Climate change and adaptation strategies for resident avian species



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In the context of climate change planning…

adaptation generally refers to human activities intended to minimize the adverse effects of climate change on human infrastructure and *sensitive aspects of the natural environment*.

ADAPTATION STRATEGIES DEFINED

MAWDSLEY ET AL. 2009, CONBIO

- Shifting ranges
  - Animal distribution & abundance
  - Habitat availability & distribution
- Phenology disconnect
- Vital rates
- Extinction

EFFECTS ON WILDLIFE AND HABITATS

LAWLER, J. 2009, ANNALS NY ACAD. SCI.

1) Increase connectivity
2) Integrate climate change into planning exercises (incentives, timing)
3) Mitigate other threats (invasive species, fragmentation)
4) Study response of species to climate change (translocations)
5) Increase number of reserves
6) Address scale problems for improved predictive (projection) capacity

(Improve inter-agency, regional Coordination)

7) Increase and maintain basic monitoring programs

(Practice adaptive management)

8) Create and manage buffer zones around reserves
9) Create ecological reserve networks
10) Adopt long-term and regional perspective in planning, modeling, and management

FEASIBLE ACTIONS AND ADAPTATION STRATEGIES

HELLER AND ZAVALETA (2009, BIOL. CONS.)

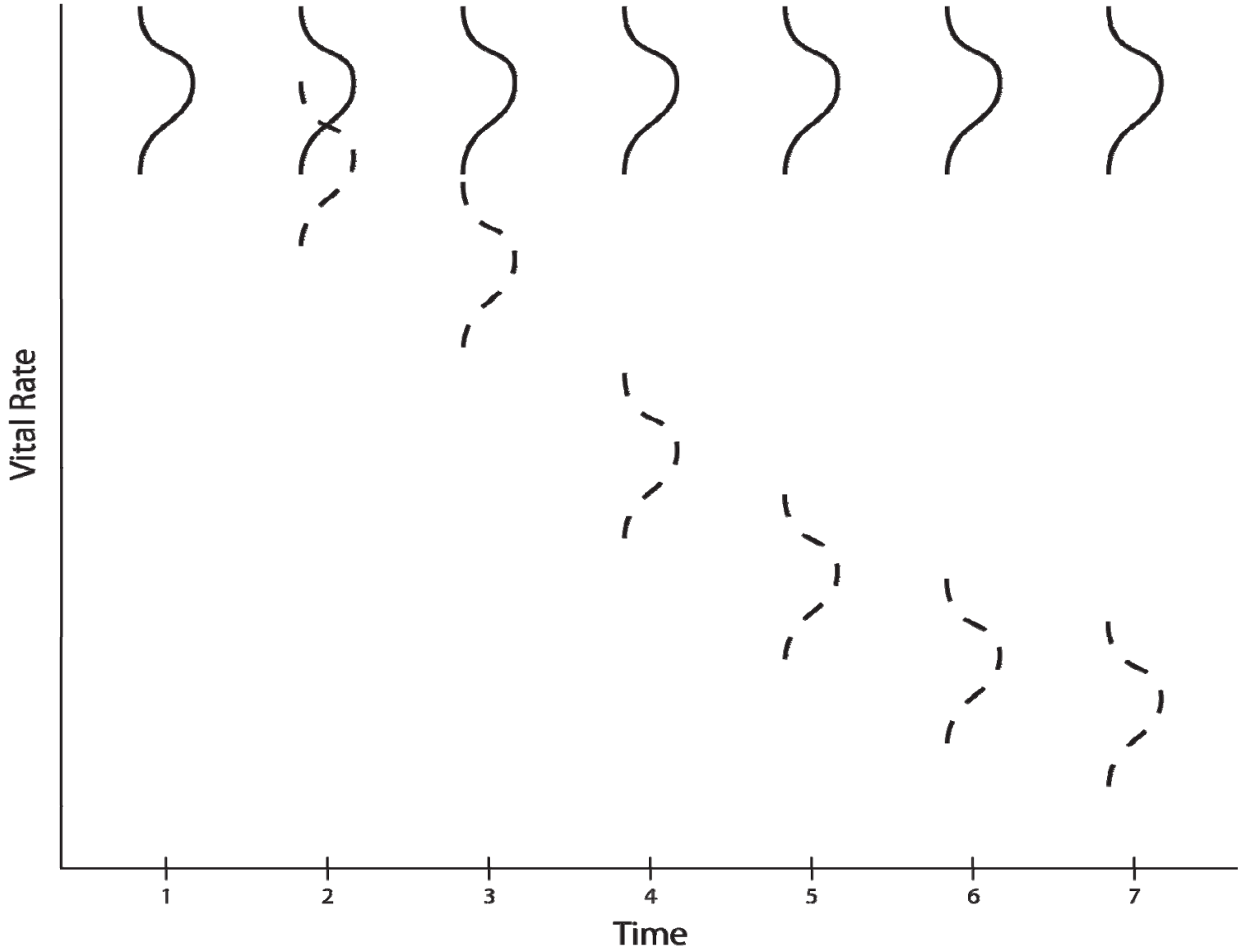
➢ Challenge

- ✓ Understand and predict responses…
  - Resistance – ability to remain unchanged
  - Resilience – ability to recover from perturbation
  - Change – systems move from one state to another

- ❖ But predictions based on historical information and experiences may not be appropriate in a changed or changing system—non-stationarity.

