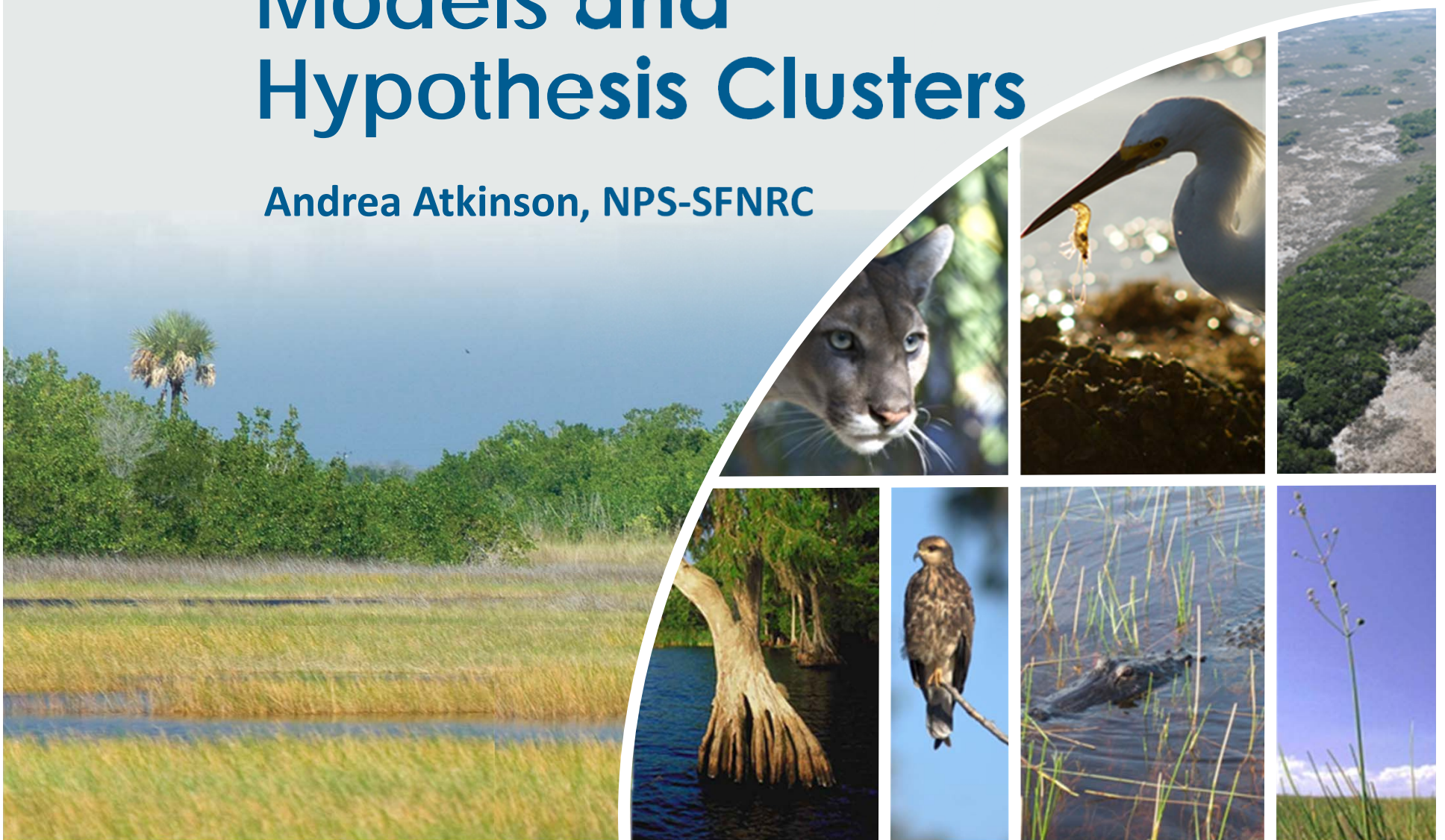




# RECOVER Update to Conceptual Ecological Models and Hypothesis Clusters

Andrea Atkinson, NPS-SFNRC



# Why Update CEMs & Create HCs?

- RECOVER Models first published in 2005... Much has been learned over past 10-15 years.
- New problems/issues have emerged.
- Restoration actions better defined.
- Needed to update Monitoring and Assessment Plan (MAP) and determine priorities for funding.
- Puts basic understanding of system in one document.



# What is a Conceptual Ecological Model (CEM)?

- *CEMs, as used in CERP, are **non-quantitative planning tools** used to identify major ecological and anthropogenic drivers and stressors on natural systems, the ecological effects of these stressors, and biological attributes or indicators of these ecological responses (Ogden et al. 2005a).*
- What is causing this system to change?



