Adaptive governance of riverine and wetland ecosystem goods and services

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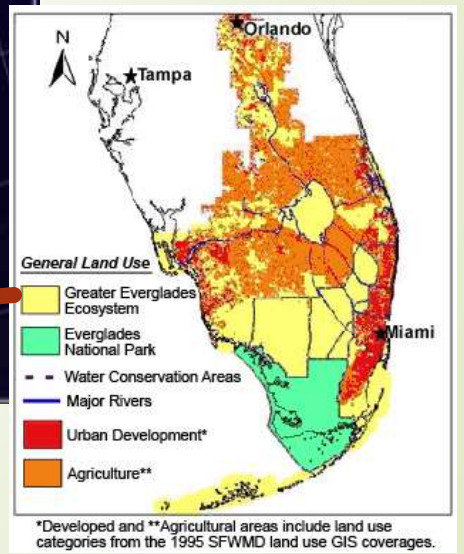
Adaptive management and adaptive governance for ecosystem goods and services

Columbia



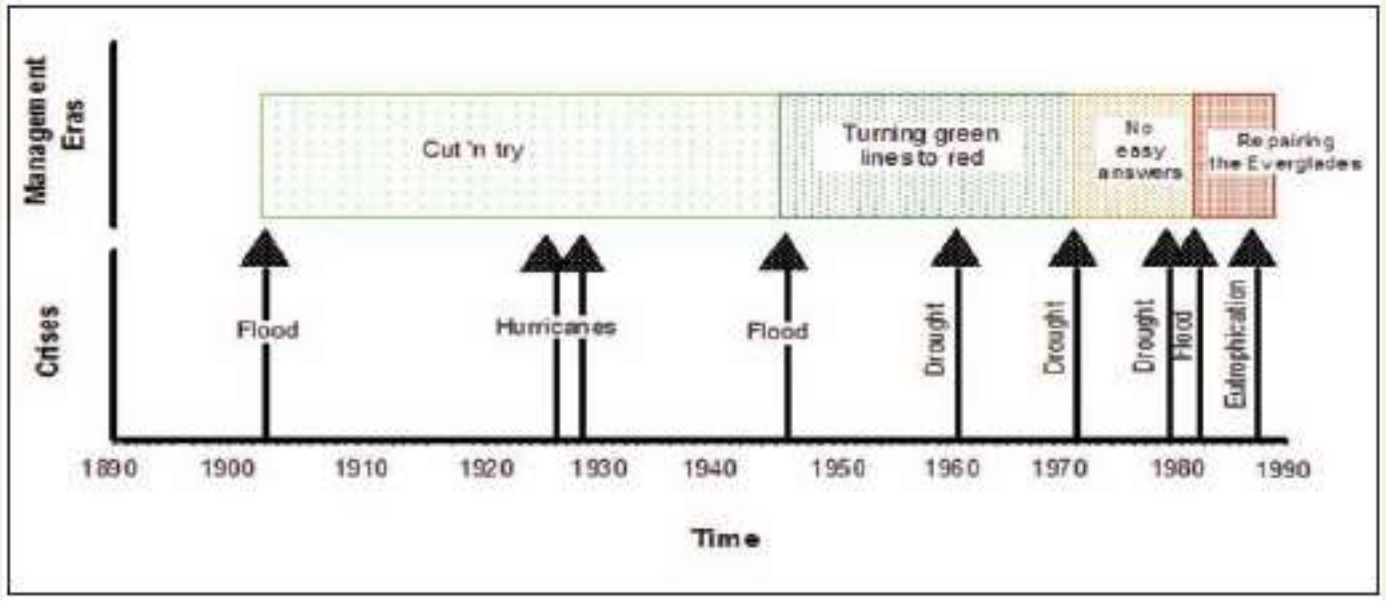
Everglades

Development of complex social-ecological water systems to control floods, supply water, support diverse land uses

In retrospect, water management system was designed to procure and provide suite of ecosystem services

Type of Ecosystem Service/Good	Everglades Water Management Social-Ecological System	Columbia River Social-Ecological System
Provisioning Services		
Water supply to users	Water moved from wetlands through canals to coastal aquifers for human water supply,	Reservoir storage and canals for irrigation Urban water supply primarily on tributaries Substantial hydropower production from coordinated dam system
Food	Series of canals, levees pumps to tightly control water levels in agricultural area to produce food	River water now irrigates over 2400 km^2 about half of original area (4500 km^2) designated for irrigation.
Biological Productivity	Water diverted through canals to meet urban/agricultural needs, at expense of biological productivity in estuaries	Commercial and recreational salmon fishery substantially affected by dams and habitat loss, supplemented by over 200 hatcheries.

