What Managers Need to Know About System-wide Science to Improve Restoration Planning and Maximize Adaptive Management

Chairs of RECOVER Assessment Team, Integrative Assessment Sub-team, and MAP Module Groups

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Effective Use of Science in South Florida

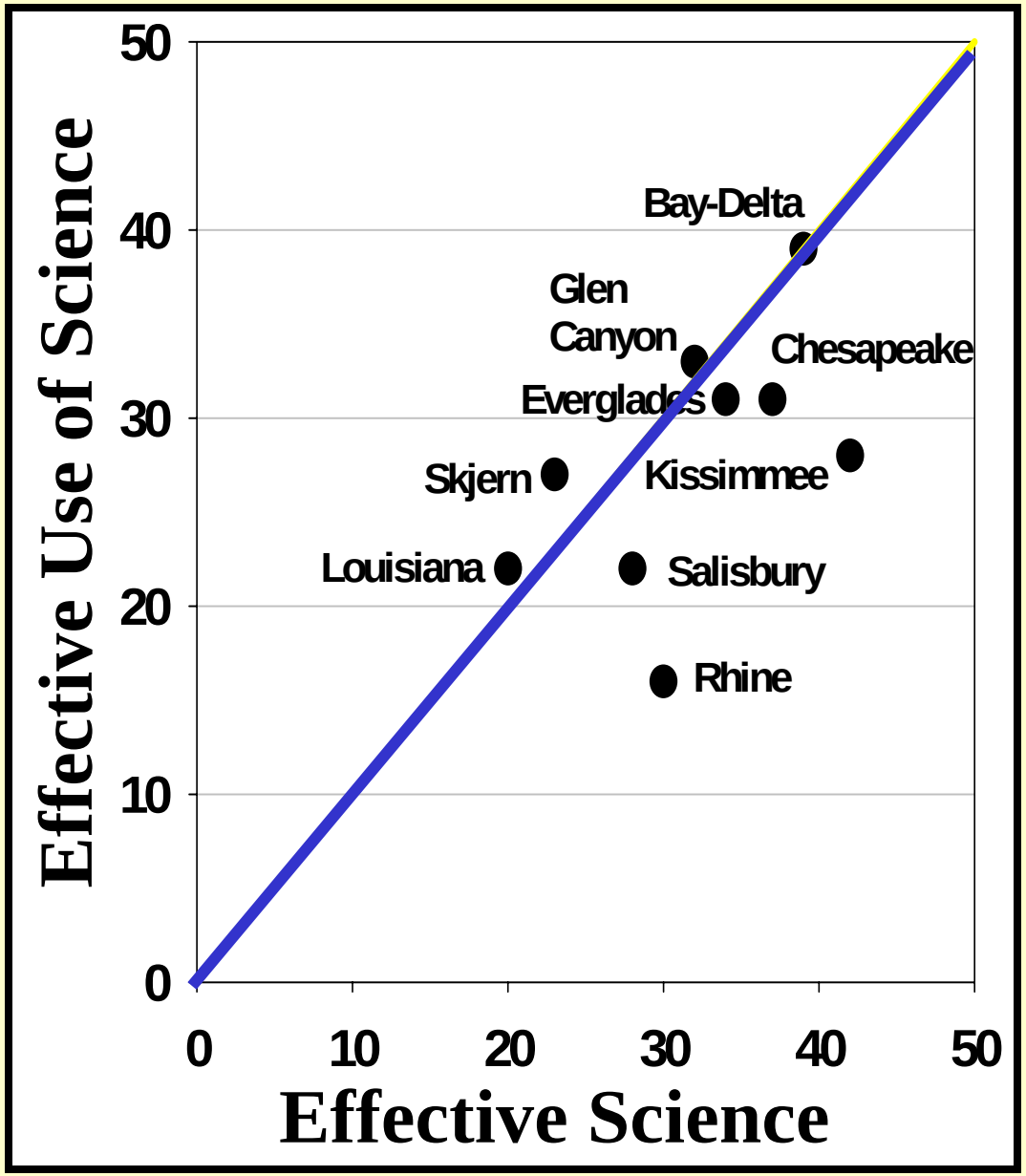
Effective Science

- **Content**
- **Quality**

Effective Use of Science

Institutional process where science is:

- **Generated**
- **Evaluated**
- **Applied**



From: Van Cleve et al. (2006) Environ. Manage. 37:367-379

Themes Covered

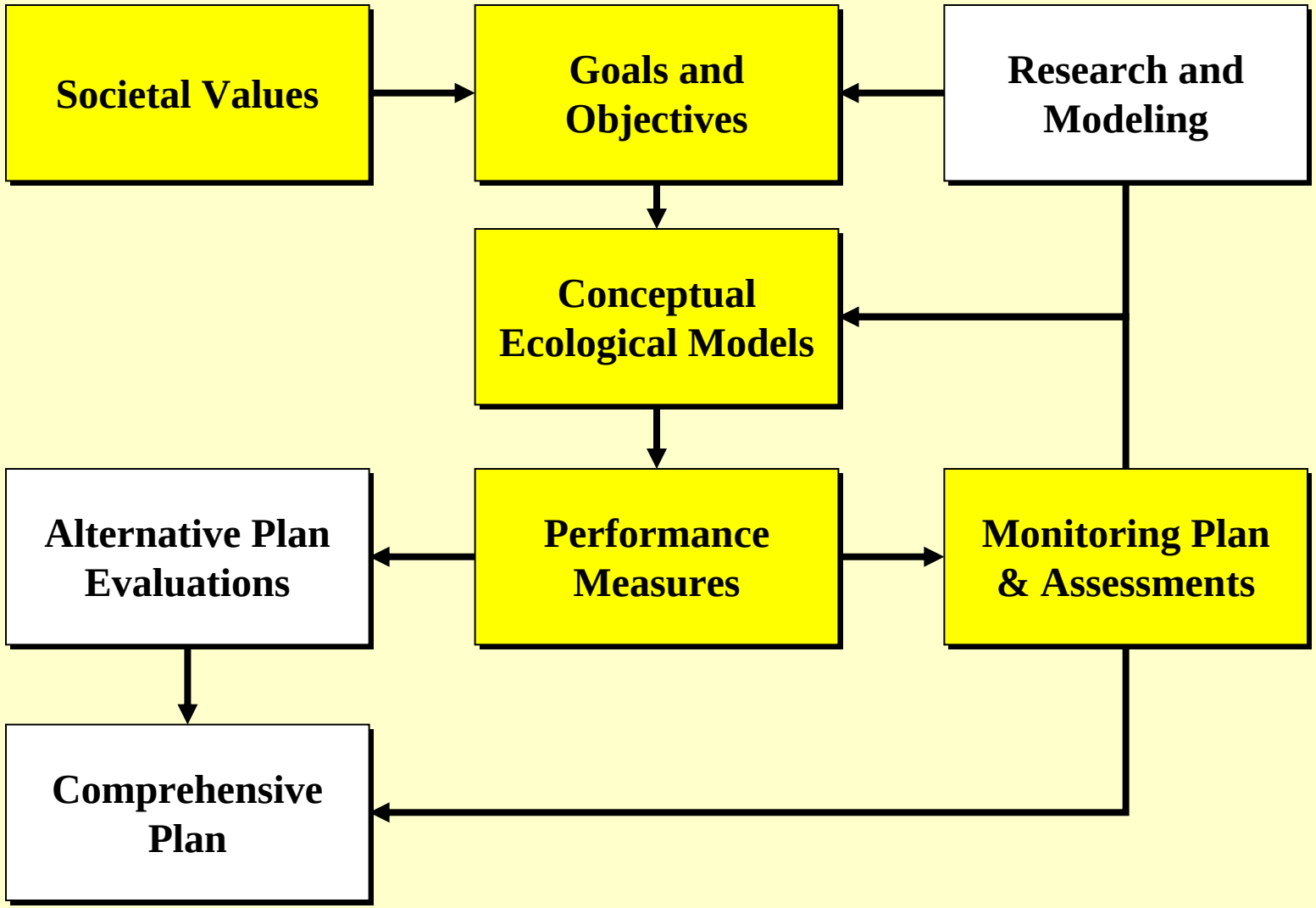
- **History of the Monitoring and Assessment Plan (MAP)**
- **System-wide monitoring and assessment for AM**
- **MAP and project planning and implementation**
- **Lessons-learned**
- **Long-term monitoring, sustainability, and thresholds**
- **MAP future**
- **Synthesis of key messages for managers**

