

MEASURING ECOLOGICAL OUTCOMES AND MONITORING & ADAPTIVE MANAGEMENT (MAMP)

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- ▶ Workshop
 - ▶ Presentation/Labs (Group Participation)
 - ▶ Modeling Basics
 - ▶ Conceptualization + (Lab 1)
 - ▶ Quantification + (Lab 2)
 - ▶ Evaluation/Application
 - ▶ Communication/Monitoring Plan + (Lab 3)
- ▶ Presentation
 - ▶ Ecological Restoration
 - ▶ Measuring Ecological Outcomes



OVERVIEW

Ecosystem Restoration: the assisted recovery of ecosystem structure, function or process that had been degraded, damaged or destroyed

Monitoring and Adaptive Management: deliberate collection of data in order to understand impact of actions (restoration) to system of interest, to make informed management decisions and to apply understanding to future projects.



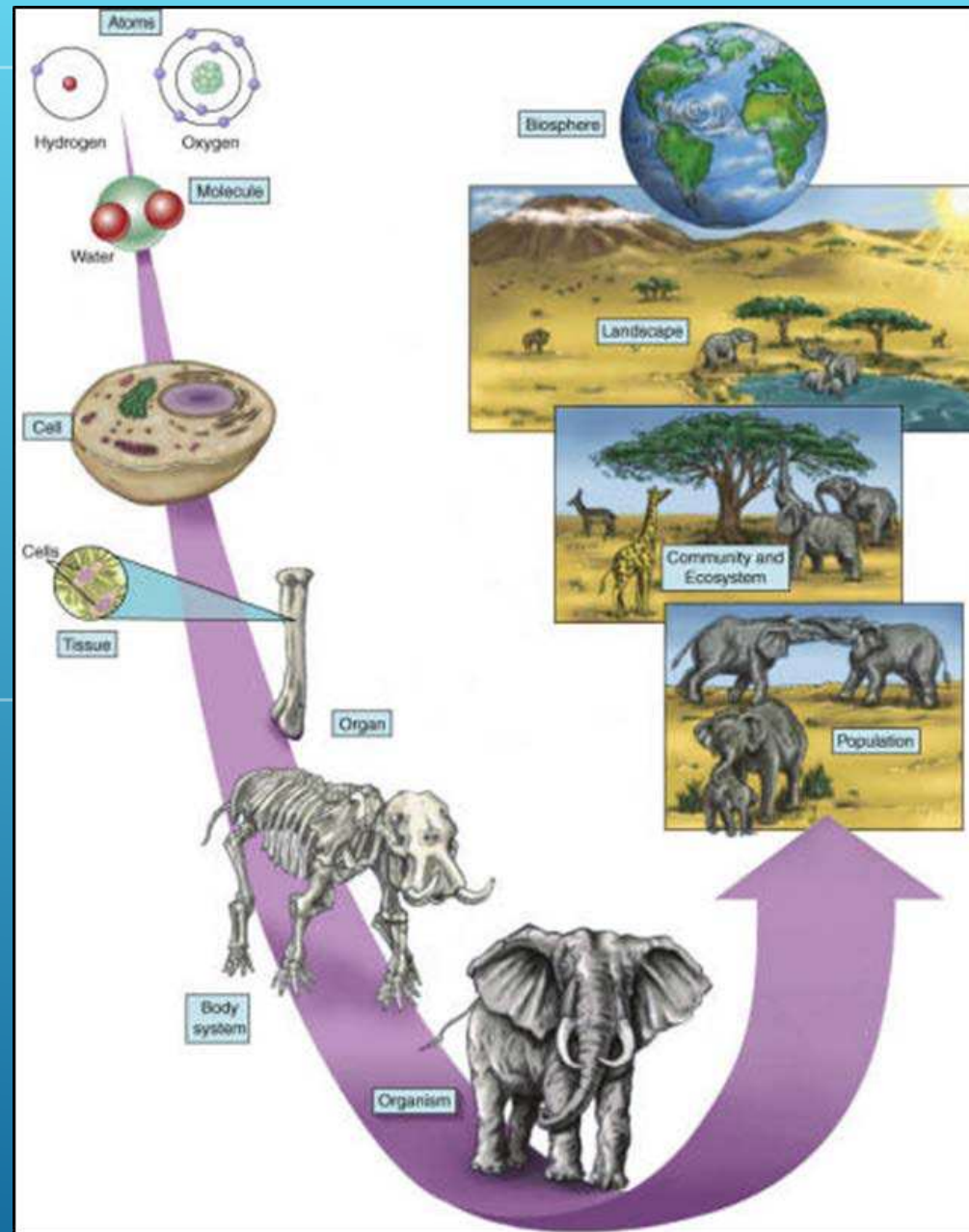
SWAN ISLAND ECOSYSTEM RESTORATION



MONITORING REQUIRES UNDERSTANDING
OF SYSTEM DYNAMICS

*An ecosystem is greater than
the sum of its parts.*

-Eugene P. Odum



Increasing uncertainty and complexity

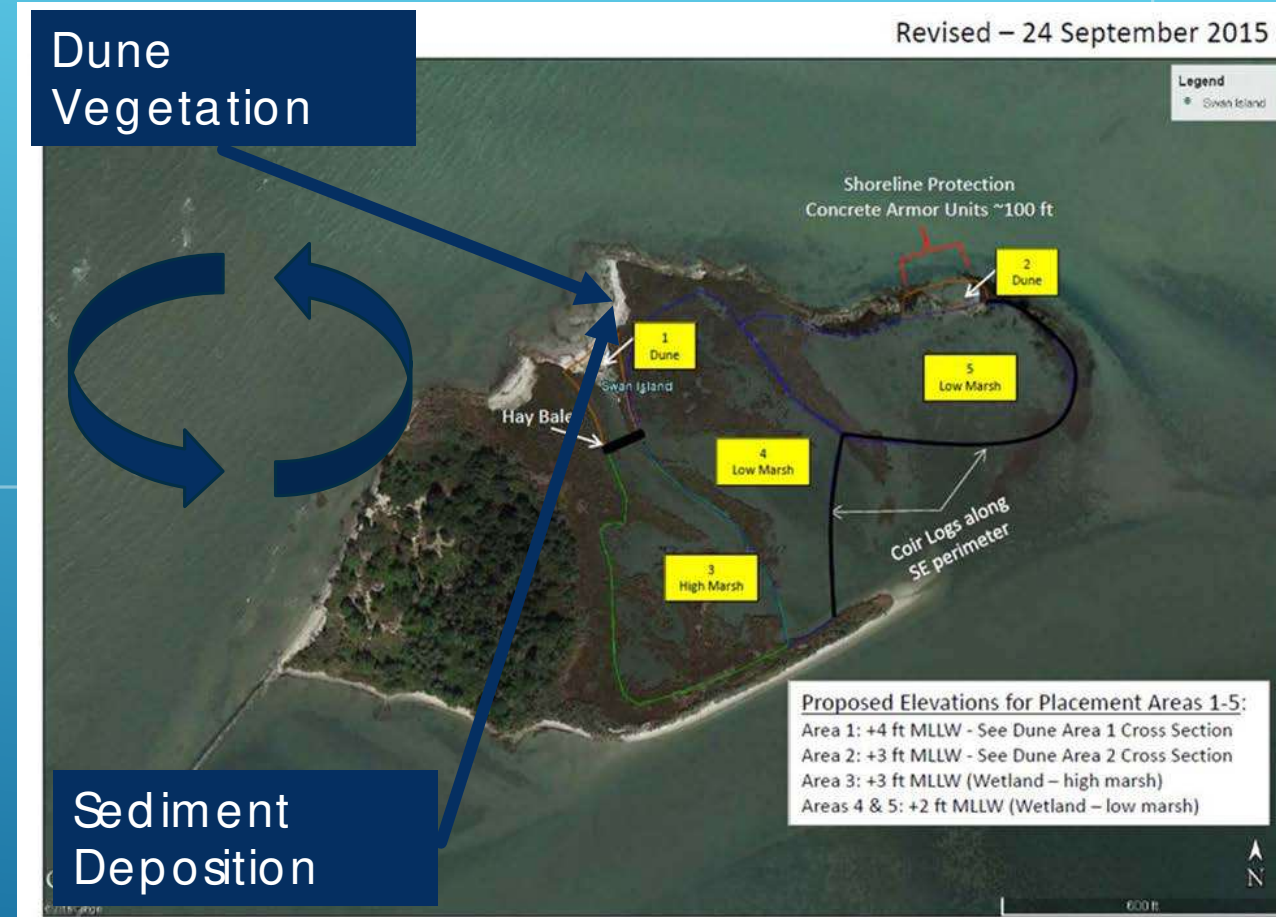
ECOLOGICAL SYSTEMS

Structure: “refers to both the composition of the ecosystem (i.e., its various parts) and the physical and biological organization defining how those parts are organized”