Everglades History - Management Eras



Transformations in the System

Transitions of Ecosystem Services

	Drainage 1900 -1947	Flood control 1947-1971	Water supply 1971-1987	Ecosystem restoration 1988- present
Provisioning Services				
Water	Surplus, sought to remove	Procure to Prevent Excess	Law of allocation	Same as previous
Food	Beginnings of agriculture	Designation of Agricultural Area (EAA)	Shift to sugarcane	EAA land removed from production as soil oxidized
Biological Productivity	Supported Large populations of nesting birds	Decline in productivity	Decline to lower levels	Stabilized at low levels
Supporting Services				
Soil	Organic soil used for agriculture	Oxidation, subsidence of soils	Continued subsidence	Loss of agricultural production areas

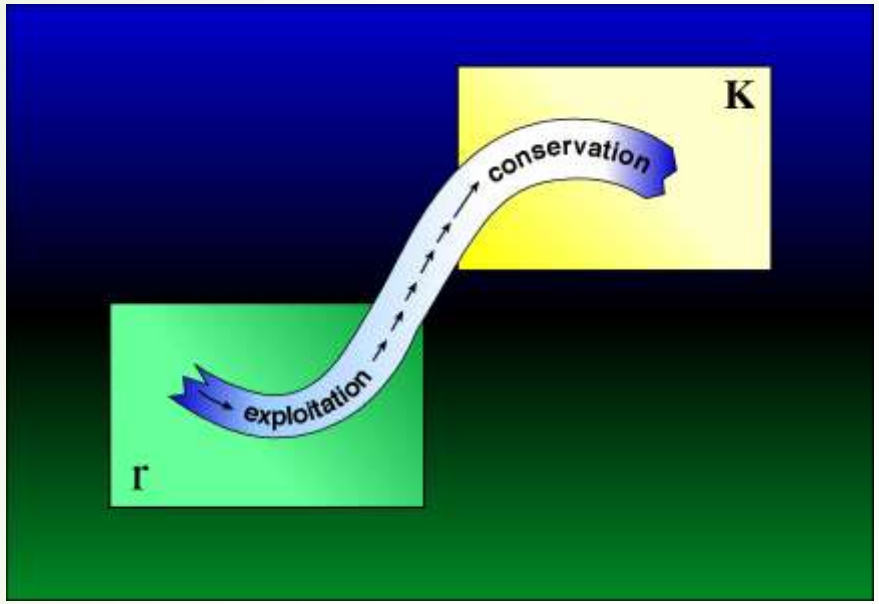
Growth and Development Phases

Conservation (K) phase

Maintenance infrastructure

Policy Achieved: floods controlled

Ecological resilience declines due to stability



Growth (r) phase

Procure Ecosystem Services

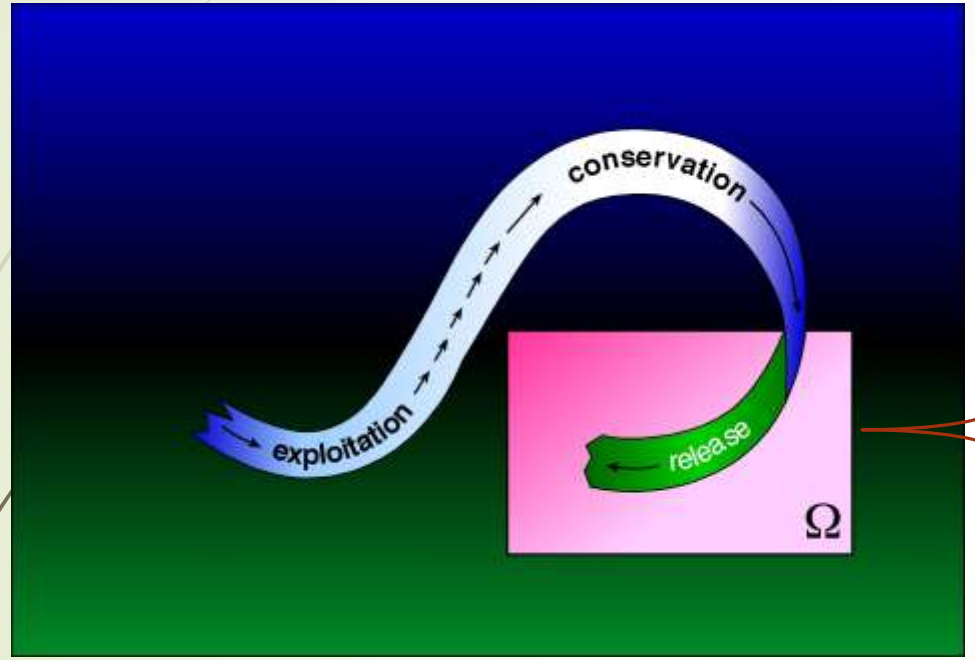
Infrastructure- Levees, Canals, Dams)