PREDICTIONS AND CLIMATE CHANGE

CONROY ET AL. (2011); LAWLER (2009)



DYNAMIC RATHER THAN STATIC CONTEXT

➢ Current restoration strategies

- Return system to historic conditions
- Return community to historic assemblage

➢ Climate-forced paradigm shifts?

✓ Restore ecosystem process
✓ Focus on abiotic aspects
✓ Allow species assemblages to fluctuate

PARADIGM SHIFTS

LAWLER, J. 2009, ANNALS NY ACAD. SCI.

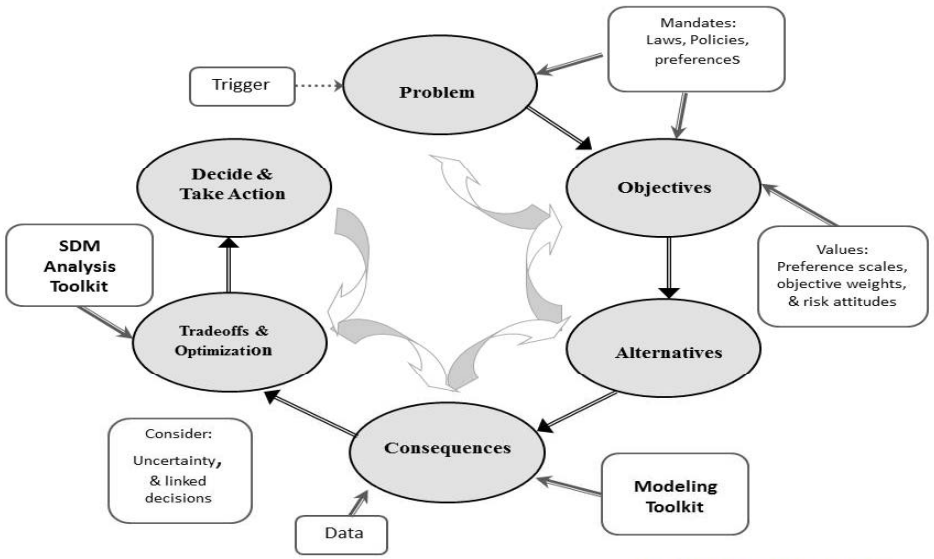
From a practical point of view, a focus on the science of climate change divorced of the decision context is only an exercise in academic curiosity; what is needed is an understanding of how climate change will affect our decisions (Conroy et al. 2011, BiolCons).

ADAPTATION STRATEGIES AND DECISION MAKING

DECISION MAKING

- Problem decomposition
  - Break the problem into components, separating policy from science
  - Complete relevant analyses
  - Recompose the parts to make a decision
- Values-focused
  - The objectives (values) are discussed first, and drive the rest of the analysis
  - This is in contrast to our intuitive decision-making, which usually jumps straight to the alternatives

