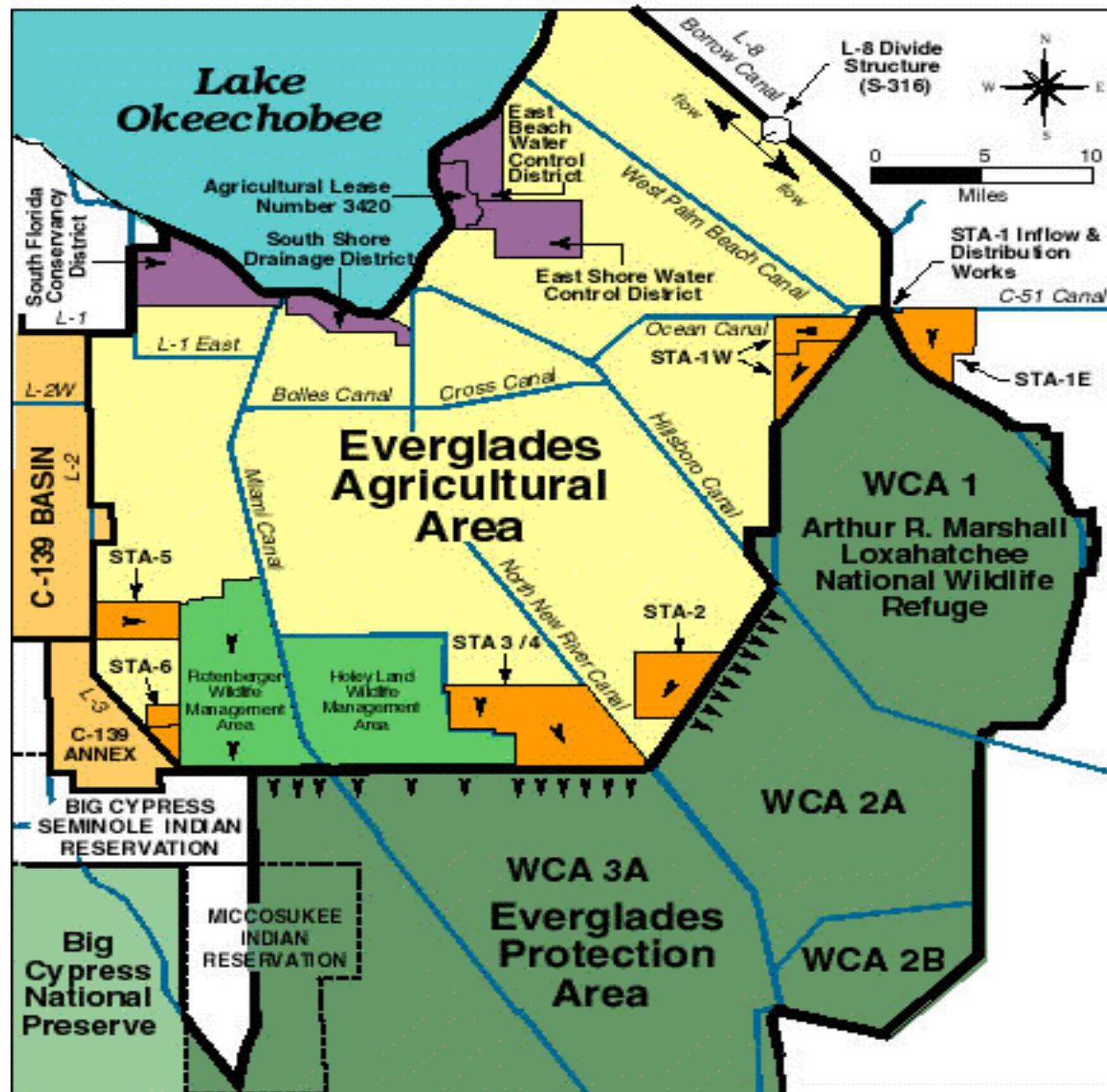
## **Adaptive Management?**

- ★ How is this framework adaptive management?
  - A decision framework—we have admitted uncertainty
  - A management framework—we are trying things that we would not have done otherwise
  
- ★ How do you judge success?
  - It's okay to have multiple indicators of success
  - It's okay to judge the process—but it is not sufficient
  - Because the problem has been defined as the resource(s), we should judge by whether the resource is being improved



## **Adaptive Management?**





## **Conclusions on Adaptive Management**

- ★ It appears that several important institutional pieces are in place to conduct adaptive management:
  - Science Coordination Team,
  - Monitoring plan,
  - Models for testing alternatives, and
  - Some research plans to fill knowledge gaps.
  
- ★ The institutional capacity remains to be tested.
  - Assessments of monitoring data have not yet been done.
  - Reports to decision makers have not yet been made.





## **Conclusions on Use of Scientific Information**

- ★ Progress has been made in developing scientific information:
  - Hydrologic models, past and current conditions,
  - Sources, transformation, and fate of mercury,
  - Stormwater treatment areas, and
  - Biological control for *Melaleuca*.



## **Conclusions: Gaps in Scientific Information**

- ★ Gaps in scientific information remain.
  - Gaps remain in information that could affect systemwide restoration—invasive species and contaminants.
  - Gaps remain in project specific information that could delay the projects or make them less successful—Biscayne Bay salinity data and Modified Water Delivery tree island and flow information.
  - Gaps in tools that will hinder adaptive management—models for Biscayne Bay, Florida Bay, and vegetation systemwide.



## **Conclusions: Science Coordination**

- ★ Science coordination group needs to be better organized with clearer purpose to:
  - Organize scientific information for all three restoration goals—produce science plan for gaps and reports on progress;
  - Organize monitoring plan for all three restoration goals; and
  - Ensure synthesis of scientific information being produced and assessment for decision makers.
- ★ Managers have to be involved in setting goals for science plan—to ensure their needs are met.



## **Lessons Learned**

- ★ Adaptive management is about managing uncertainty for decisions
- ★ We need to be explicit about the decision context
  - The decision context is not a “clean slate”
- ★ We need to make the scientific information relevant to the level of the decision maker and the decision
  - The information to provide answers the questions at this level
  - Each level of decision maker will need interactions with scientists