Function/ Process: “describes a process that takes place in an ecosystem as a result of the interactions of plants, animals, and other organisms in the ecosystem with each other or their environment”

- Comprised of numerous ongoing processes

ECOSYSTEM STRUCTURE AND FUNCTION/ PROCESS



Component	Description	Examples
Hydrogeomorphology	Physical processes governing geologic setting, climate, hydrologic cycling, and watershed land use with implications for channel morphology, sediment regimes, channel hydraulics, and hydrologic connectivity	Sediment Transport
Biogeochemistry	Chemical processes driving the concentration, fate, and transport of nutrients, contaminants, and other constituents	Salinity
Biological Systems	Reproduction, survival, and movement of living components of an ecosystem	Vegetation
Socio-economics	Instrumental value of ecosystems to humans	Storm Protection
Cultural-personal values	Intrinsic value of ecosystems to humans and resulting influence of humans on ecosystems	Loss of Bay Islands

COMPONENTS OF ECOSYSTEMS

What natural disturbances govern ecosystem structure and function?

- ❑ Pulses: discrete events (e.g., Storms)
- ❑ Presses: slowly escalating events (e.g., Boat Wake, Recreation)
- ❑ Ramps: slowly changing conditions (e.g., Sea Level Rise)

What is the disturbance regime?