# What is a Conceptual Ecological Model (CEM)?

## Narrative

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### BIG CYPRESS REGIONAL ECOSYSTEM CONCEPTUAL ECOLOGICAL MODEL

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**Abstract:** The Big Cypress region of southwest Florida is a diverse mosaic of upland pine flatwoods and hardwood hammocks, herbaceous wet prairies and marshes, and forested wetlands. Besides large natural landscapes, it includes extensive areas of residential and agricultural development. Dominant natural controlling factors are hydrology on the low relief land surface and fire in a subtropical environment with a strong wet-dry seasonal cycle of rainfall. Human influences on the Big Cypress ecosystem are all associated with extensive residential and agricultural development. Lowered water levels and shortened hydroperiods cause shifts to drier communities, which leads to habitat loss and more intense fires. Higher nutrient concentrations associated with agriculture and more mineralized ground-water inputs from a variety of sources favor nuisance and exotic plant species. Fragmentation of the plant community mosaic interferes with seasonal expansion and contraction of wetland water bodies and associated seasonal movements of animal populations. Fragmentation also interferes with wildlife movements and the natural spread of fire across the landscape. Disturbed environments along edges created by fragmentation facilitate invasion of natural plant and animal communities by exotic species. Efforts to eradicate fire have eliminated large areas of early successional communities, while creating high fuel loads that ultimately result in very destructive fires. The spread of exotic plants is resulting in the replacement of large areas of native plant communities, but the effects of exotic animal invasions on native animal populations are poorly known. The objective of this paper is to present a conceptual model of the major human influences on the Big Cypress region, and how they affect natural processes and selected components of the ecosystem.

**Key Words:** Big Cypress, hydrology, fire, landscape fragmentation, wildlife, southwest Florida plant communities, exotic plants, exotic animals, nutrients, agricultural development, residential development, pesticides, organic soils

#### BACKGROUND

The Big Cypress region covered by this conceptual ecological model includes the freshwater portions of the area extending from the southern edge of the Caloosahatchee River watershed boundary in Lee, Hendry, and northern Collier Counties, and west of the Everglades, as delimited approximately by the eastern and southern boundary of Big Cypress National Preserve (Figure 1). In this region, historic water flows were primarily south to the Gulf of Mexico, with minor flows in small creeks that pass through the west coast ridge to the Gulf (Klein et al. 1970). I define the water table throughout Big Cypress as being at the top of the surficial aquifer, which is above ground over much of the area during wet season and below ground over most of these same areas during dry season.

The Big Cypress region has three distinct subregions based on the kind and degree of development present in each (Lehman 1976). The least disturbed area, where hydrology is largely rainfall-driven, is located within Big Cypress National Preserve in the southeastern portion of the region (Duever et al. 1986).

The most developed portion of the area, including both urban and agricultural development, is located on and just east of the coastal ridge from Naples north to Fort Myers. The rest of the area is a mixture of agricultural lands, suburban and rural communities, and small-to-large natural areas that have been altered to varying degrees by upstream and/or adjacent development. Despite varying degrees of development in the three subregions, kinds of stressors and their effects on ecosystem attributes are similar throughout the Big Cypress region, and they differ only in severity of their impacts.

The Big Cypress region is comparable to the freshwater Everglades in natural community diversity, although Big Cypress communities are primarily forested and tend to form more of a mosaic, as opposed to vast expanses of a number of primarily herbaceous community types. The most extensive natural communities in Big Cypress are distributed throughout the region along very gentle topographic gradients from short-hydroperiod pinelands on uplands through marshes to long-hydroperiod cypress forests on lower elevations (Davis 1943, Klein et al. 1970, Craighead

## Diagram

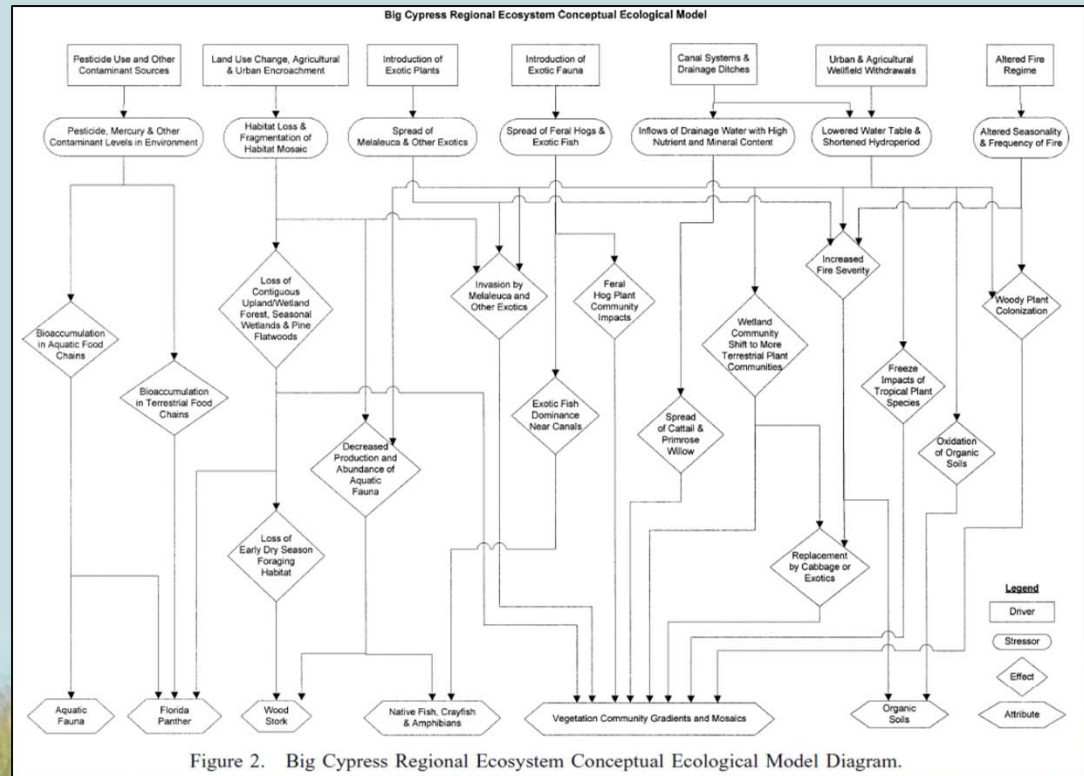


Figure 2. Big Cypress Regional Ecosystem Conceptual Ecological Model Diagram.