Policy Implementation:

Rules to Control Hydrologic Variation for Flood Control, Water Supply

Optimize Resource Use for Economic Output

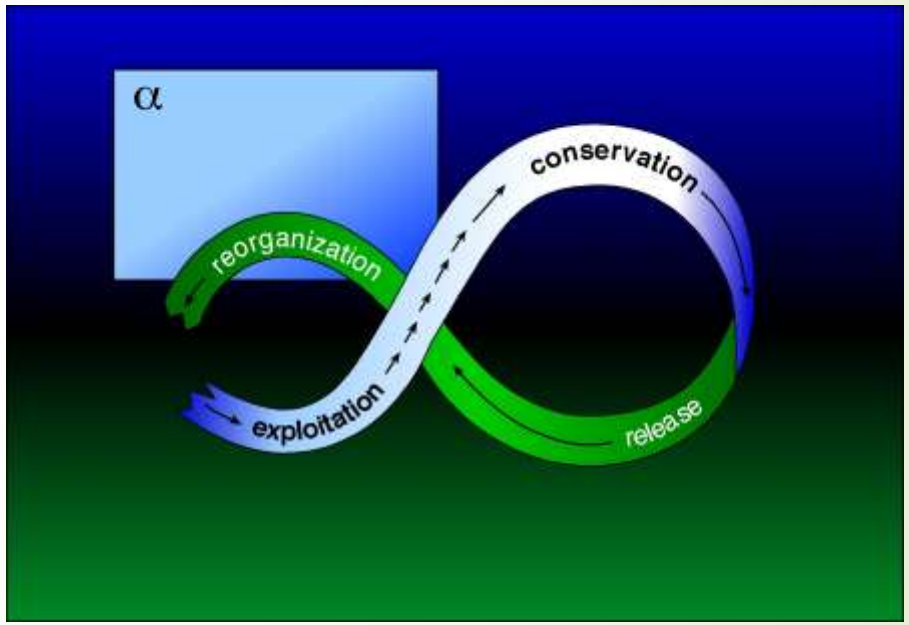
Instabilities, Crises, Surprises (Ω)