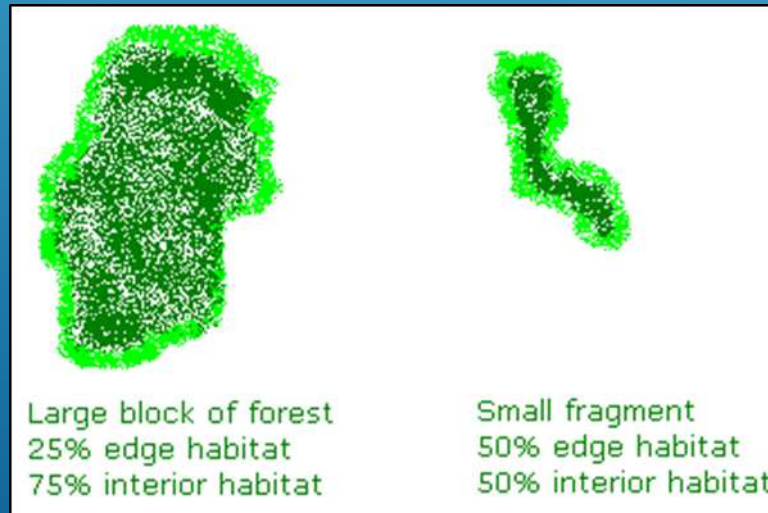
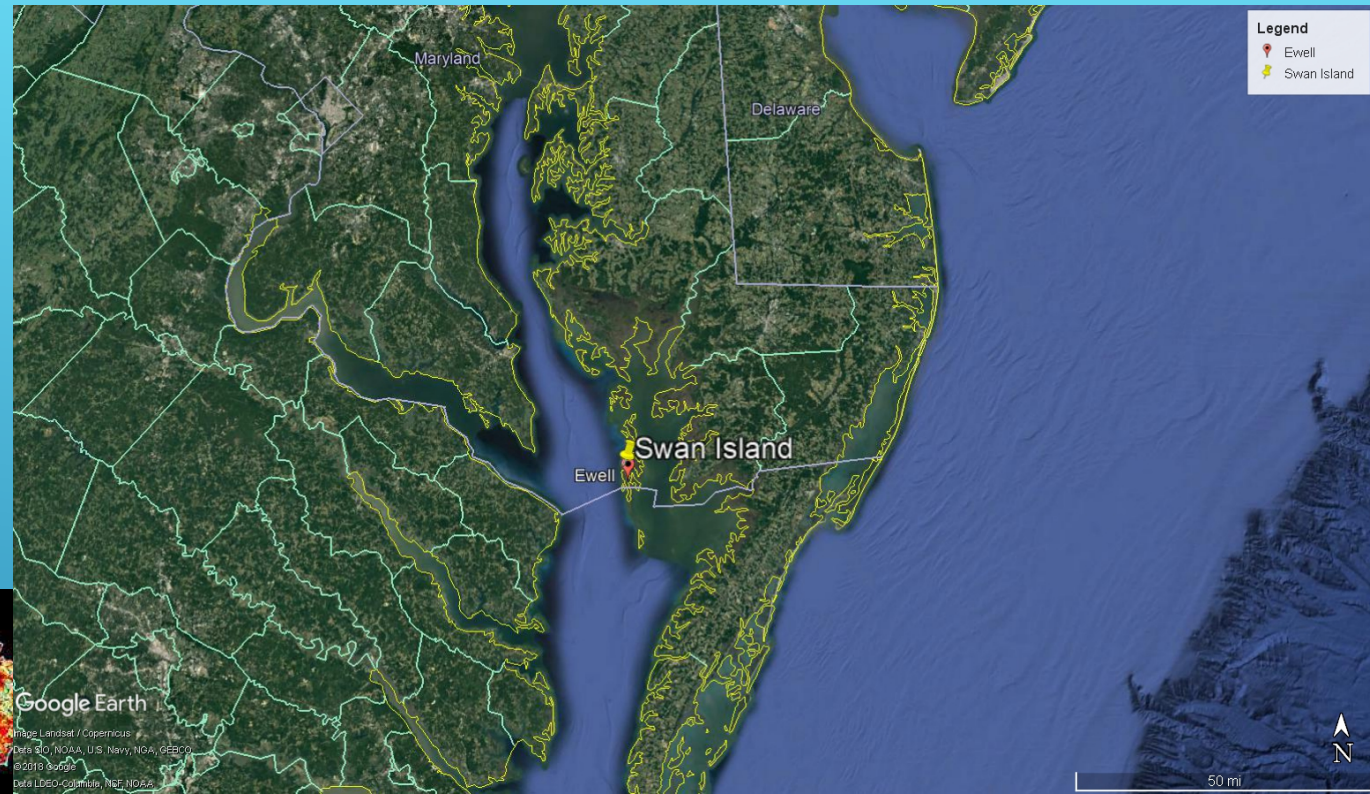
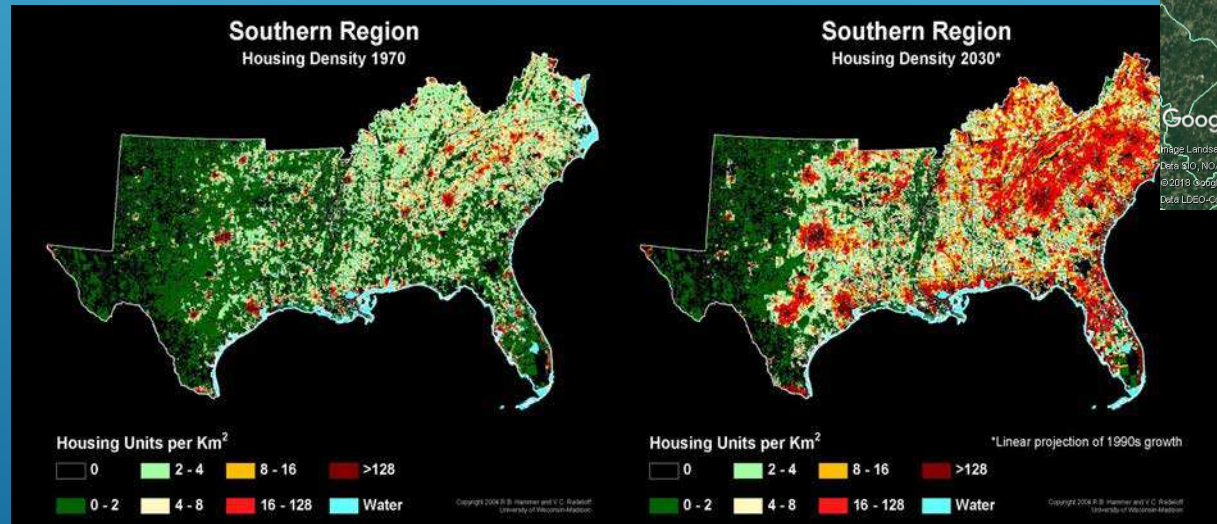
i.e., magnitude, frequency, duration, timing, and rate of change (sensu, Poff et al. 1997)

Is the system “stationary”? Are disturbance regimes changing?