# CEM Framework

DRIVERS

Drivers are forces that are the underlying causes of change in the Everglades system.

STRESSORS

Stressors are physical, chemical, and biological mechanisms that cause change(s) in the ecosystem. Stressors are the particular effects of Drivers in the ecosystem.

EFFECTS

Ecological effects are physical, chemical, and biological responses that are intrinsic to the ecological system and which are triggered by stressors. Ecological effects can be dynamic processes, and can be positive, negative, or neutral.

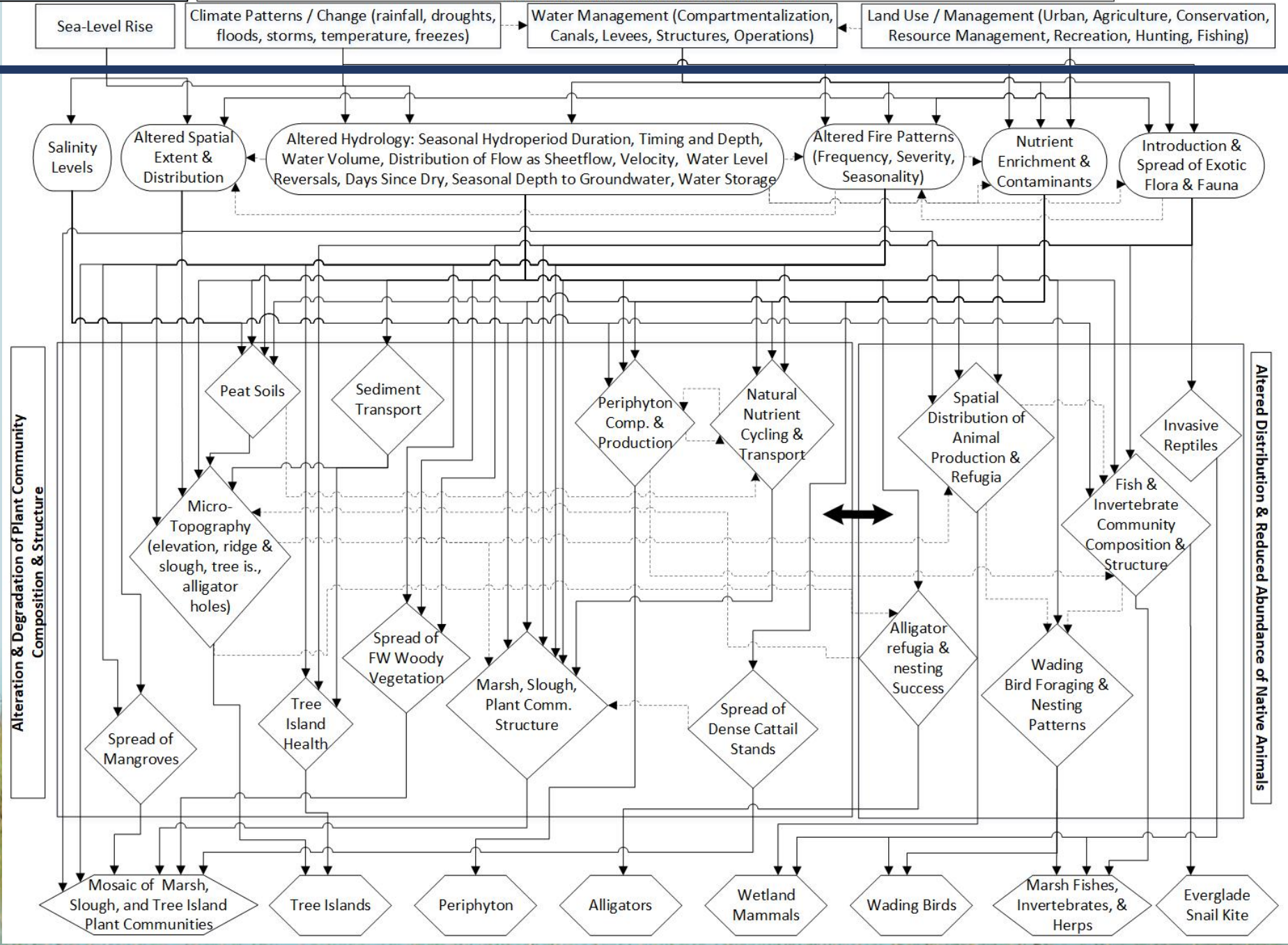
ATTRIBUTES

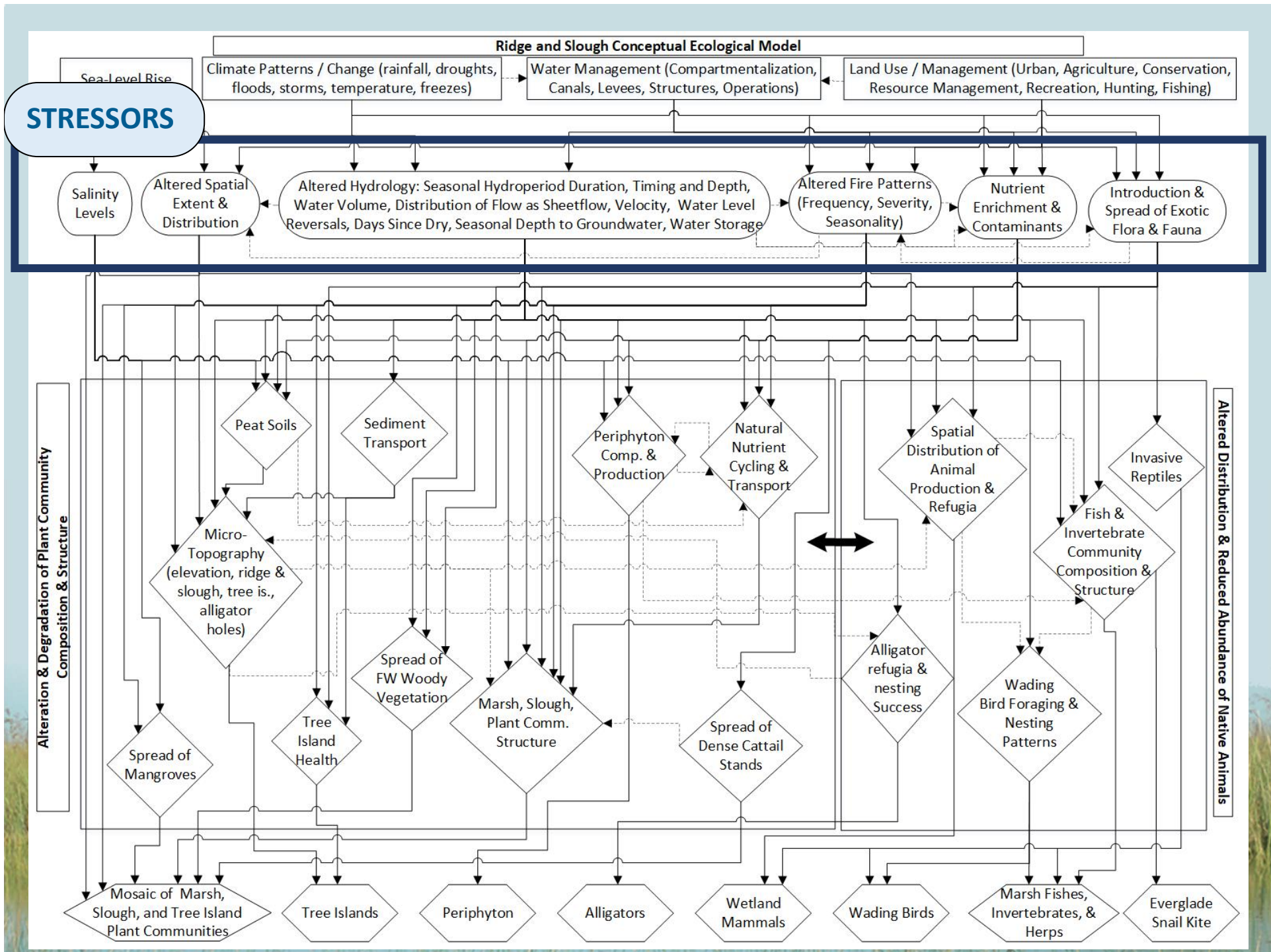
Attributes are a parsimonious subset of ecosystem components that are thought to be representative of overall ecological conditions of the system.