History of the Monitoring and Assessment Plan

Purpose of the MAP

- **Document restoration-induced change and status of system**
  - **Measure hydrology, water quality, ecology responses**
- **Confirm/develop scientific information**
- **Feedback loop integrating science and management**
- **Informed decision-making**
  - **Provide science to guide implementation, operation, and maximize benefits, i.e., Adaptive Management**
  - **Sound science to reduce risk and uncertainty**

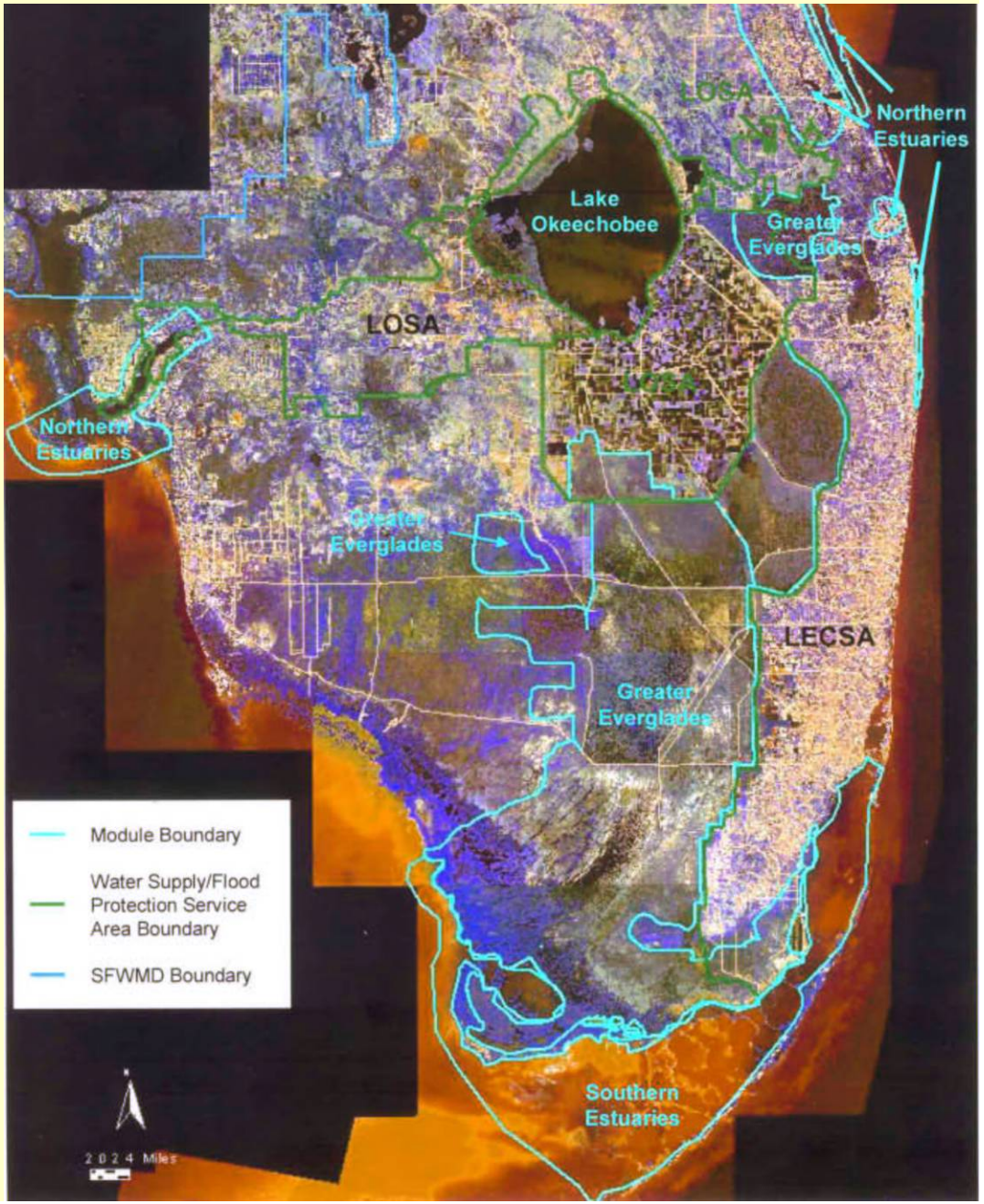
CERP Applied Science Strategy



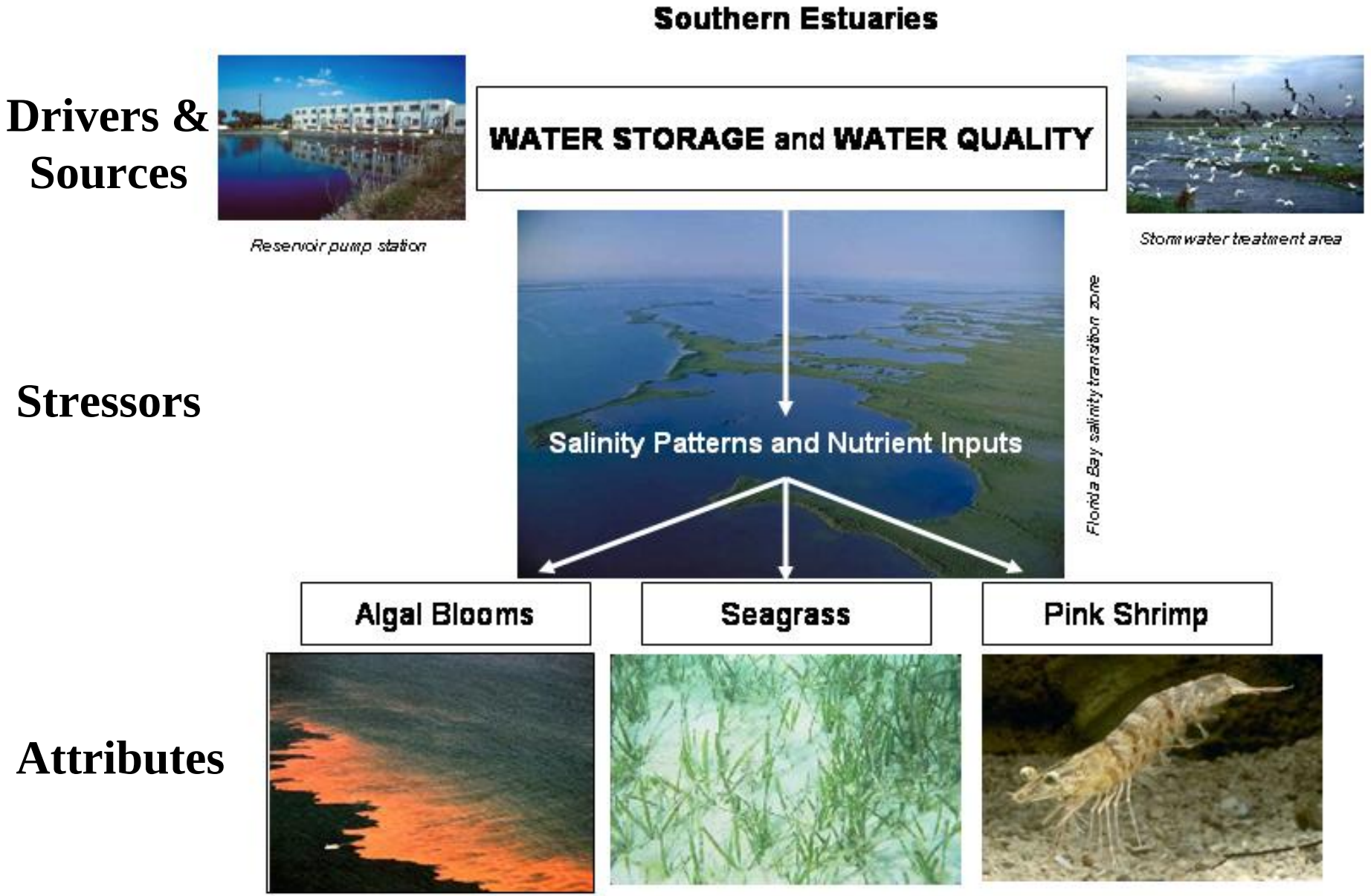
Conceptual Ecological Models

Ridge & Slough
Marl Prairies
Mangrove Estuaries
Big Cypress
Florida Bay
Biscayne Bay
Caloosahatchee Estuary
St. Lucie Estuary/IRL
Lake Okeechobee
Loxahatchee R.
Lake Worth Lagoon