TEMPORAL VARIABILITY

- Composition
- Configuration
- Connectivity
- Location



SPATIAL CONSIDERATIONS

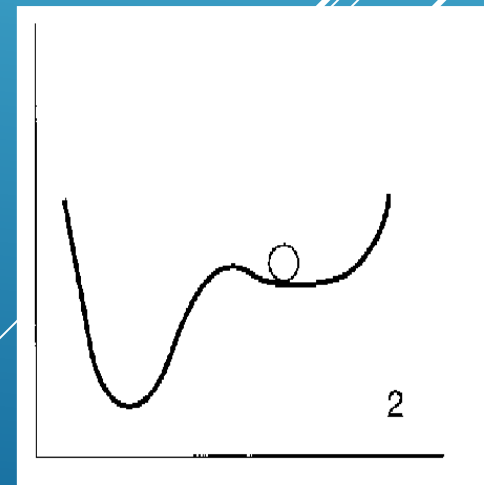
Attribute	Recovery	Resistance	Adaptive capacity
Commonly referred to as:	Engineering Resilience	Ecological Resilience	Community Resilience
Definition	Speed or rate of system recovery after disturbance	Magnitude of disturbance that can be absorbed without flipping into an alternative state	Ability to preempt and avoid major mishaps in institutions
Emphasis	Efficiency, constancy, predictability, stability	Persistence, change, unpredictability, thresholds	Monitoring, measurement, management, and operation

What is ecological resilience?

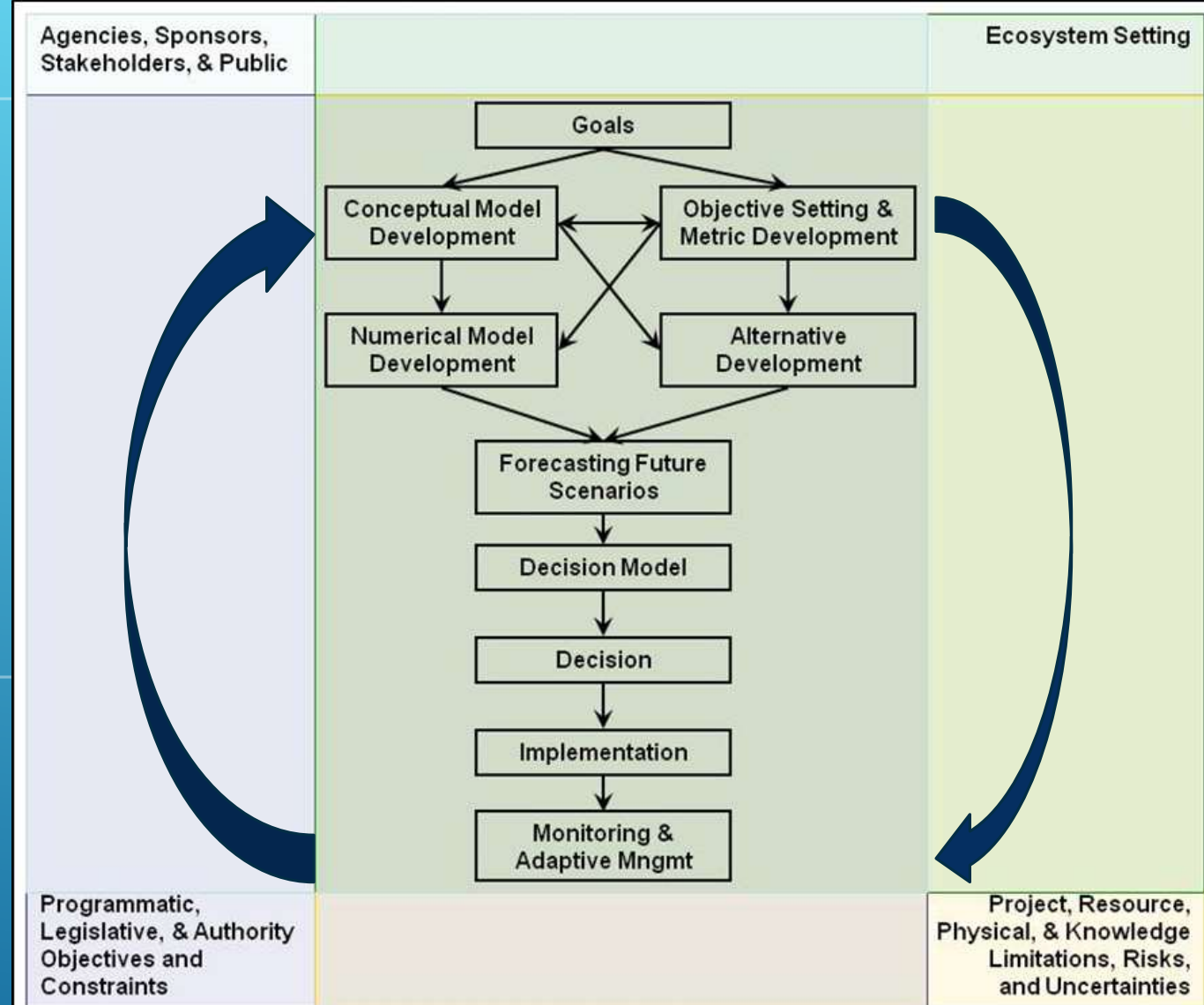
Ability to resist/absorb disturbance, no change

