Adaptive Capacity

Session Goals

- Review the concept of adaptive capacity
- Introduce roots of concept and its applications
- Understand factors affecting adaptive capacity
- Recognizing adaptive capacity and its limits

Definitions

- "…the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences."

  » IPCC 2007

- "Coping range" or "coping capacity"
  - Ability for a system to reconfigure without significant declines in crucial functions

Definitions

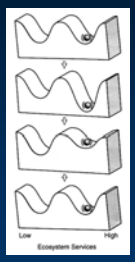
- Internal
- External
- "Adaptive capacity is different from specific adaptation measures; it can be considered a 'pre-existing condition.'"
  - Glick et al. 2011

Resilience and Adaptive Capacity

- Resilience
  - "…the capacity of a system to absorb disturbance; to undergo change and still retain essentially the same function, structure, and feedbacks." (Walker & Salt)
  - Sometimes considered "temporary" change (return to prior state)
- Adaptive Capacity
  - retain functionality during a shift
  - "directional" change
  - adjust to a new "normal"

Ecological Thresholds

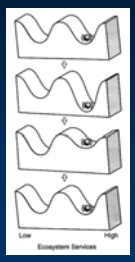
- Ball: current state of the system (e.g., amount of phosphorous)
- Basin: "…the set of possible states the system can be in and still have the same structure and function." (e.g., clear water lake)
- Peaks represent thresholds between alternate states
- Thresholds can be thought of as conditions that exceed a system's adaptive capacity



From Carpenter & Gunderson 2001

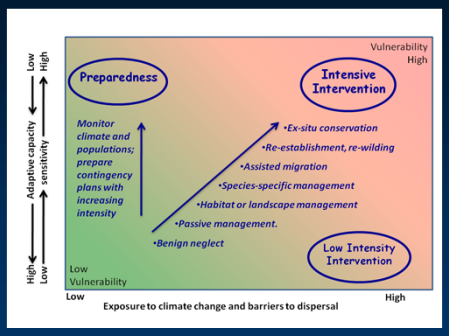
Ecological Thresholds

- Capacity to manage resilience:
  1. Determine the trajectory of the system state - position in basin
  2. Alter the shape of the basins; move the positions of thresholds or make the system more or less resistant to perturbation
- Thresholds can be thought of as conditions that exceed a system's adaptive capacity



From Carpenter & Gunderson 2001

"the capacity for self-renewal"
-- Aldo Leopold



Source: Dawson et al. 2011

Factors Affecting Adaptive Capacity

SCALE!

- Species
- Habitat
- Ecosystem

Species-Level

- Phenotypic plasticity
- Behavioral plasticity
- Dispersal ability
- Evolutionary Potential (generation time, genetic diversity, population size)

Caution!

Birch flowering

- 2.83 days earlier for each degree C for black birch
- no relationship for grey birch

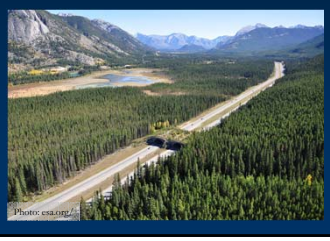
Goldenrod flowering

- 11.7 days earlier for rough stemmed goldenrod
- no relationship for lance leaved or most other goldenrod species

(Rushing and Primack 2008)

Habitat-Level

- Landscape Permeability
  - Relative to species or process
- Management Potential



Ecosystem-Level

- Functional Groups
  - Redundancy
  - Response Diversity

Recognizing the Limits of Adaptive Capacity

From Zhu et al 2012 based on FIA Data (92 sp., >43,000 plots)

Northward range shift:

Species is expanding north and retreating from southern limits: offspring will extend north of adults at northern limit and adults will extend south of offspring at southern range limit

Overall range contraction (59%):

Offspring have less latitudinal extent than adults

Southern range shift (16%):

Adults extend north of offspring at northern range limit offspring extend south of adults at southern range limit

Overall Range expansion (4%):

Offspring will have greater latitudinal extent than adults at both range limits

Social System Applications

- Important to think about the adaptive capacity of social systems, not just species, habitats, and ecosystems

Social System Applications

- Scale
  - Individuals
  - Households
  - Communities
  - Local, state, federal institutions

Social System Applications

- Key attributes in social systems include:
  - Capital
    - Human (Health, Literacy)
    - Social (Networks)
    - Physical (Transportation, Housing)
    - Financial (Wealth)
    - Natural (Nat. Resources)
  - Cultural Context
  - Governance

Institutional Aspects of Adaptive Capacity

- What is the ability of our institutions to adjust to and respond to change?
  - Learning, flexibility, responsiveness
  - How prepared are our institutions to reconsider conservation goals and management objectives, and to put adaptive management into practice?