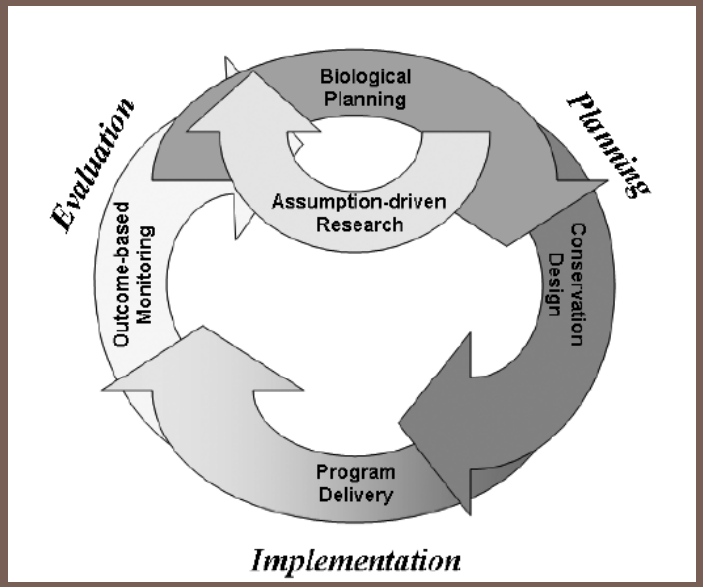
Structured Decision Making



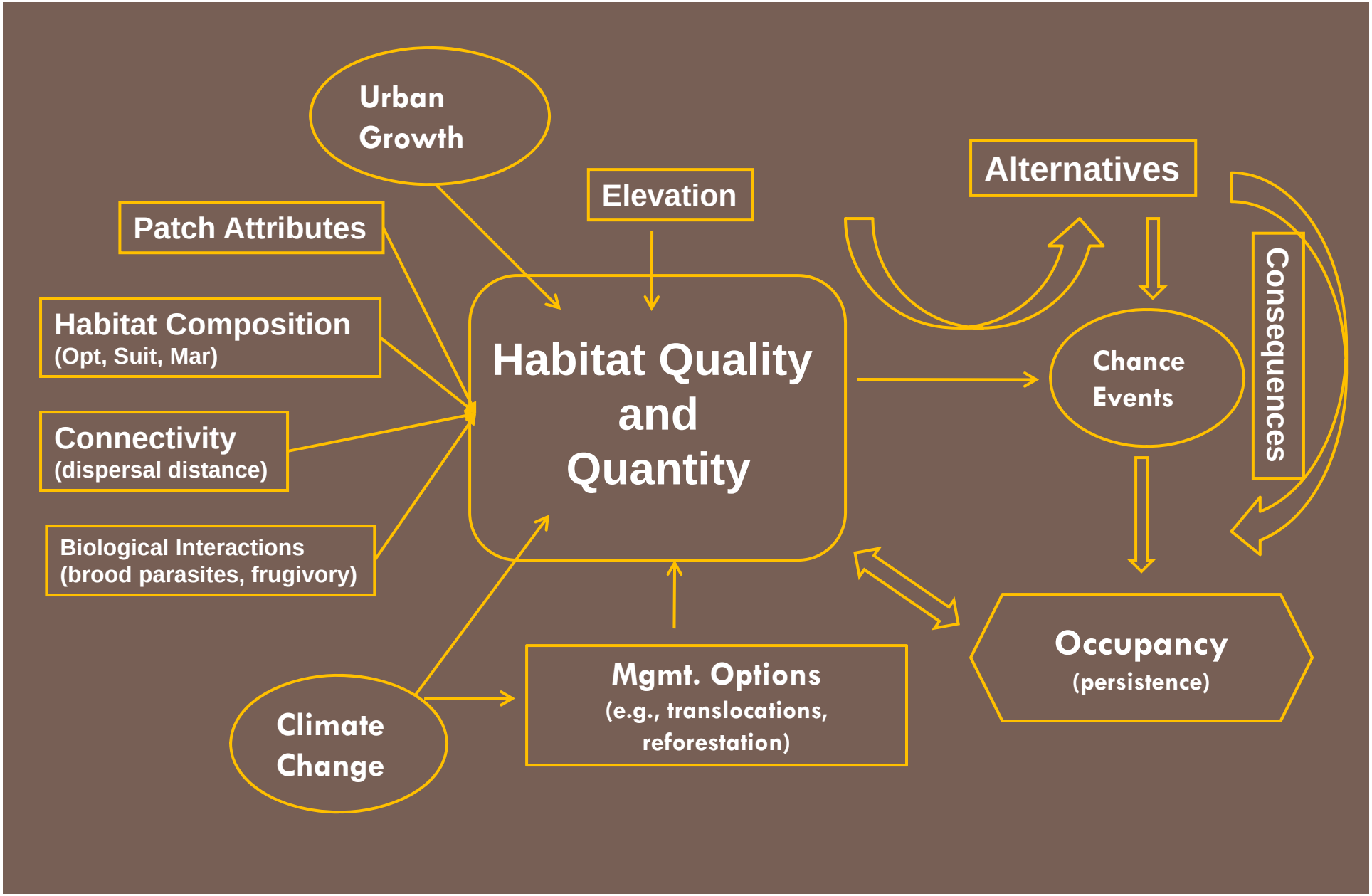
Source: Jean Cochrane

Open Standards for the Practice of Conservation