Total System Model

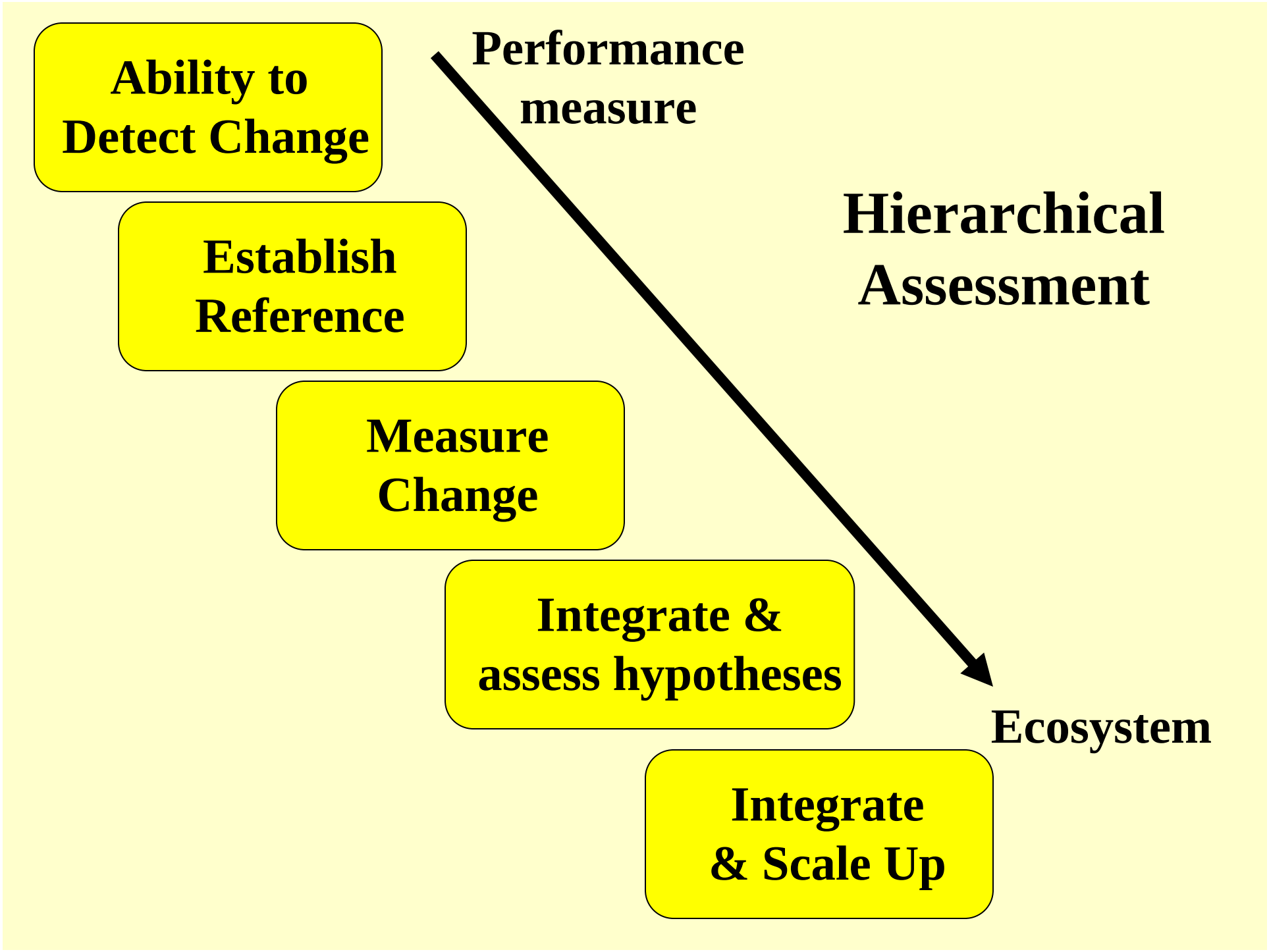


Conceptual Ecological Models



MAP Implementation

- Capture baseline info for monitoring components that do not have adequate existing information
- Fill gaps in existing networks
  - hydrology
  - water quality
  - biology
- Initiate high priority new biological monitoring
- Initiate priority supporting ecological research
- Develop guidance for assessment protocols


Ability to Detect Change
Establish Reference
Measure Change
Integrate & assess hypotheses
Integrate & Scale Up
Performance measure
Hierarchical Assessment
Ecosystem

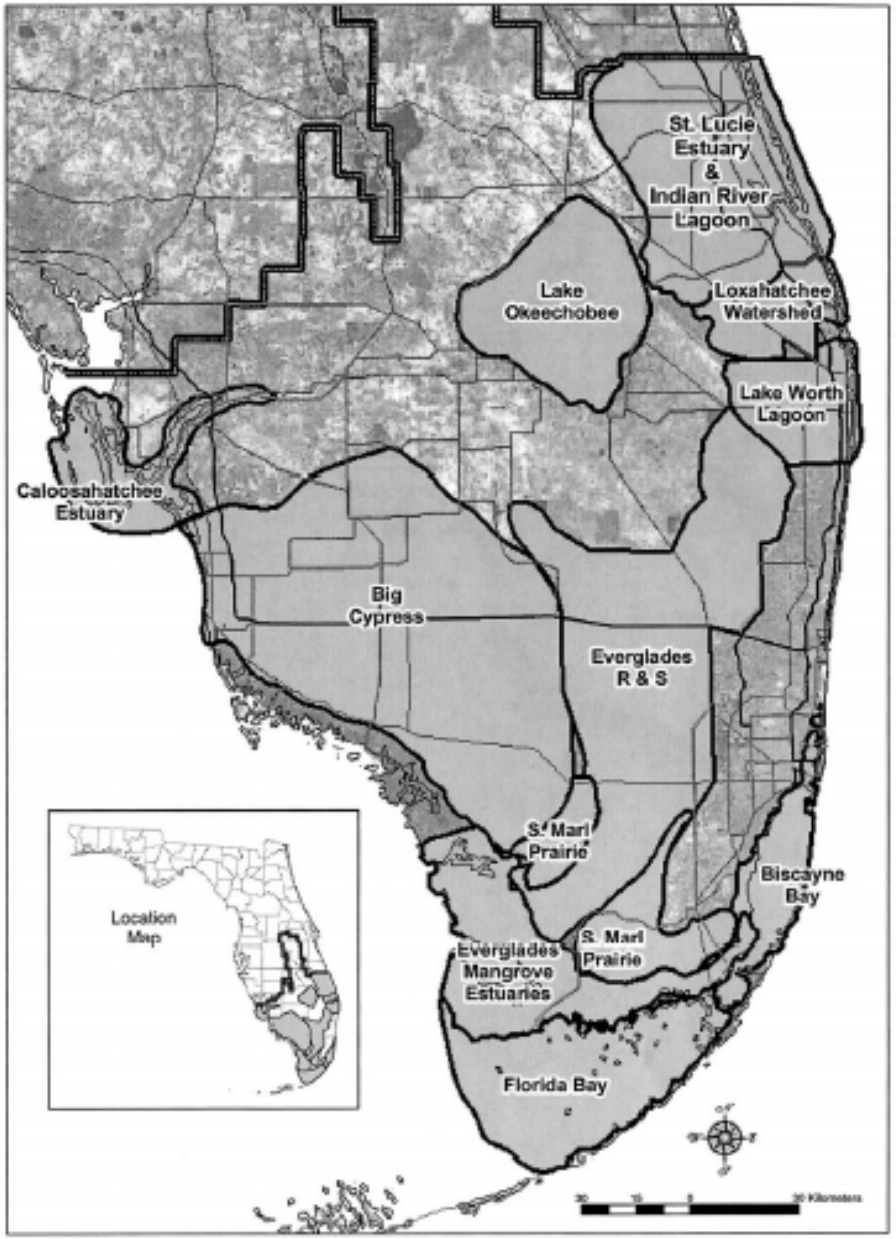


Figure 1. The total South Florida ecosystem has 11 regions for which conceptual ecological models have been developed. These regions combined form the boundary of the Total System Conceptual Ecological Model.