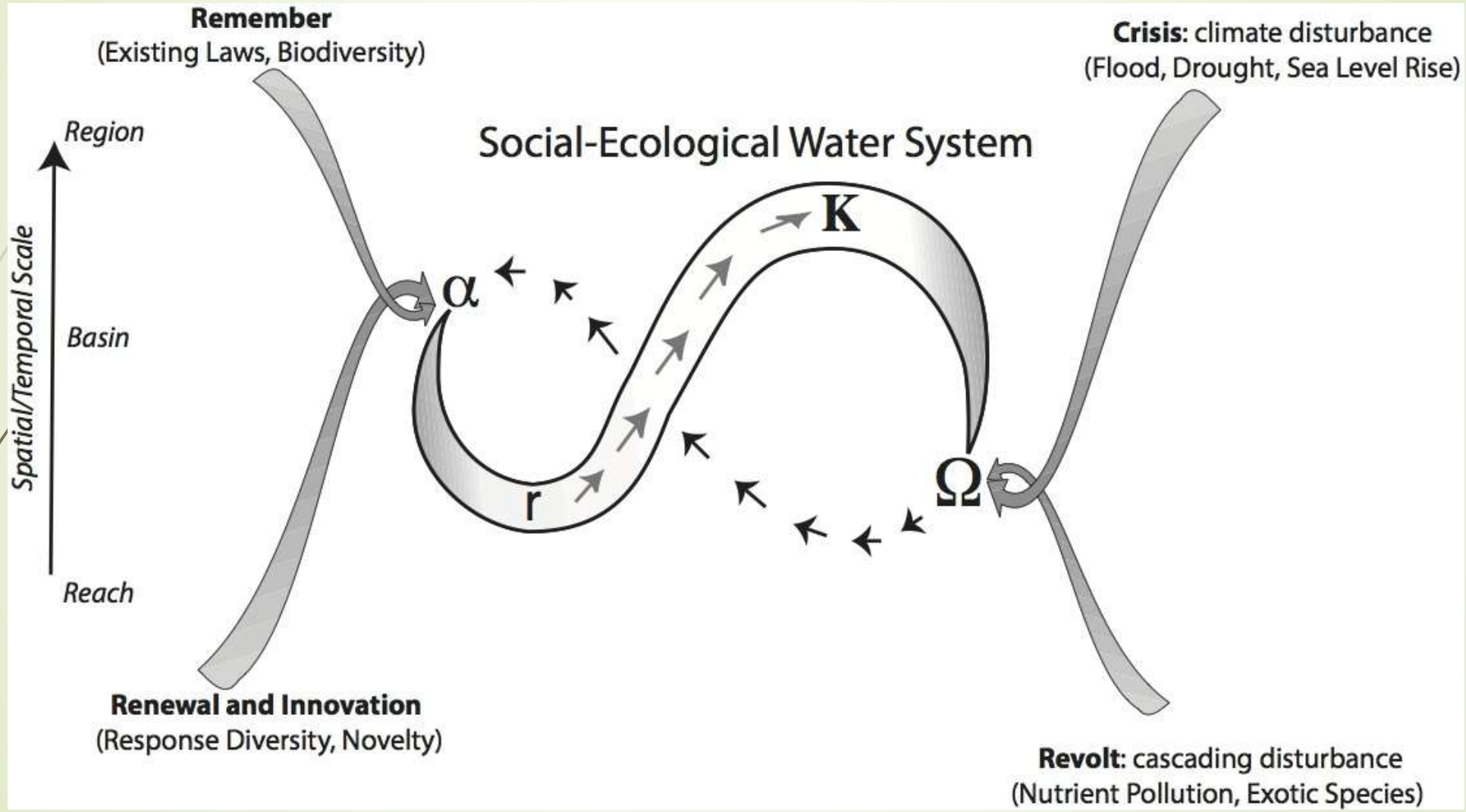
- Exogenous (larger scales)
  - Ecological : Flood, Storm, Drought
    - Perceived variance exceeded
  - Social: Political Elections, New Laws
- Cross-Scale Processes (Slow/Fast)
  - Contagious spread (Invasive species)
  - Cross-scale (federal/state lawsuits
  - Shift in Social Values – NEW Ecosystem Services

Reorganization (α)

- Cross-Scale Interactions
  - Slow Variables –
    - Capital (soil, nutrients, social)
    - Connectivity
  - Modularity
  - Functional Diversity
- Human Systems
  - Foresight – Resolve Tradeoffs
  - Innovative – New Ecosystem Services/Goods
- System Regime Shifts?
  - New – ecological resilience
    - Policy, Institutions
  - Old – engineering resilience