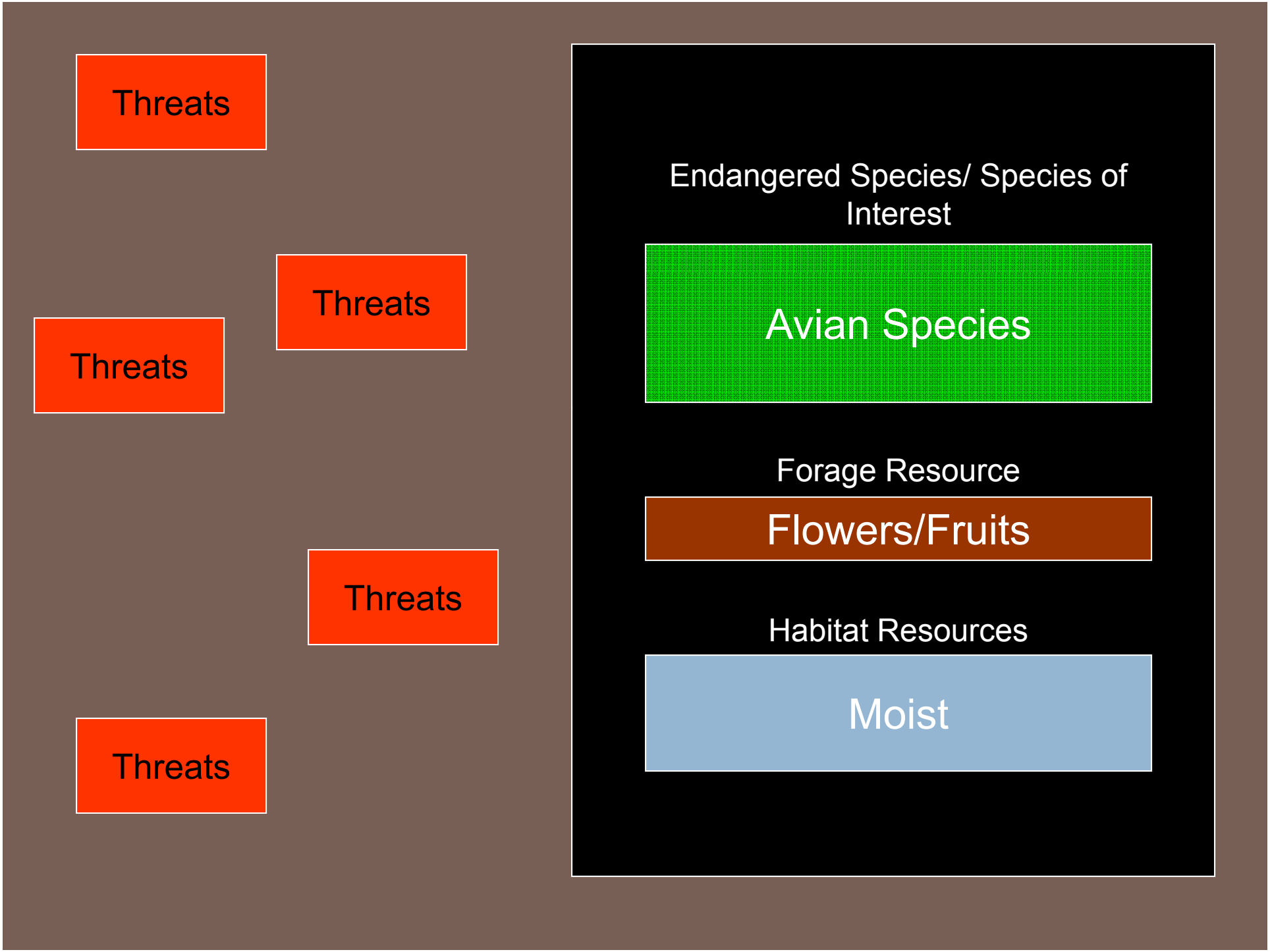
Strategic Habitat Conservation

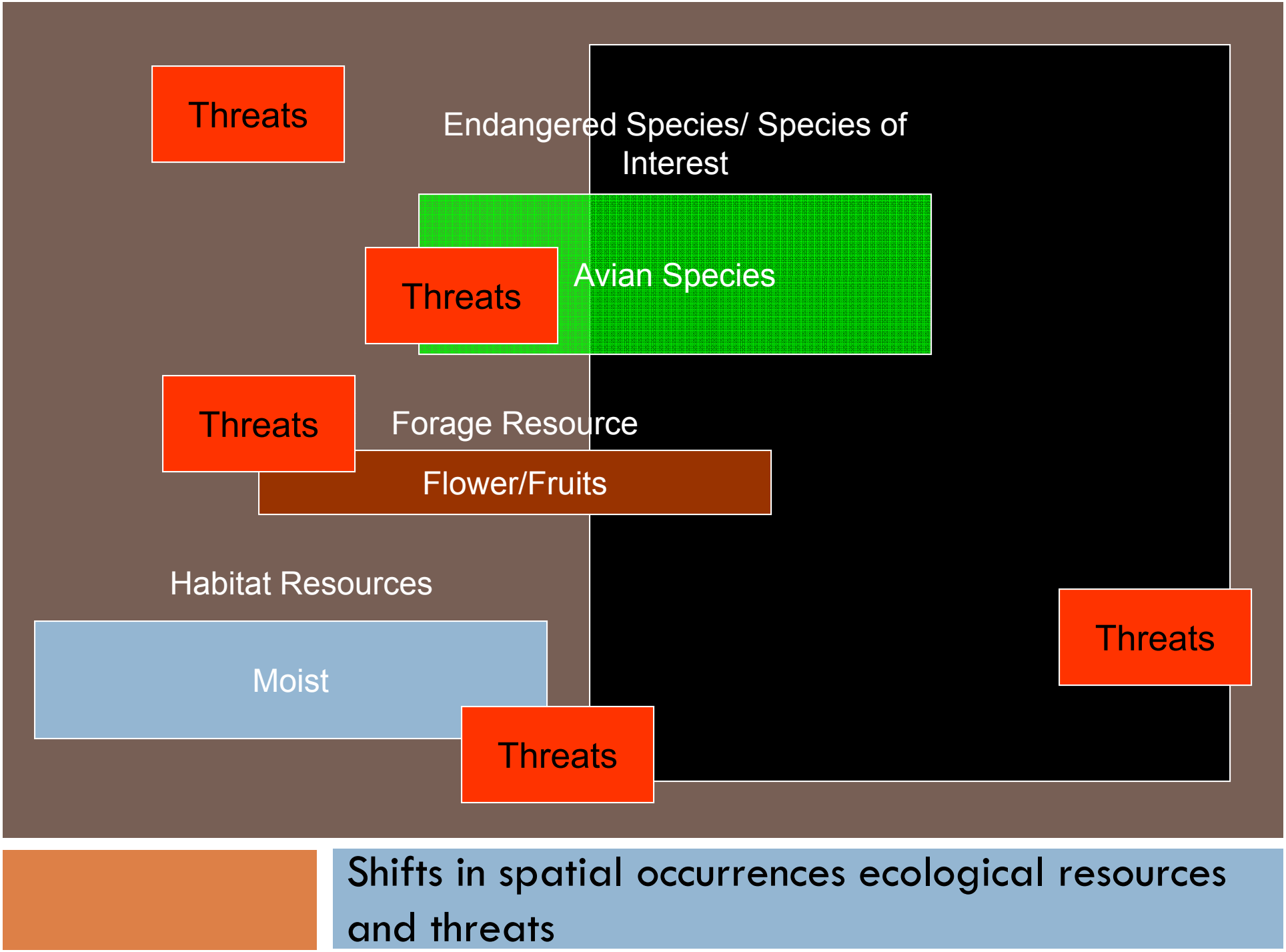


Approaches for Conservation and Decision Making

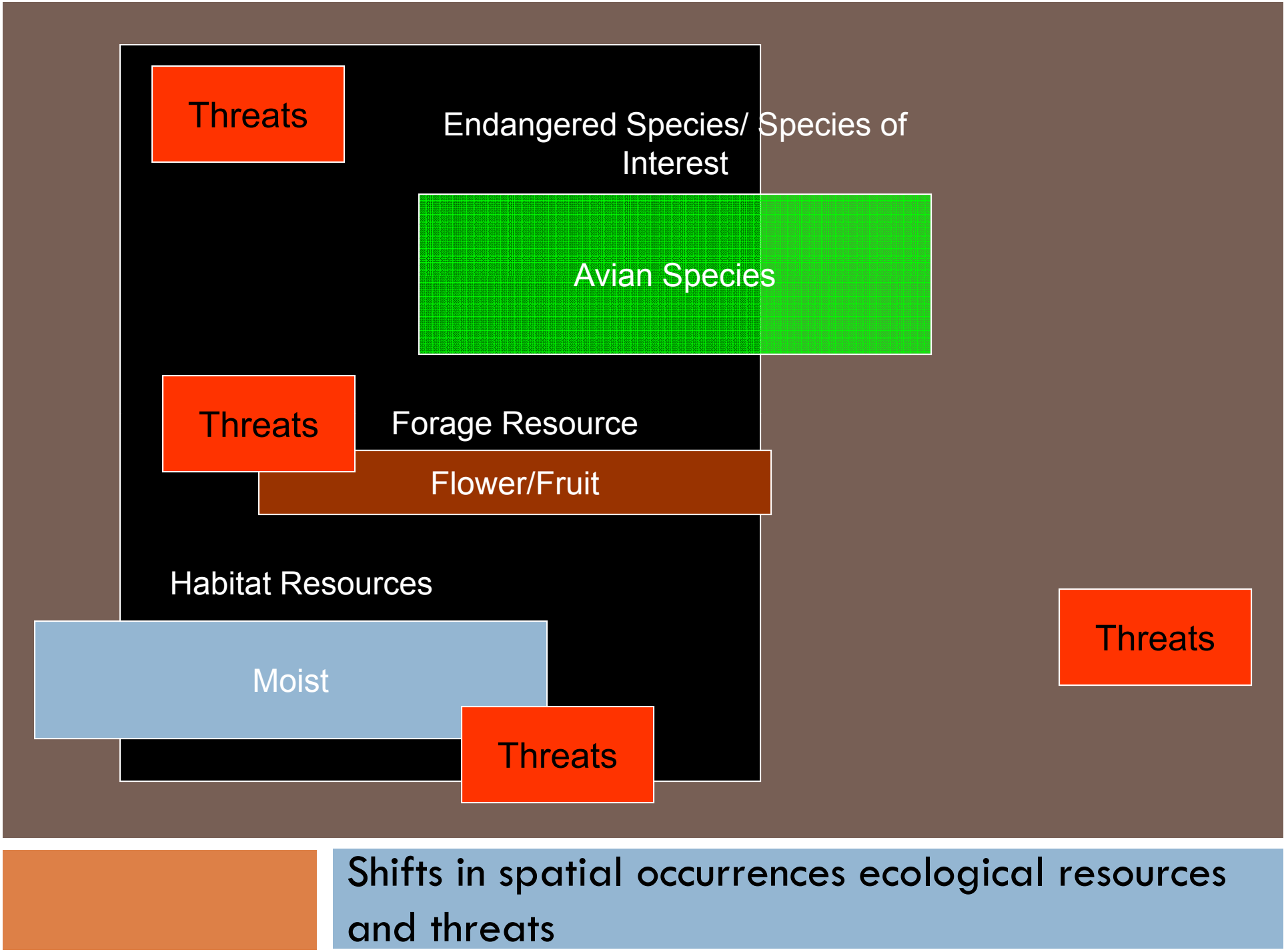


LINKING ALTERNATIVES AND OBJECTIVES


Threats
Threats
Threats
Threats
Threats
Endangered Species/ Species of Interest
Avian Species
Forage Resource
Flowers/Fruits
Habitat Resources
Moist