Ability to recover from a disturbance, how fast

Ability to adapt to disturbance



RESILIENCE



ECOSYSTEM RESTORATION PLANNING PROCESS

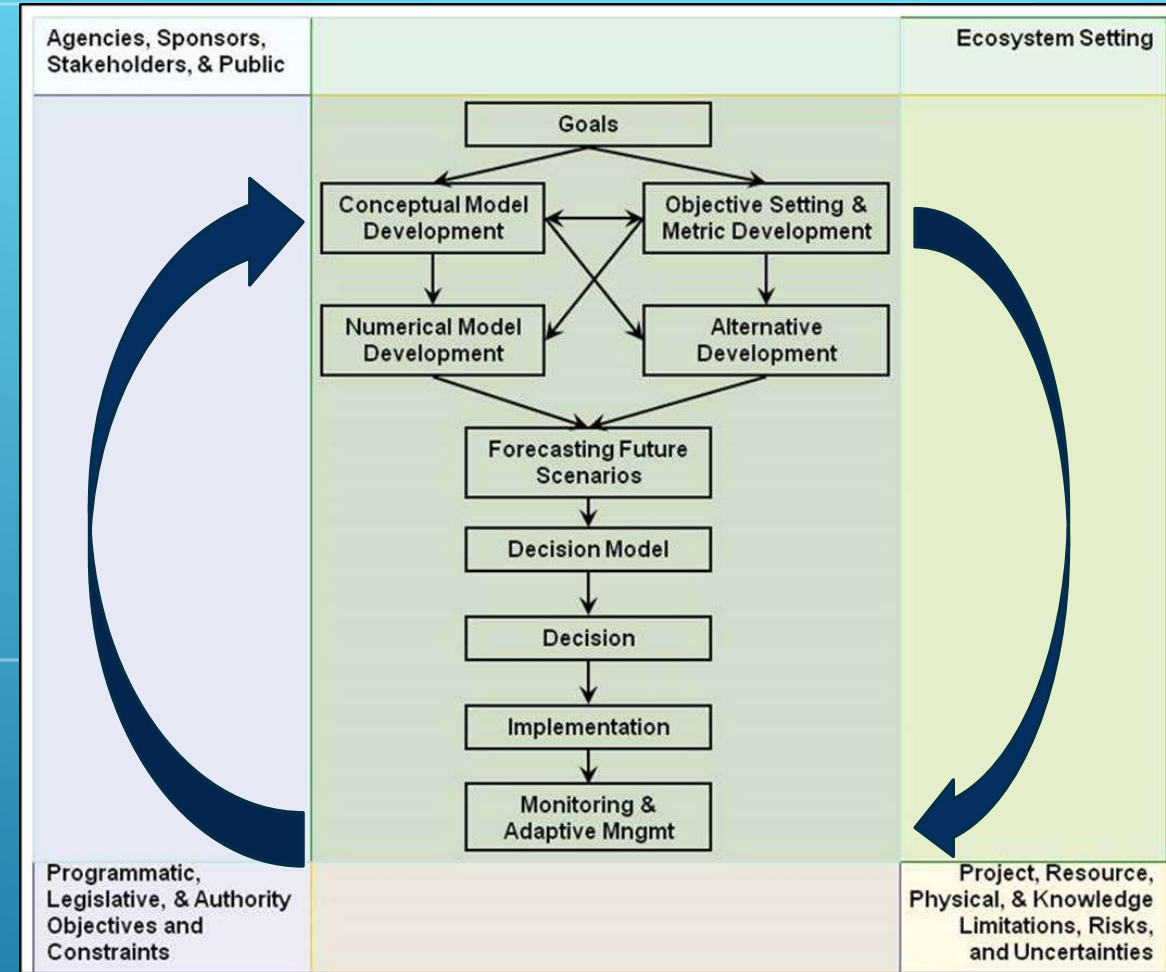
- ▶ Ecosystems are complex, self-organizing, interacting systems
- ▶ Modeling provides mechanism to capture current knowledge of the system, identify important process/interactions, facilitate communication, and increase transparency

WHY MODELS?