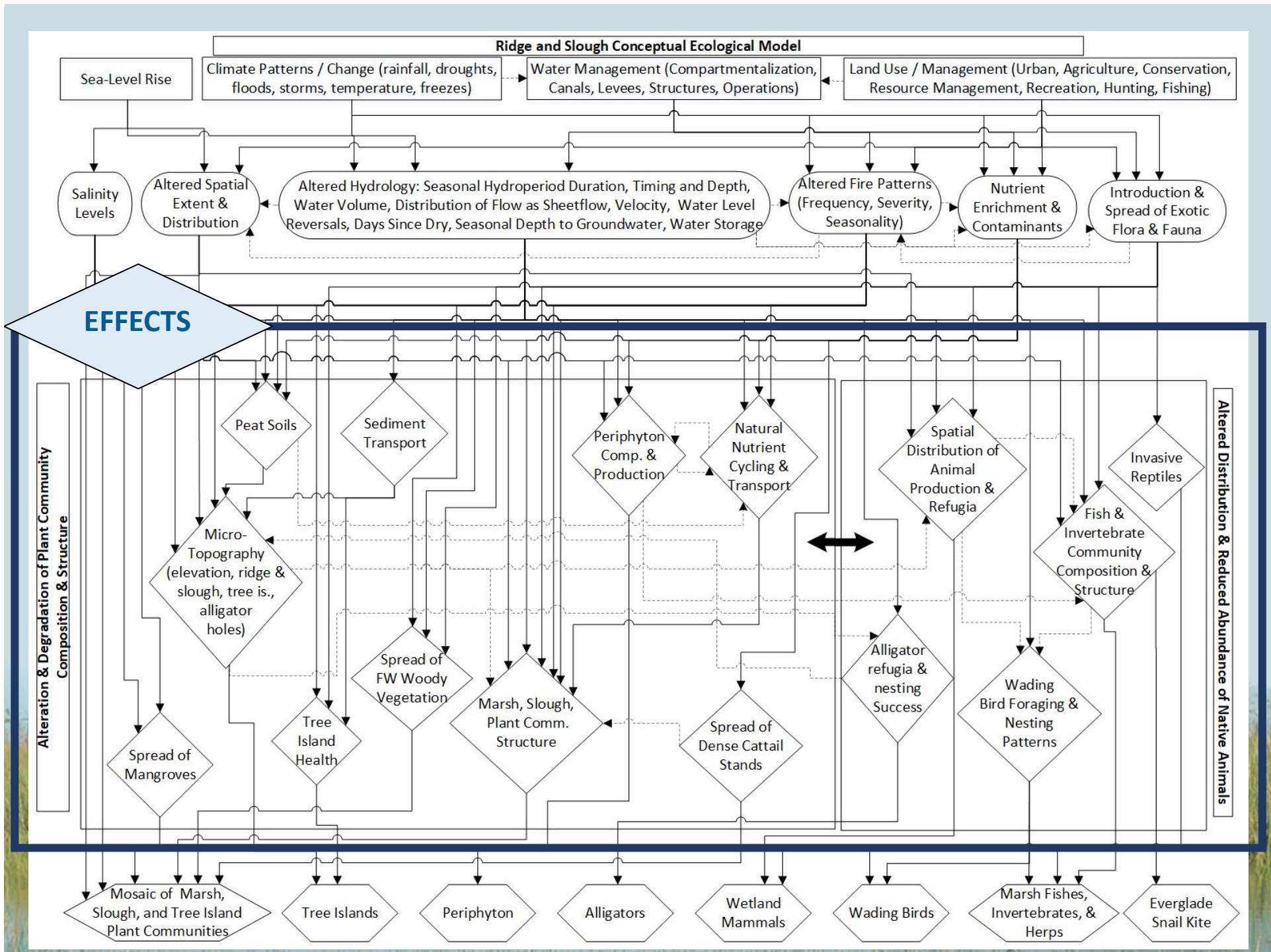


# DRIVERS

## Ridge and Slough Conceptual Ecological Model

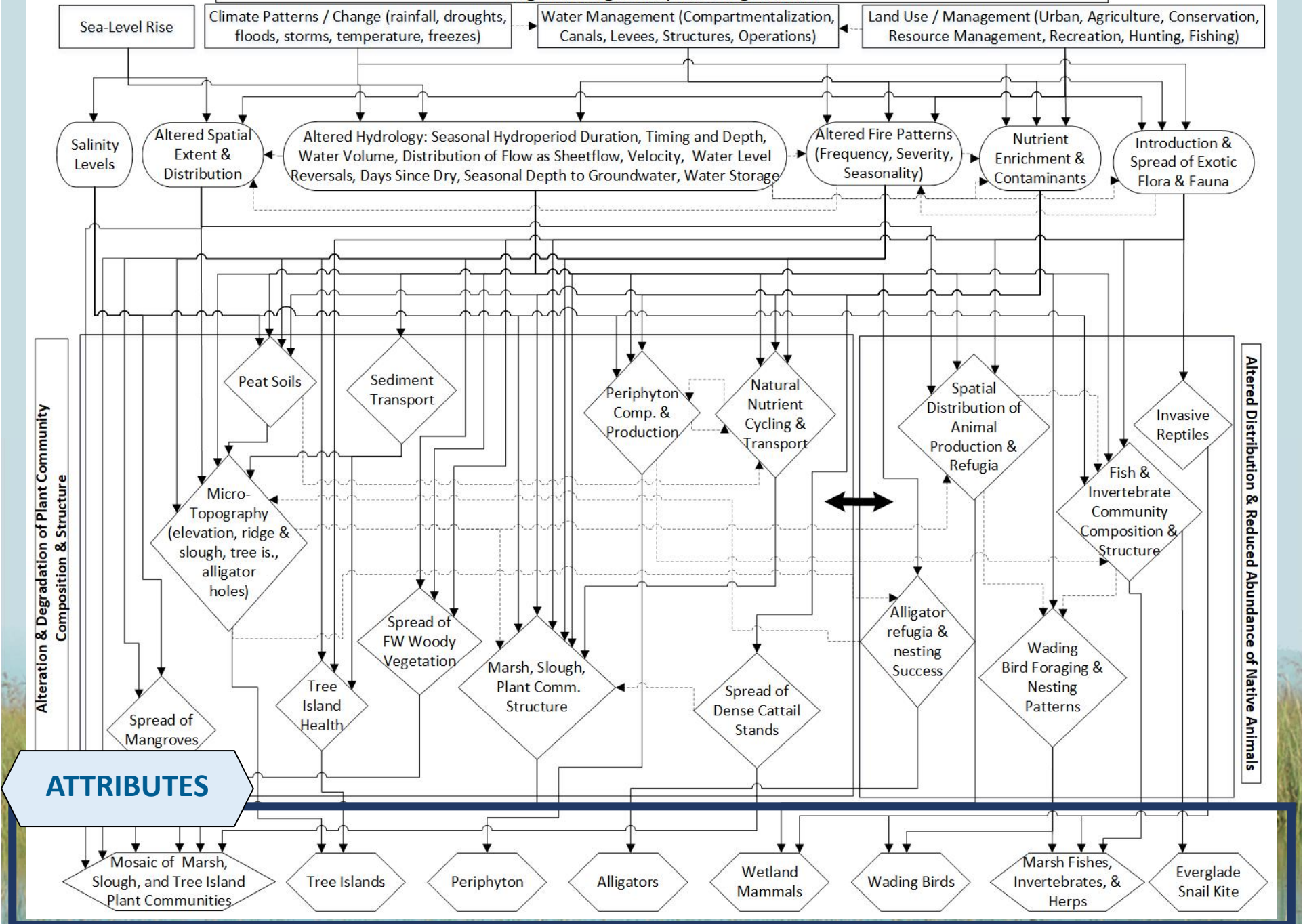




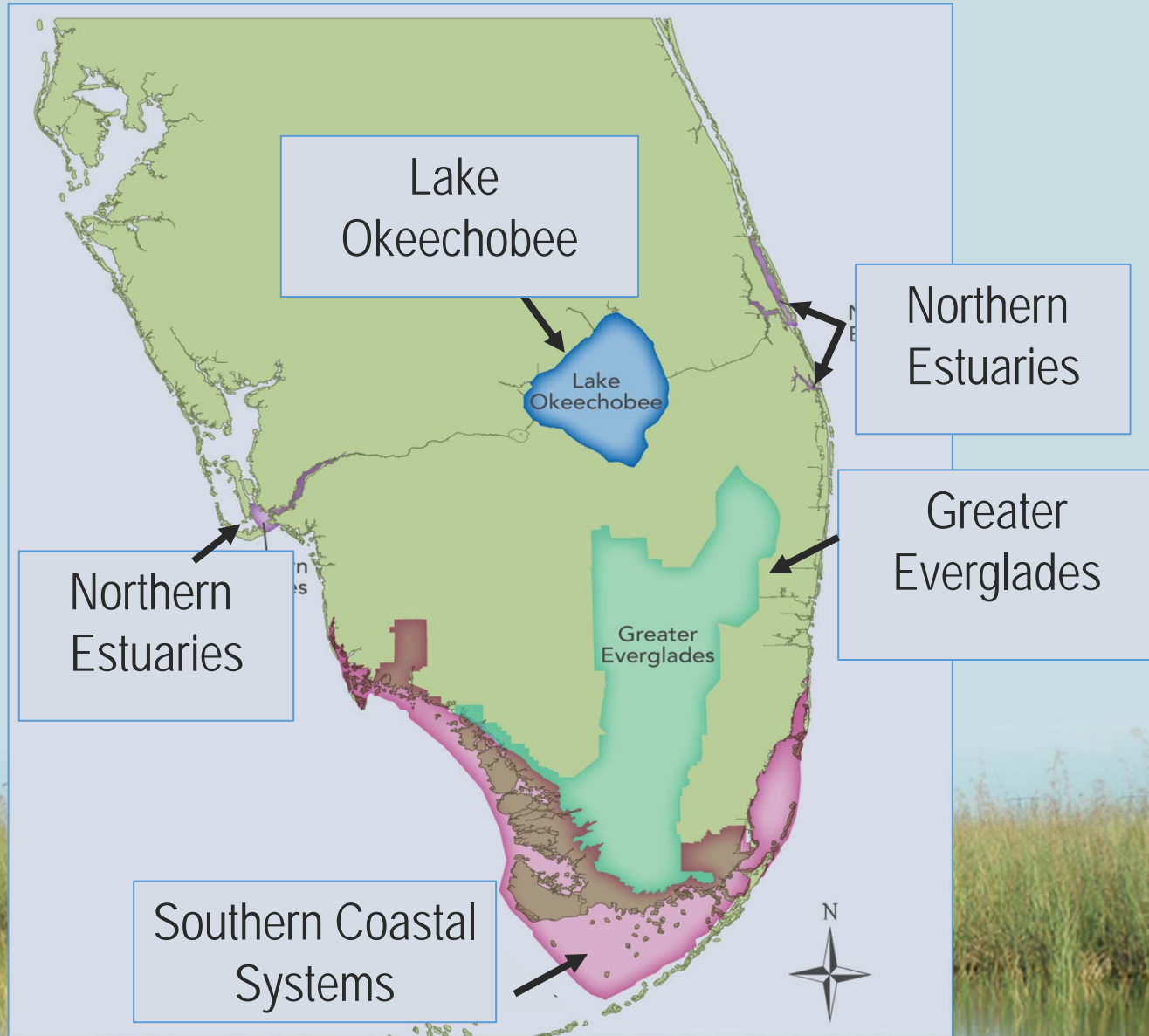




### Ridge and Slough Conceptual Ecological Model



# RECOVER Regions



# RECOVER Conceptual Ecological Models (CEMs)

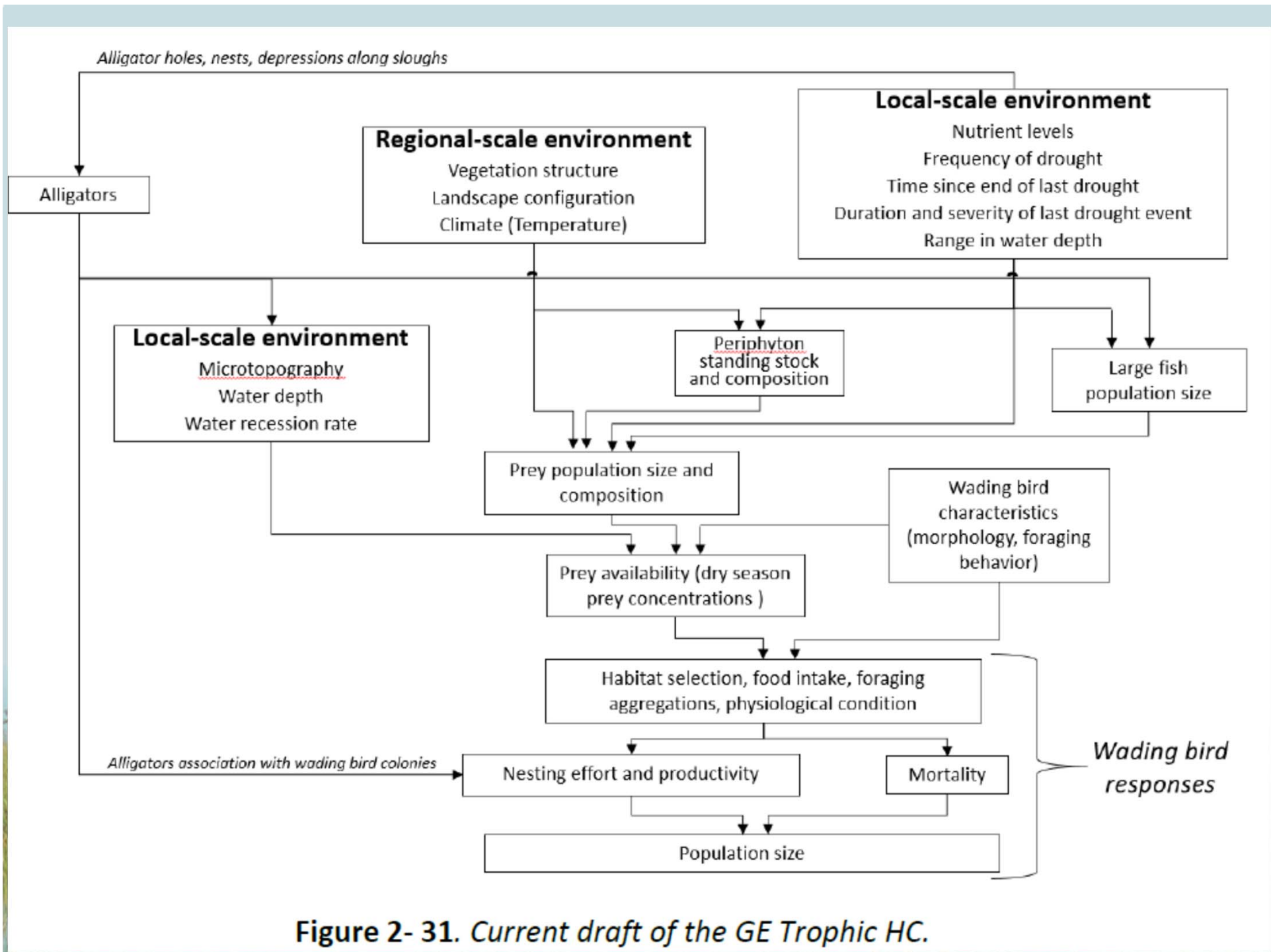
- Total System
  - Lake Okeechobee
  - Northern Estuaries
  - Greater Everglades
    - Ridge & Slough
    - Southern Marl Prairies
    - Big Cypress
  - Southern Coastal Systems
    - Biscayne Bay
    - Florida Bay
    - Southwest Coast



# What is a Hypothesis Cluster (HC)?

- Subsets of CEM with more details, especially how restoration is anticipated to affect ecosystem components and relationships.
- Don't follow Driver-Stressor-Effect-Attribute framework





**Figure 2- 31. Current draft of the GE Trophic HC.**

# Hypothesis Clusters

NORTHERN ESTUARIES	LAKE OKEECHOBEE	GREATER EVERGLADES	SOUTHERN COASTAL SYSTEMS
Oyster Submerged Aquatic Vegetation Benthic Infauna Coastal Habitat and Floodplain Phytoplankton Fisheries	Vegetation Mosaic Macro-invertebrate Fish Phytoplankton Avian Amphibian	Tree Islands Trophic (Fish, Birds) Alligator Big Cypress – Fire & Hydrology Big Cypress – Traditional Use Plants Big Cypress - ?	Salinity Submerged Aquatic Vegetation Phytoplankton Native Vegetation Mosaic Characteristics of Everglades Coastal Wetlands Prior to Drainage Nursery Habitat Predator-Prey Interactions (Trophic Interactions) Oyster Habitat