Shifts in spatial occurrences ecological resources and threats



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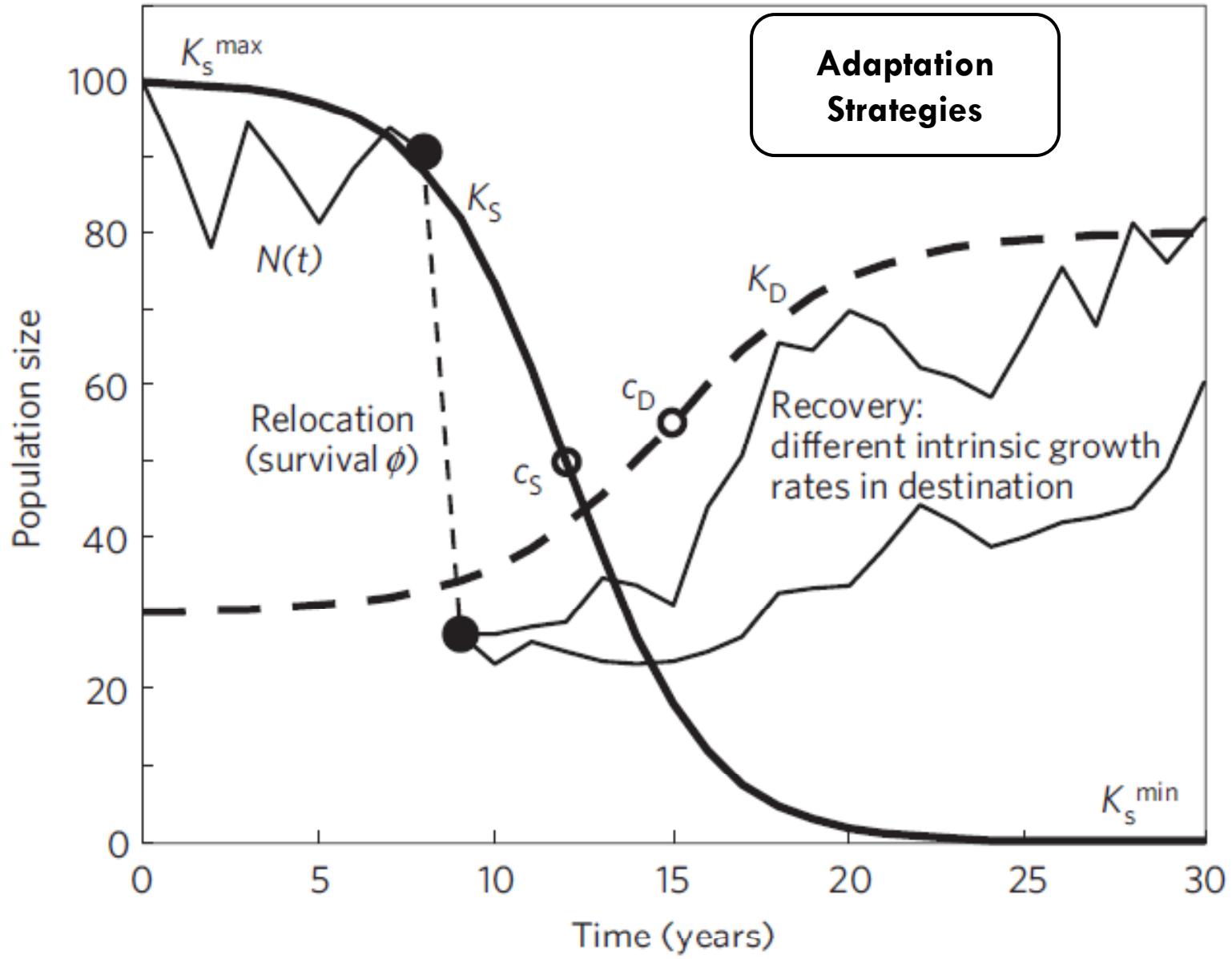
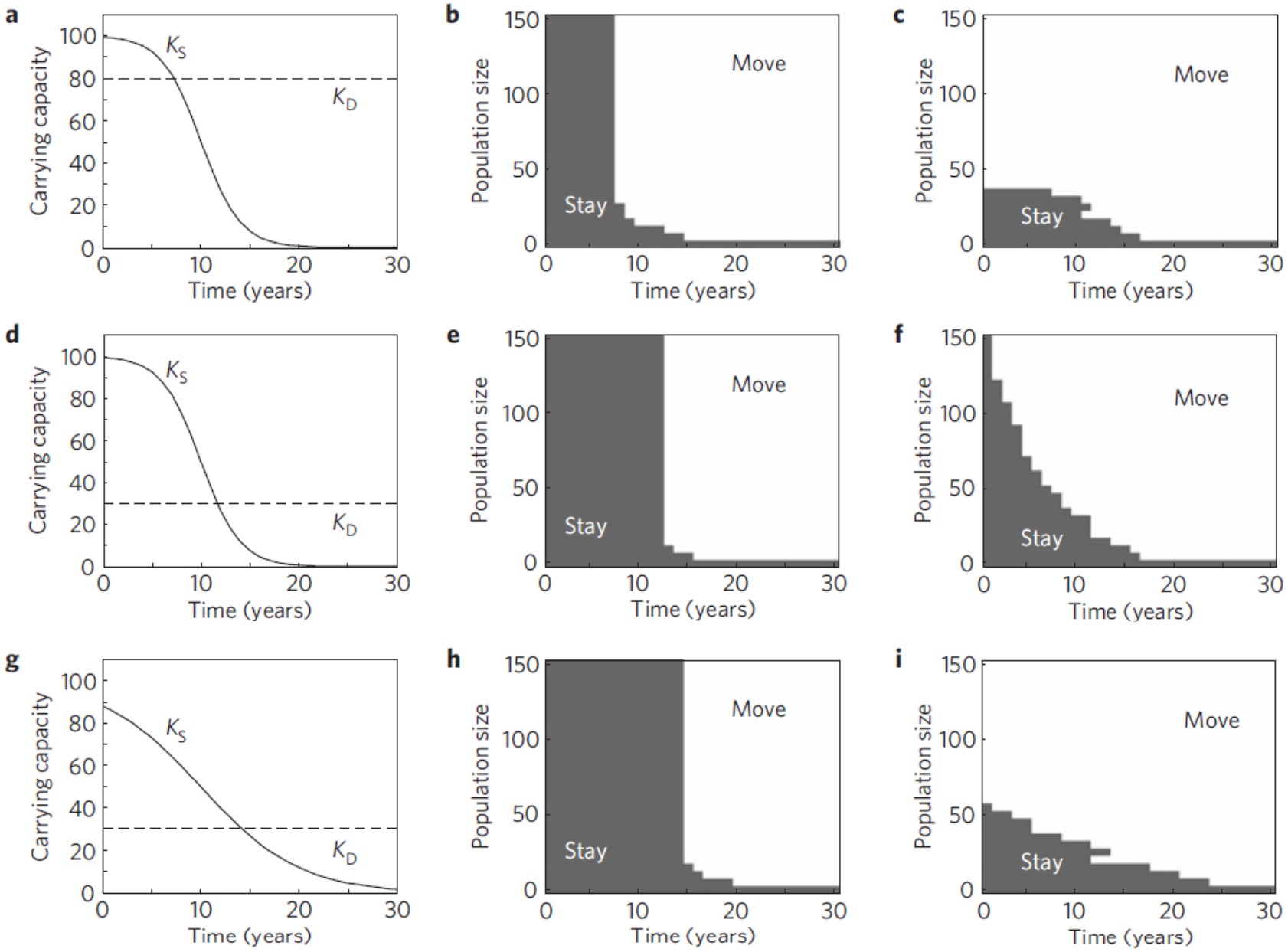