Metrics for Assessment

- Was >> than 100 PMs
- Combined across CEMs
- Distilled CEMs
  - 17 major organizing hypothesis clusters

System-wide Assessments

GEER 2008 System-wide Assessment workshop

Components	N. Estuaries	L. Okeechobee	G. Everglades	S. Estuaries
Data Status				
Ability to Detect Change				
Reference Condition				
Measure / Assess Change				
Apply to AM				
Lessons Learned				

System-Wide Monitoring and Assessment for Adaptive Management

CERP AM Definition

"Adaptive management is a science- and performance-based approach to ecosystem management in situations where predicted outcomes have a high level of uncertainty. Under such conditions, management anticipates actions to be taken as testable explanations, or propositions so the best course of action can be discerned through rigorous monitoring, integrative assessment, and synthesis. Adaptive management advances desired goals by reducing uncertainty, incorporating robustness into project design, and incorporating new information about ecosystem interactions and processes as our understanding of these relationships is augmented and refined. Overall system performance is enhanced as AM reconciles project-level actions within the context of ecosystem-level responses."

- CERP AM Strategy, 2006

Nine Activities in CERP AM

Plan Formulation | **Design/Construction** | **Operations**

Activity 1: ***Engage Stakeholders and Collaborate***

Activity 2:

Establish or Verify Program Goals and Objectives

Activity 3:

Identify and Prioritize Unanswered Questions

Activity 4:

Use Conceptual Models, Hypotheses, and Performance Measures

Activity 5:

AM Integration into Restoration Plan

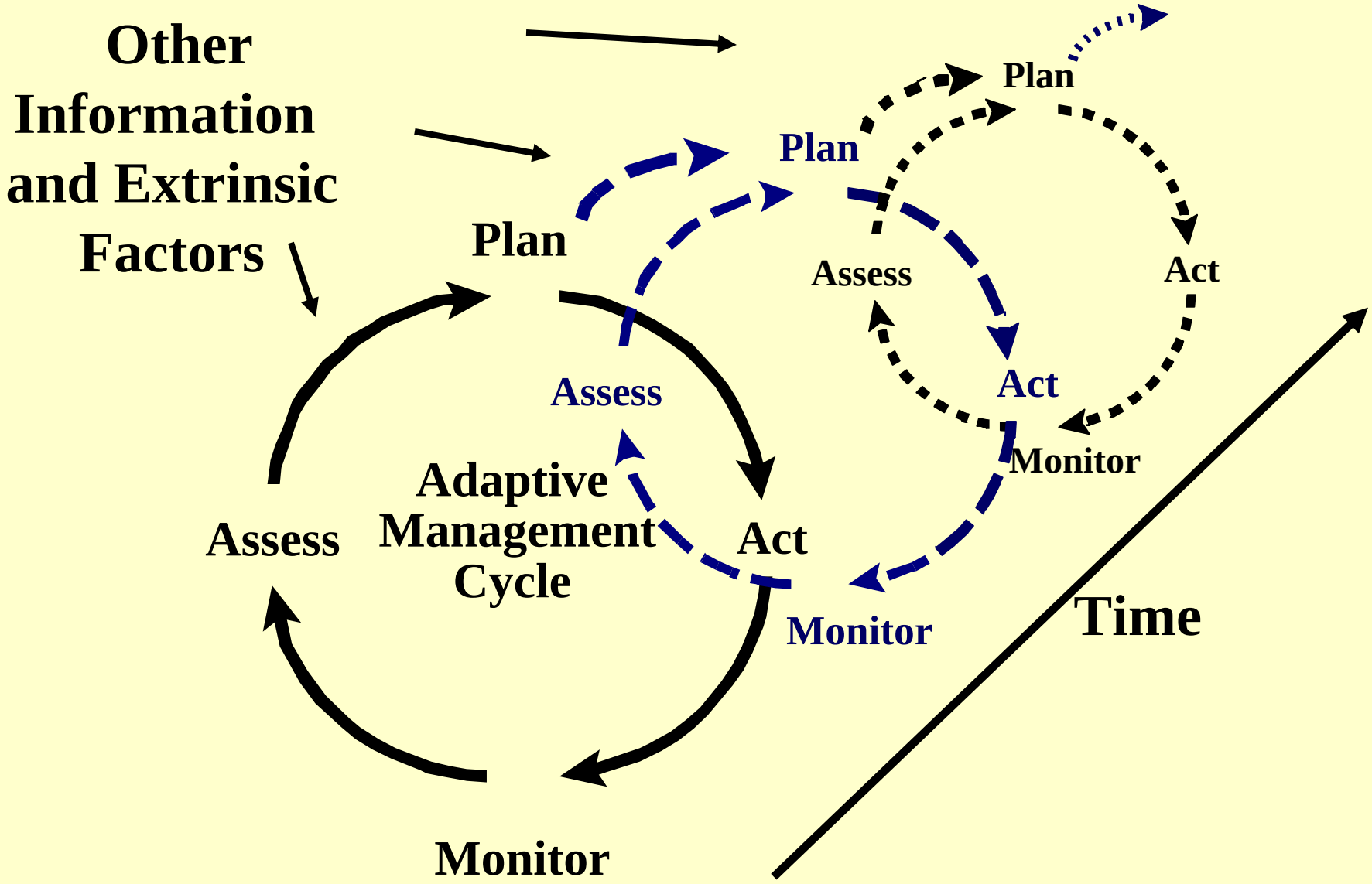
Activity 6: ***Monitoring***

Activity 7: ***Assess***

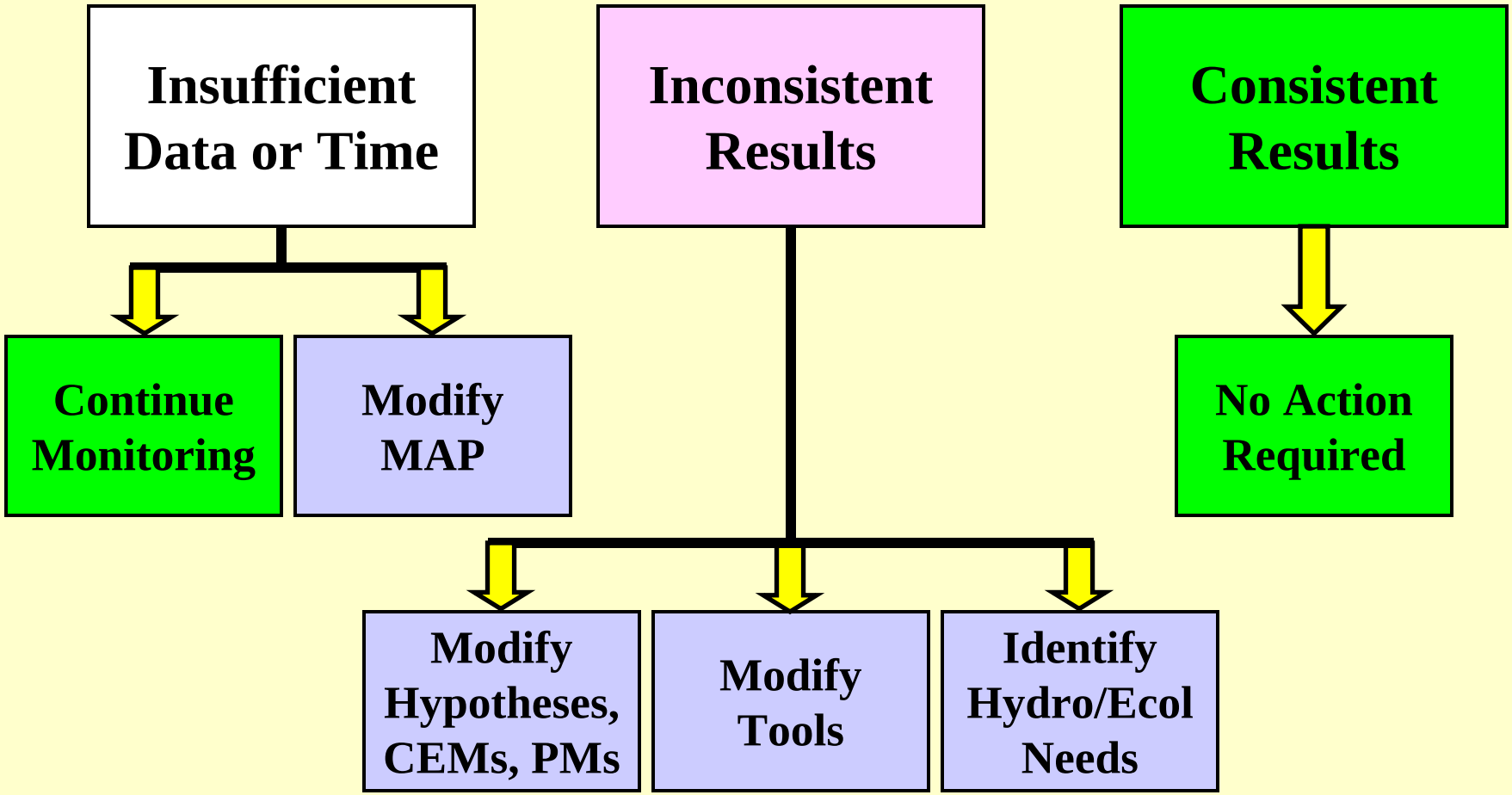
Activity 8: ***Decision-Making***

Activity 9: ***Implement and Refine***

A structured process of learning by doing



Framework for Synthesis and Interpretation



Northern Estuaries

Water Management **Water Treatment** **Habitat Alterations**

Reservoirs

StormwaterTreatment Areas

Muck Removal

Wetlands Rehydration

Improve salinity patterns, water quality and habitat

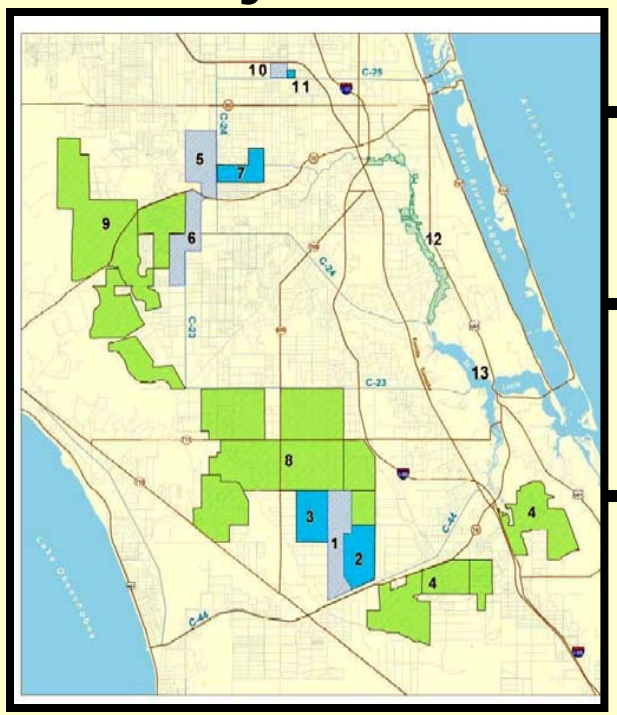
Artificial Habitat

Seagrass

to restore

Oysters

Oyster Performance Measure Example



IRL-S Implementation

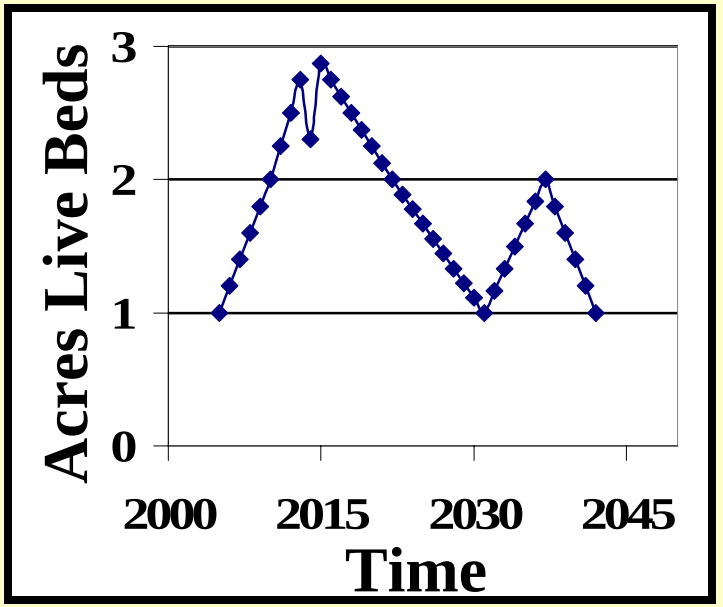
Substrate Suitability

Nutrient Reductions

Flow/Salinity Envelope

Oyster Distribution, Quantity and Health

Adaptive Management Entry Points

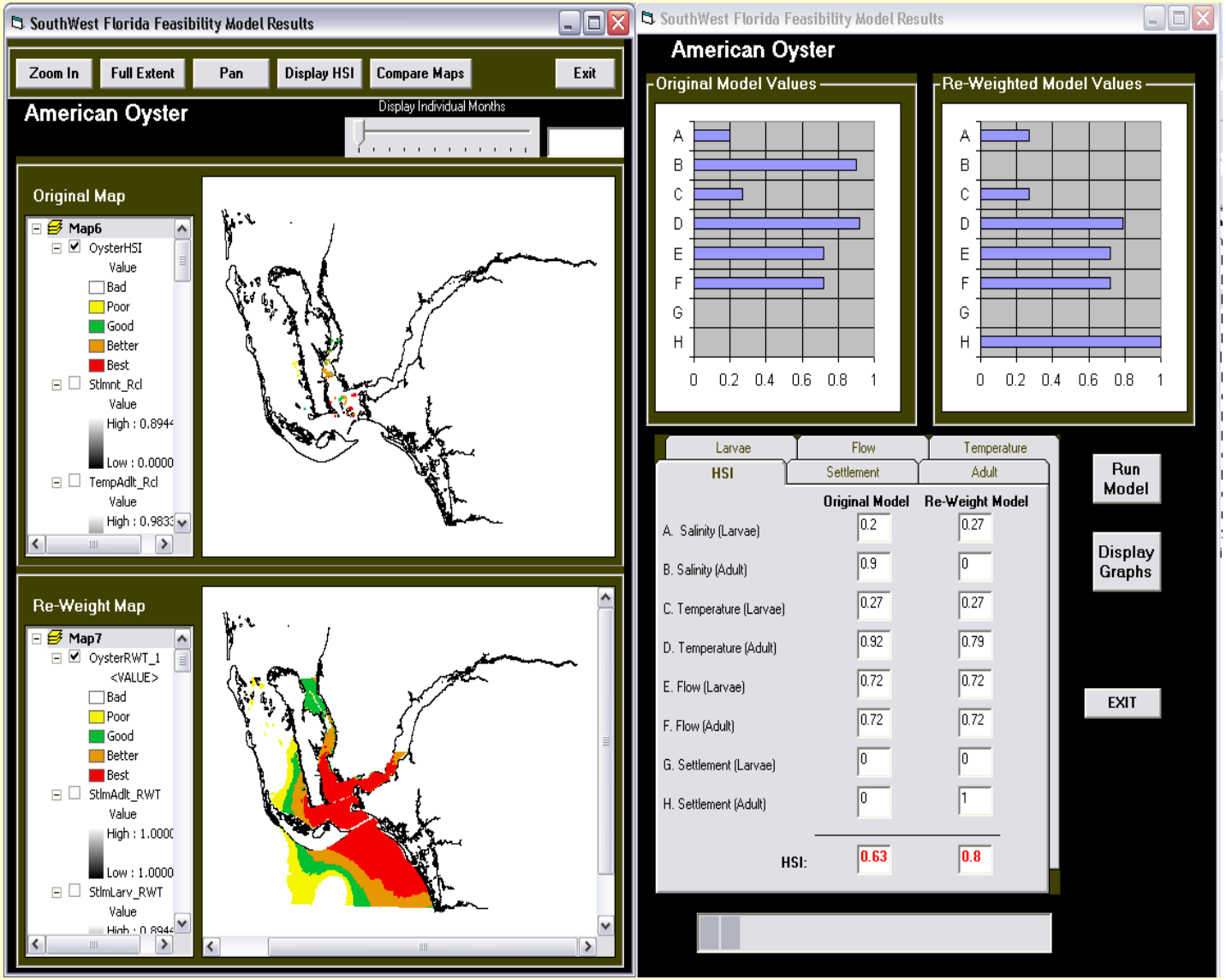


Monitoring designed to assess the success of implementation over time

Application of MAP
as it relates to project planning and implementation

Oyster Performance Measure Example

HSI to predict suitable Oyster Habitat based on differing flow/salinity scenarios that will occur as an outcome of implementation



Linkage of oyster HSI metrics to management actions

Stressor metric	Target	Management Action OPTION 1	Management Action OPTION 2	Management Action OPTION 3
Salinity	Salinity range of 10-25 ppt	Change operations to meet flows		
Recruitment	Presence Absence adults and larvae	Stock larvae	Stock adults	Operations to avoid too much or too little flow in key months