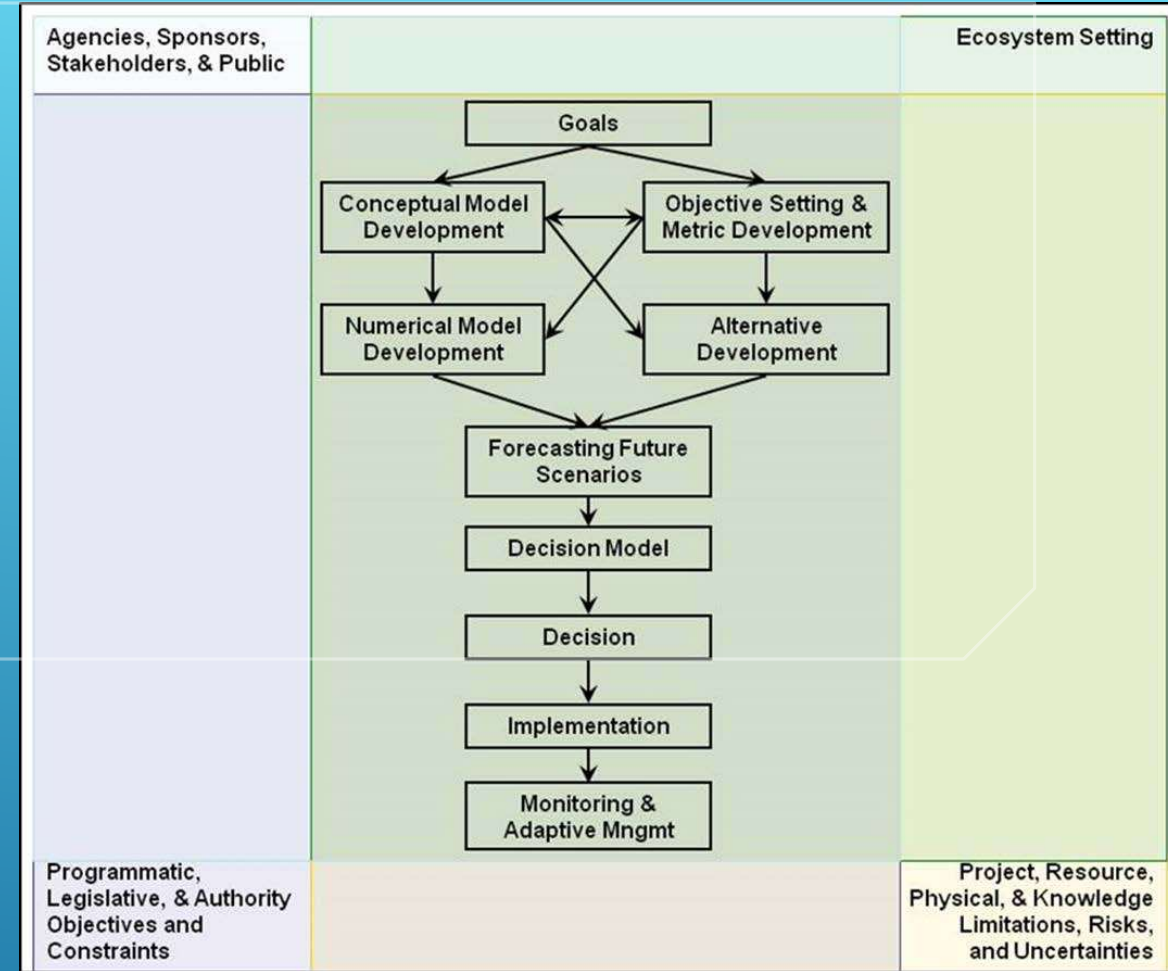


- ▶ Communicate the “process”
 - ▶ Synthesize understanding of system function
 - ▶ Understand and diagnose underlying stressors
 - ▶ Develop a common “mental picture”
 - ▶ Identify metrics for project planning, monitoring, and adaptive management
- Guide numerical model development
 - Guide and plan restoration alternatives
 - Identify R&D needs

HOW ARE CONCEPTUAL MODELS USED IN ENVIRONMENTAL MONITORING?