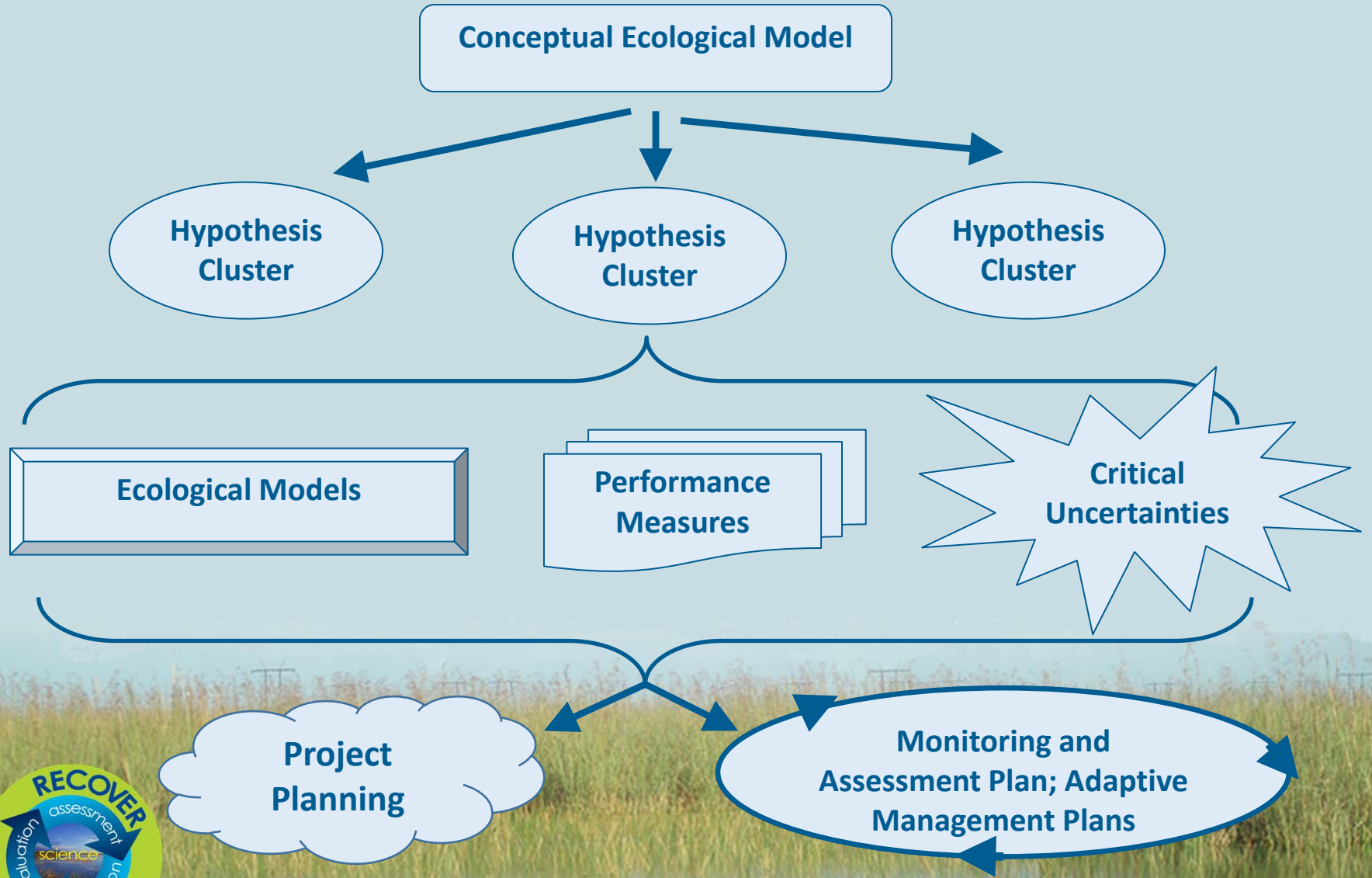
# Identify Critical Uncertainties

That constrain decision-making and/or put restoration success at risk, e.g.

- Critical information needed for modeling or planning
- Verify critical assumptions
- Optimize balance between competing objectives or constraints
- New or unclear issues that may slow or prevent achieving goals



# How do CEMs & HCs help CERP?





# Biggest Changes

- Greater emphasis on Sea Level Rise & Climate Change
- Big Cypress Hypothesis Clusters being added,
  - Flood & Fire, Traditional Use Plants
- Better links to management actions
- Some uncertainties resolved & new ones identified:
  - Some linkages confirmed: e.g., between alligators and wading birds; juvenile crocodiles and salinities
  - More details determined: relationship between oyster impacts and frequency & duration of high inflow events; specifics of water recession rates on wading bird foraging
  - New uncertainties: links between nutrient spikes and end of dry season flows; new invasive species-- pythons



# Report Status

- Northern Estuaries and Lake Okeechobee sections are nearly done
- Greater Everglades, Southern Coastal Systems, and Big Cypress are further behind
- Coming Soon... June? July?
- We will need your help to REVIEW!!!



# Thank you!!!

- Lake Okeechobee: Therese East (Lead), Zach Welch, Mike Baranski, Chuck Hanlon, Alyssa Jordan, Rich Botta, Paul Gray, Dale Gawlik, David Essian
- Northern Estuaries: Phyllis Klarmann (Lead), Melanie Parker, Ramon Martin
- Greater Everglades: Tasso Cocoves (Lead), Agnes Mclean, Miles Meyer, Christa Zweig, Fred Sklar, Jed Redwine, Andrea Atkinson
- Southern Coastal Systems: Mike Simmons & Ramon Martin (Co-Leads), Amanda McDonald, David Rudnick, Tasso Cocoves, Melody Hunt, Chris Kavanaugh, Leonard Pearlstine, Fred Sklar, Carlos Coronado, Jerry Lorenz, Jen Rehage, Brad Furman, and more helping update HC's.
- Big Cypress: Andrea Atkinson (lead), Tony Pernas, Shawn Clem, Eric Cline, Kevin Whelan, Kevin Cunniff, Tasso Cocoves, Art Roybal, Karli Eckel, Pablo Ruiz, Deb Jansen, Jed Redwine, Bob Sobczak, Holly Andreonata, Jimi Sadle, Melissa Nasutti, Andrea Nocetini, Mike Duever, Joe O'Brien, Grant Sullivan, Whitney Sapienza, Stacy Myers, Maya Tupaj