Substrate	Acres of Suitable habitat	Add oyster shell cultch	Try different substrate e.g., concrete	Dredge muck

Linkage of oyster HSI metrics to management actions

Stressor metric	Target	Management Action OPTION 1	Management Action OPTION 2	Management Action OPTION 3
Oyster reef development	Presence / absence of 1 m^2 reefs	Add additional cultch		
Juvenile growth and mortality	Attain natural levels of growth and mortality	Adjust operations to eliminate or minimize events	Adjust flows to attain salinities similar to creeks where oyster growth is optimal	Excessive predation may require salinity adjustments through operations
Disease	Elimination	Operate flows to maintain salinity below maximum threshold	Lower salinity threshold and adjust operations	

Application of lessons-learned to better aid managers' efforts to maximize restoration

Types of System-wide Lessons Learned

- Science
- Assessment
- Integration of science for AM

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- Application of system-wide perspectives to project planning and implementation

Lessons Learned – Science and Assessment

- **Science**
  - Specific to monitoring components
    - **e.g., network efficacy**
  - Applicable among systems
    - **sampling protocols**

- **Assessment**
  - Collaboration among scientists and agencies critical
  - Data Management:
    - **Additional structure and integration**
    - **Improved efficiency through automation**

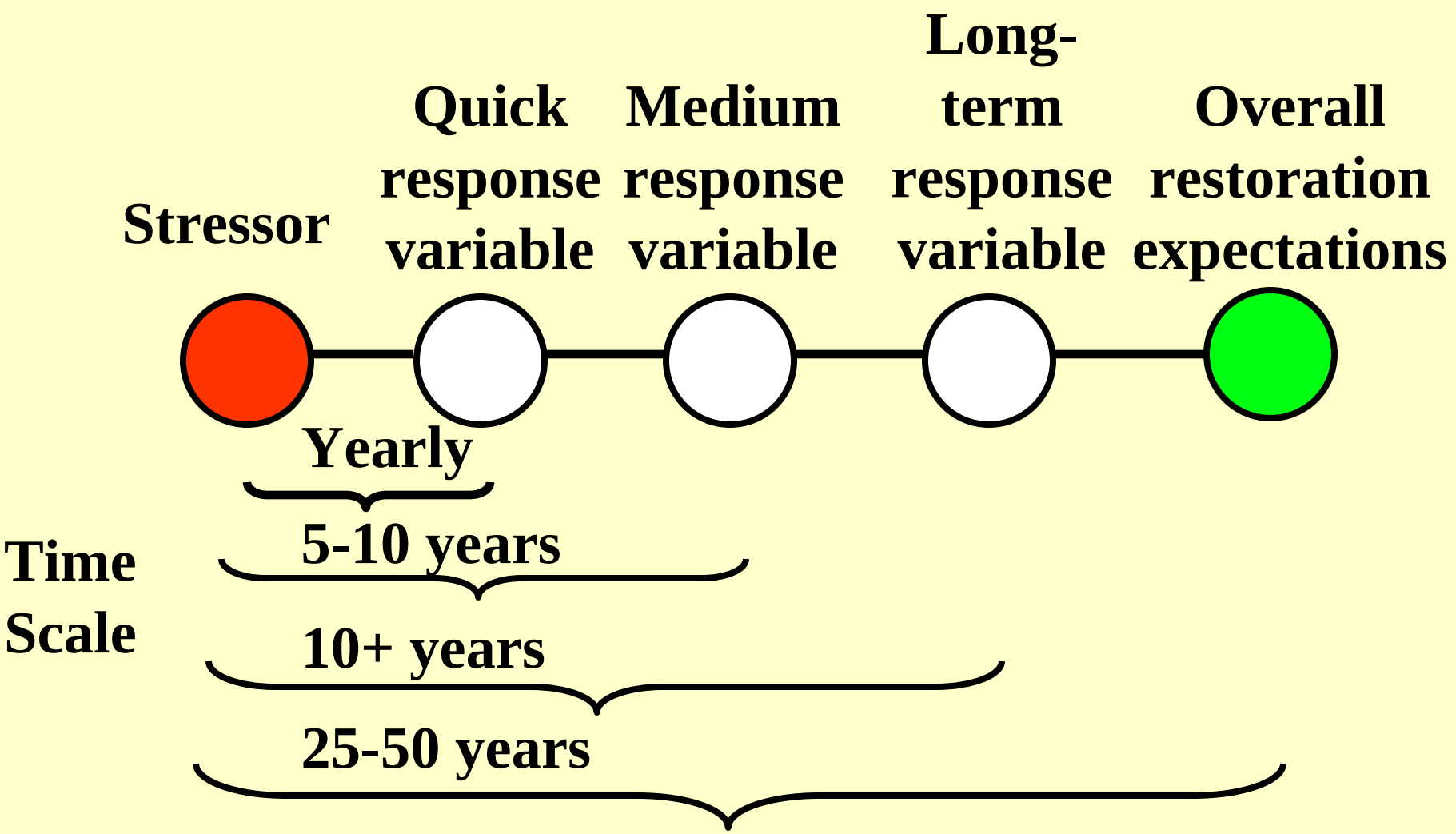
Lessons Learned – Science and Assessment

- **Integration of science for AM**
  - Continued efforts needed to develop structured process to integrate science and management decisions