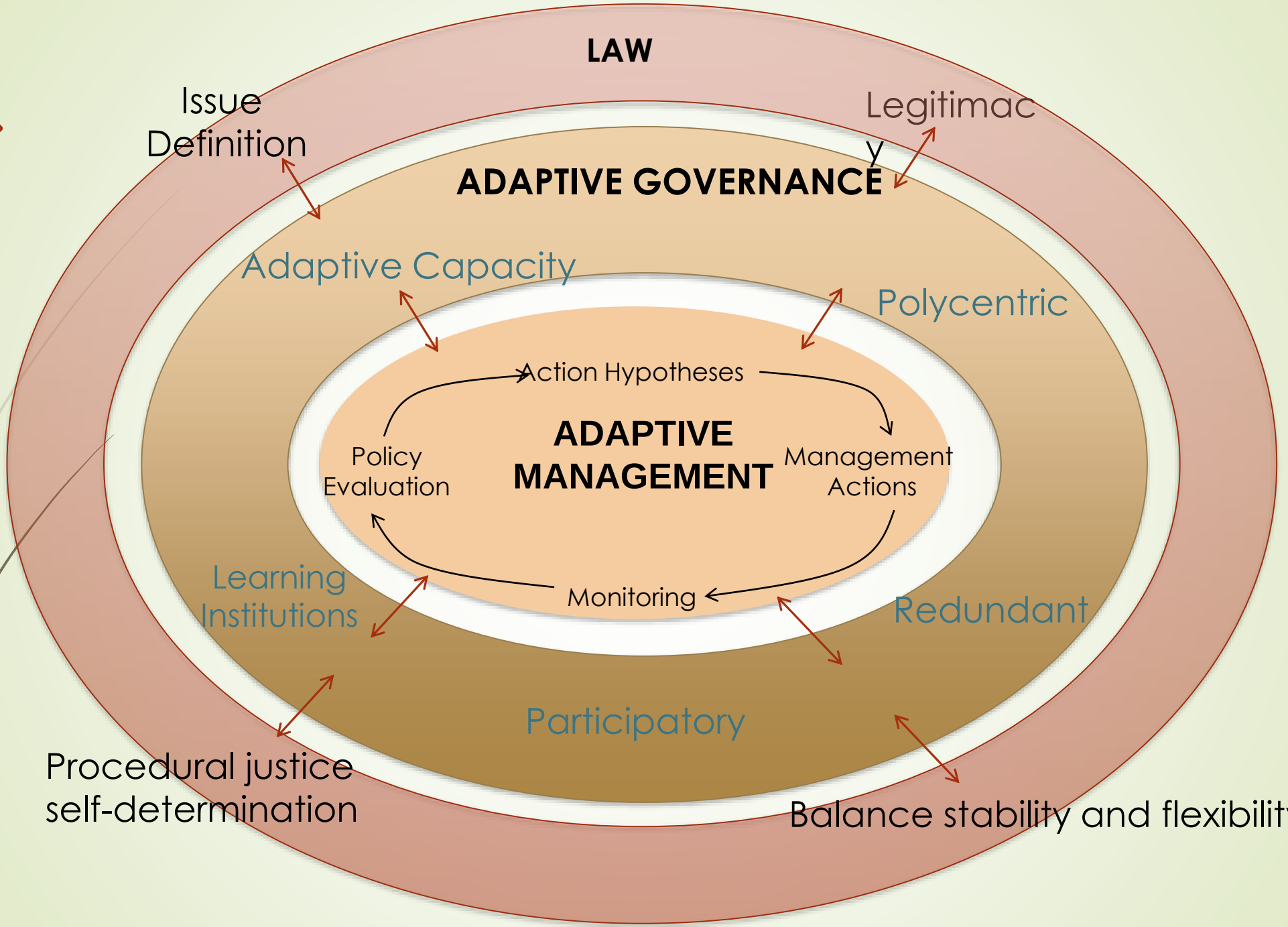


Panarchy model of change



What is Adaptive Governance?

- Governance ≠ Management:
  - "governance is the process of resolving trade-offs and of providing a vision and direction" . . ., management is the operationalization of this vision...".
- Governance ≠ Government:
  - governance includes laws, policies, regulation, institutions, and institutional structures that both enable and constrain the process of governing [i.e. government], but also the informal norms and interactions that influence decisions including those of private and nongovernmental actors.
- Adaptive Governance:
  - *governance that allows adaptation to emerge*
    - *Structures, Capacity, Process*
  - *governance that facilitates adaptive management*


LAW
Issue Definition
Legitimacy
ADAPTIVE GOVERNANCE
Adaptive Capacity
Polycentric
Action Hypotheses
ADAPTIVE MANAGEMENT
Policy Evaluation
Management Actions
Monitoring
Learning Institutions
Redundant
Participatory
Procedural justice self-determination
Balance stability and flexibility