MEASURING ECOLOGICAL
OUTCOMES



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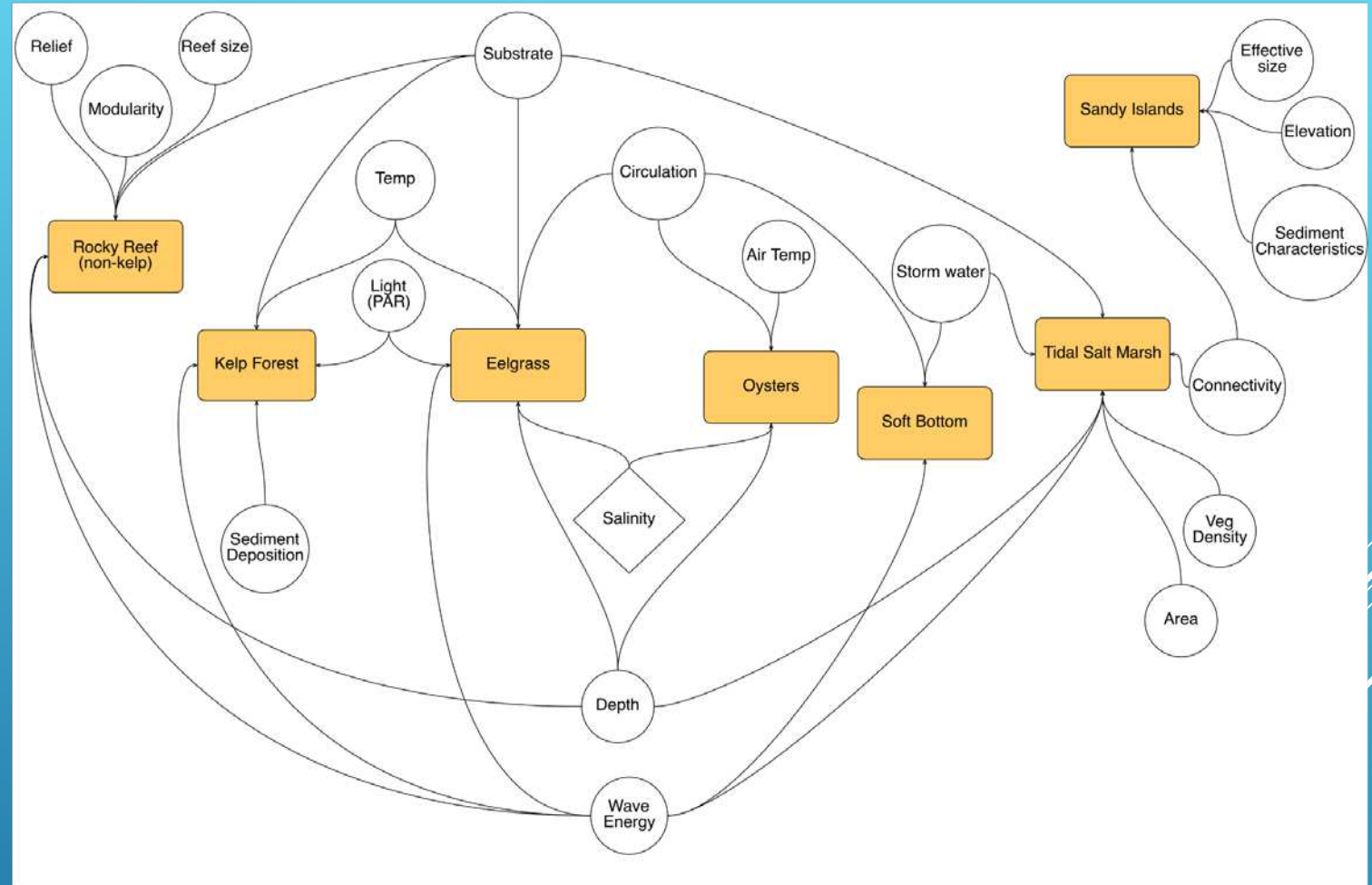
Monitoring Ecosystem Restoration Considerations:

1. What is restoration “success”?
2. Compare monitoring results to reference conditions?
3. Will you use monitoring data to determine when success has been met?

MEASURING ECOLOGICAL OUTCOMES



Conceptual model used as a template for quantitative model development, which better identifies metrics for monitoring (i.e., don't collect unnecessary data)



MEASURING ECOLOGICAL OUTCOMES

- ▶ Environmental restoration projects are complex and identifying metrics for monitoring benefits is crucial
- ▶ Ecological modeling provides tool to conceptualize system in an adaptive framework
- ▶ Models are developed for a specific purpose. Consider how monitoring data will be used before collecting it.
- ▶ Clearly documenting each step of the process increases transparency and scientific defensibility

TAKE HOME POINTS