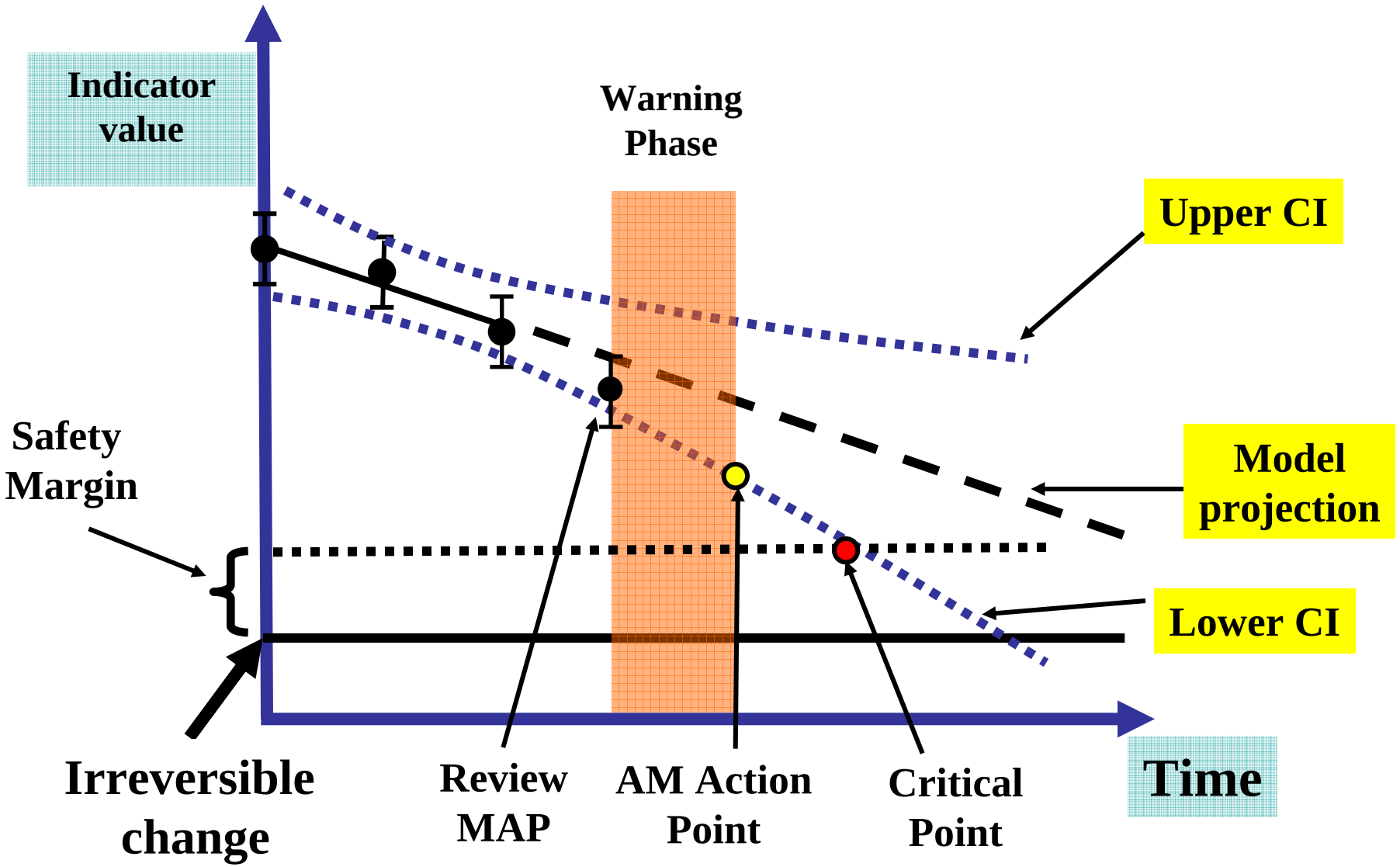
- **Application of system-wide perspectives to project planning and implementation**
  - Communication
  - System-wide science should be expressed as:
    - **A means of reducing risk**
    - **A means of reducing uncertainty**

Long-term monitoring, sustainability, and thresholds

Ecosystem Response

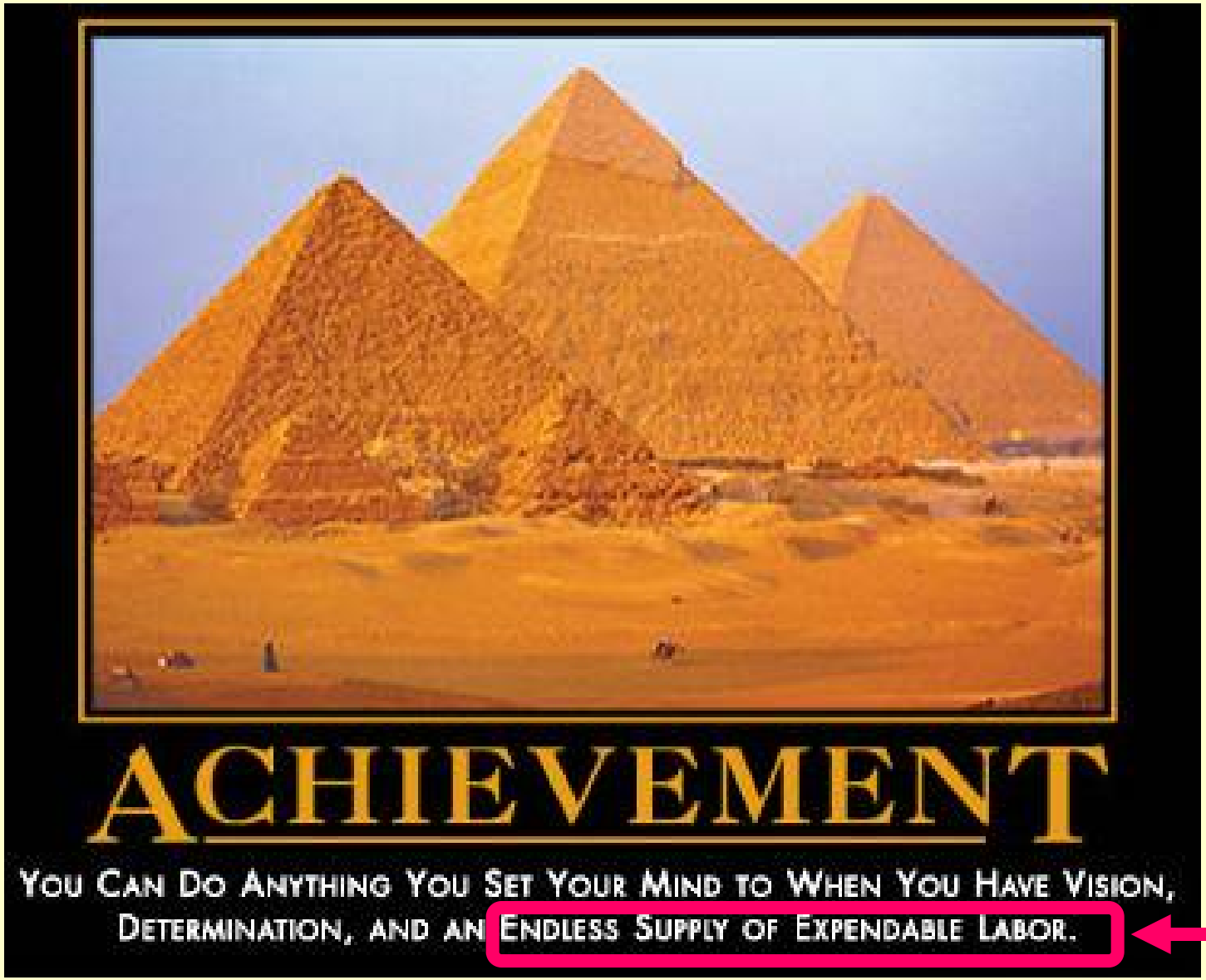


From Thresholds to Action



Modified from:
B. Scholes

Sustainability



- **$$$**
- **Resources**

- **Expectations Management**

Most needs are resource related

Future of the Monitoring and Assessment Plan

MAP 2004

- well-received
- guidepost for current monitoring

January 2004

CERP MONITORING AND ASSESSMENT PLAN:

PART 1

MONITORING AND SUPPORTING RESEARCH

REstoration COordination and VERification (RECOVER)

the journey to restore America's Everglades

COMPREHENSIVE EVERGLADES RESTORATION PLAN

CENTRAL AND SOUTHERN FLORIDA PROJECT

MAP Part 2 (2006)

- documented strategy to conduct monitoring assessments

December 2006

Monitoring and Assessment Plan (MAP), Part 2
2006 Assessment Strategy for the MAP