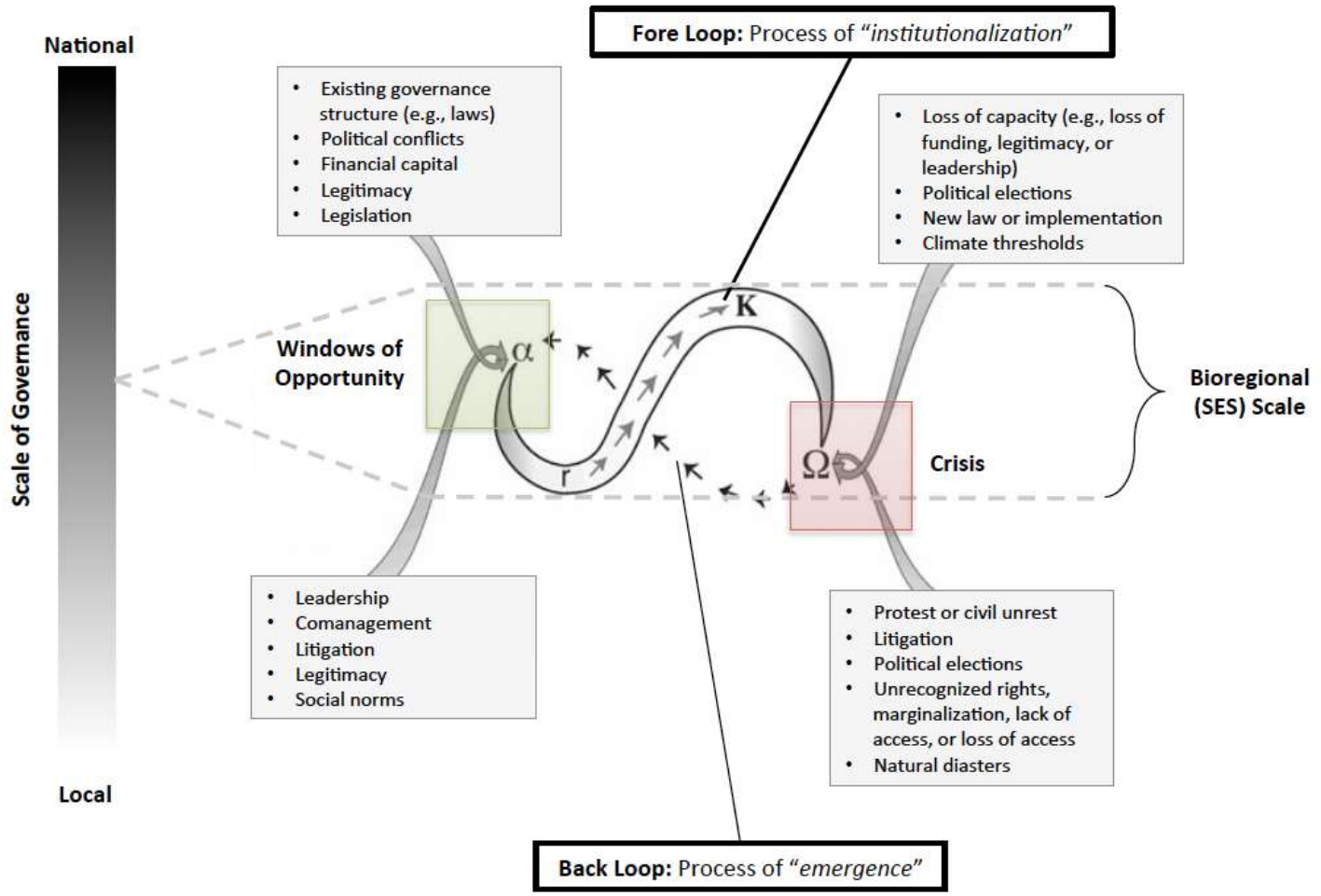
Adaptive Governance

- **Maintain desired trajectory**
  - Acknowledge Thresholds
    - Monitor key indicators
    - Build knowledge of regime shift
  - Focus on recovery and renewal

- **Increase Resilience**
  - Enhance ecological resilience
  - Reversibility/hysteresis
    - Composite actions
    - Take advantage of Climate Variability
  - Resources and authority to experiment
    - Active Adaptive Management

- **Transform to New Regime**
  - Active Exploration of Options
  - Resources and authority to experiment
    - Capacity for Active Learning
  - Incentives for new solutions

Adaptive Governance



Summary

- **Adaptive Governance**
  - *governance that fosters/ allows adaptive processes to emerge*
- **Flexibility and Experimentation Needed for Adaptation**
  - Better integrate science, management & governance
  - Accelerate learning while doing
- **Role of Law in Adaptation to Climate Change**
  - Constraints to change/learning
    - Endangered Species Act
  - Fostering change/learning
    - Assertion of Native American Water Rights
    - Everglades Restoration