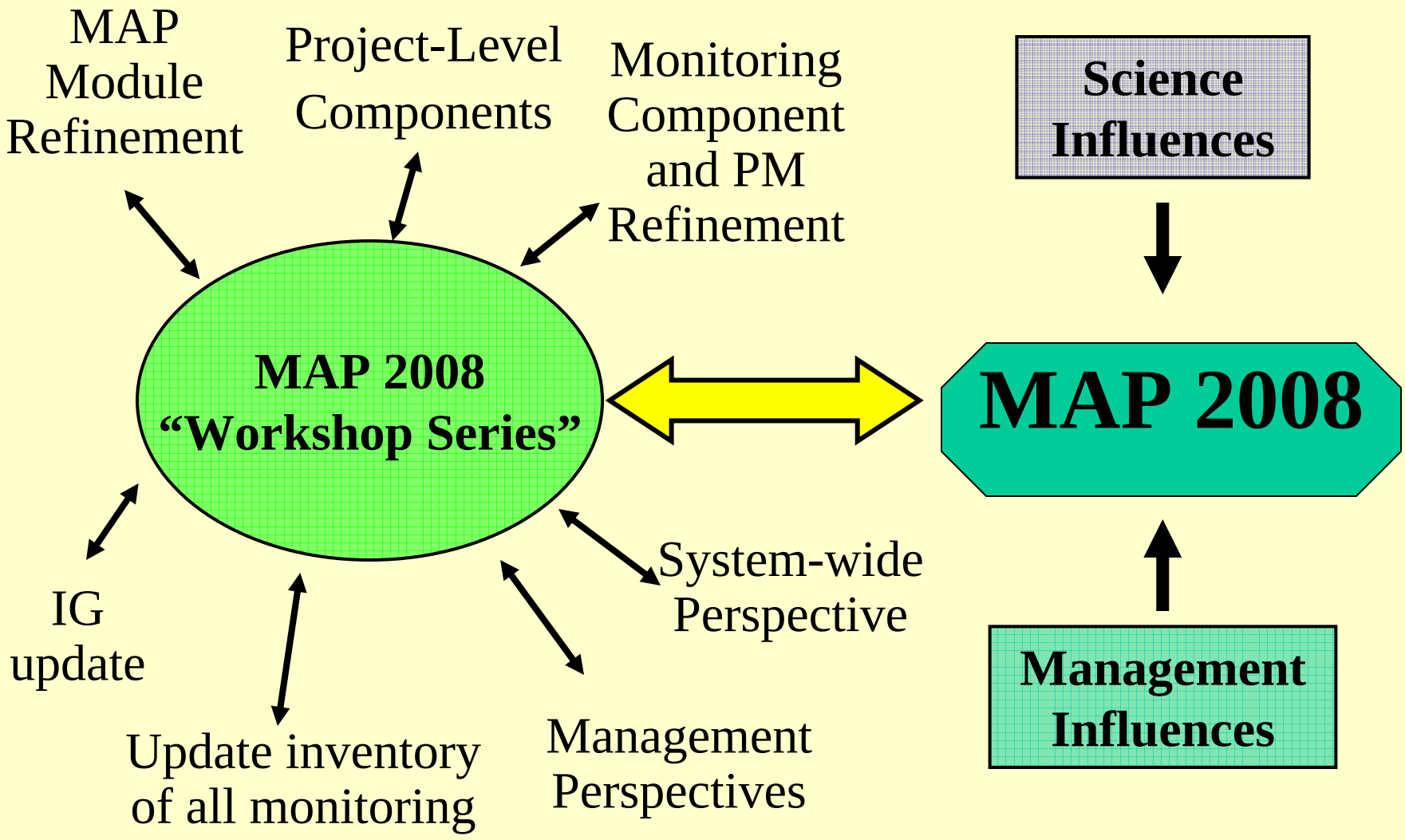
Final Draft

Prepared By:

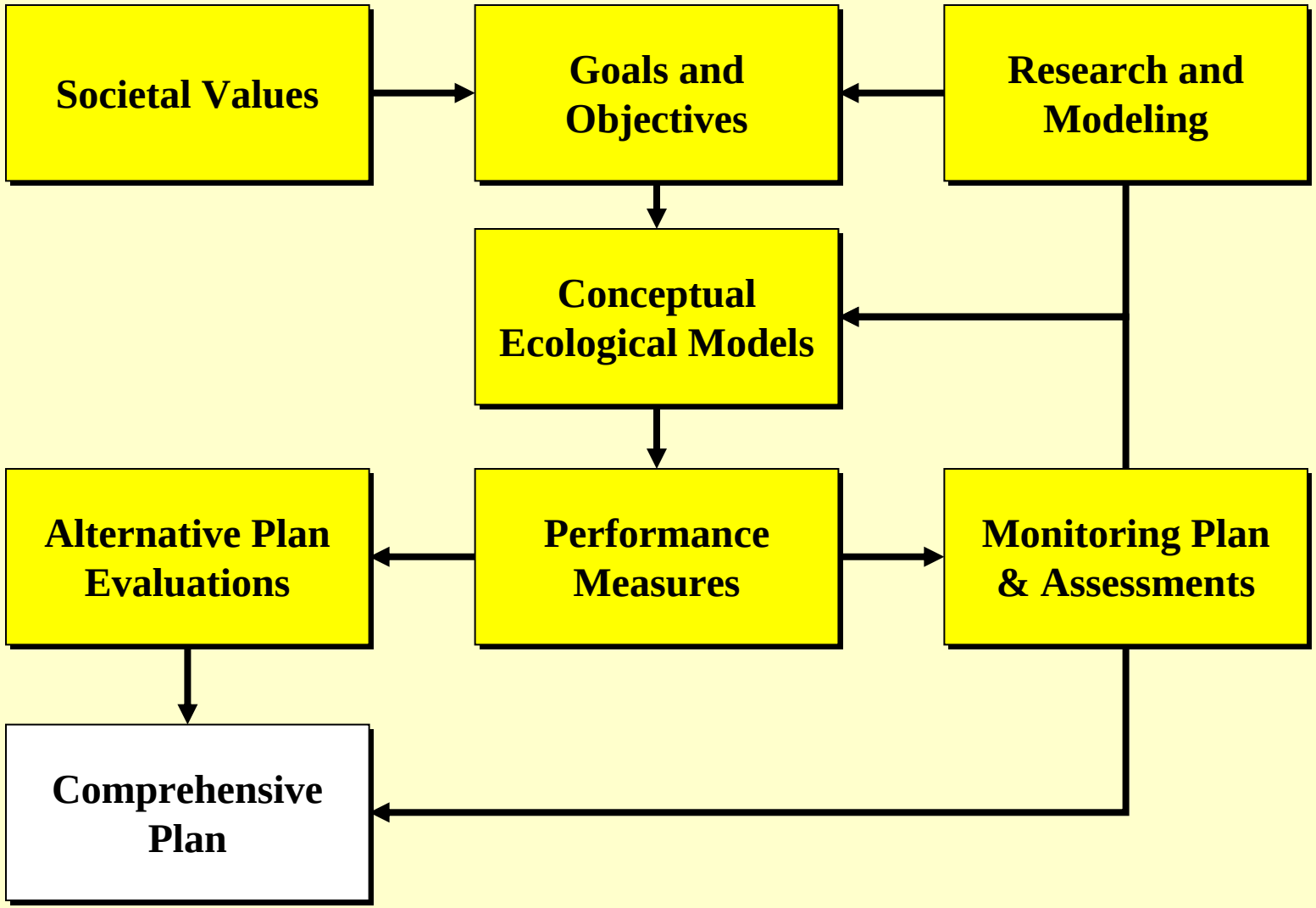
RESTORATION COORDINATION & VERIFICATION (RECOVER)

INTEGRATIVE ASSESSMENT SUB-TEAM

MAP 2008 Implementation Process



CERP Applied Science Strategy



Key Messages for Managers Relevant to Restoration

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Key Messages

- **MAP evolution**
  - Early implementation → current ecosystem health
    - **And next steps for MAP and AM program**
- **System-wide science directed to output relevant for managers**
- **Restoration benefits coupled to system-wide science based ecosystem monitoring/assessment**
- **Focus on linkages between traditional science and CERP AM program**
- **Information coupled to reporting requested by NRC, Congress, etc.**

Thank You and Questions