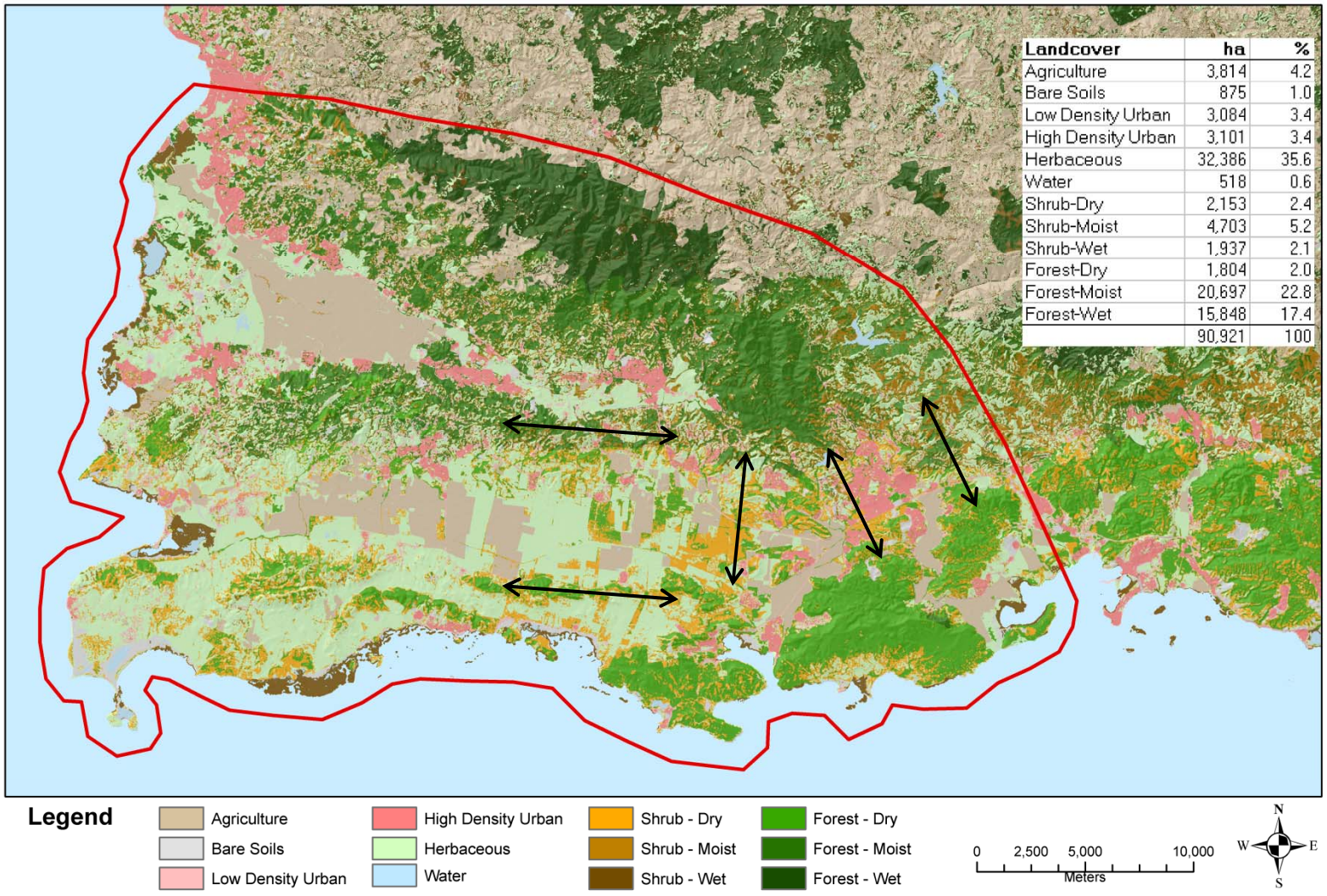
SYSTEM MODEL FOR MANAGED RELOCATION

McDonald-Madden et al. 2011 (Nature Climate Change)

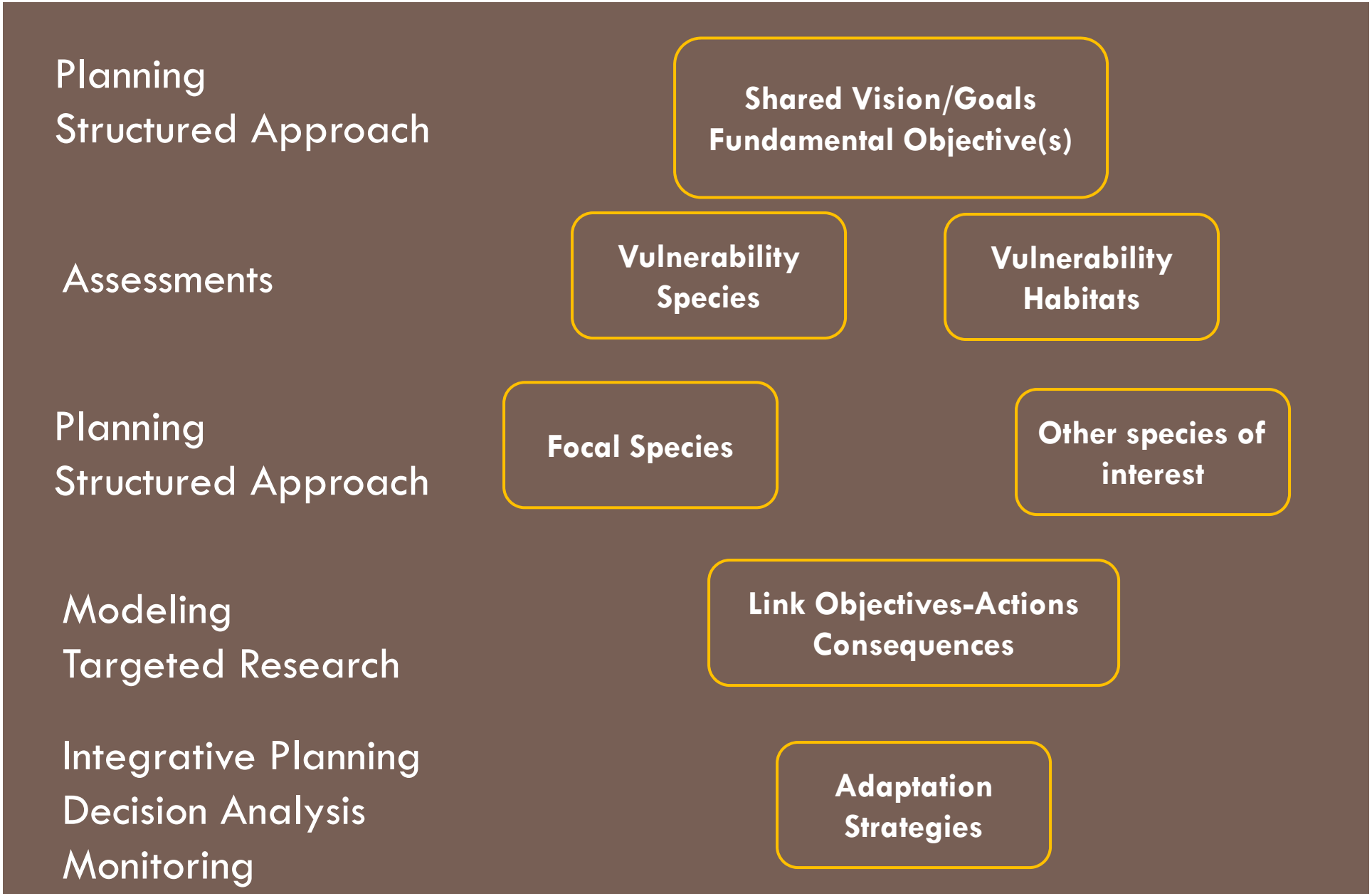


OPTIMAL TIMING FOR TRANSLOCATIONS

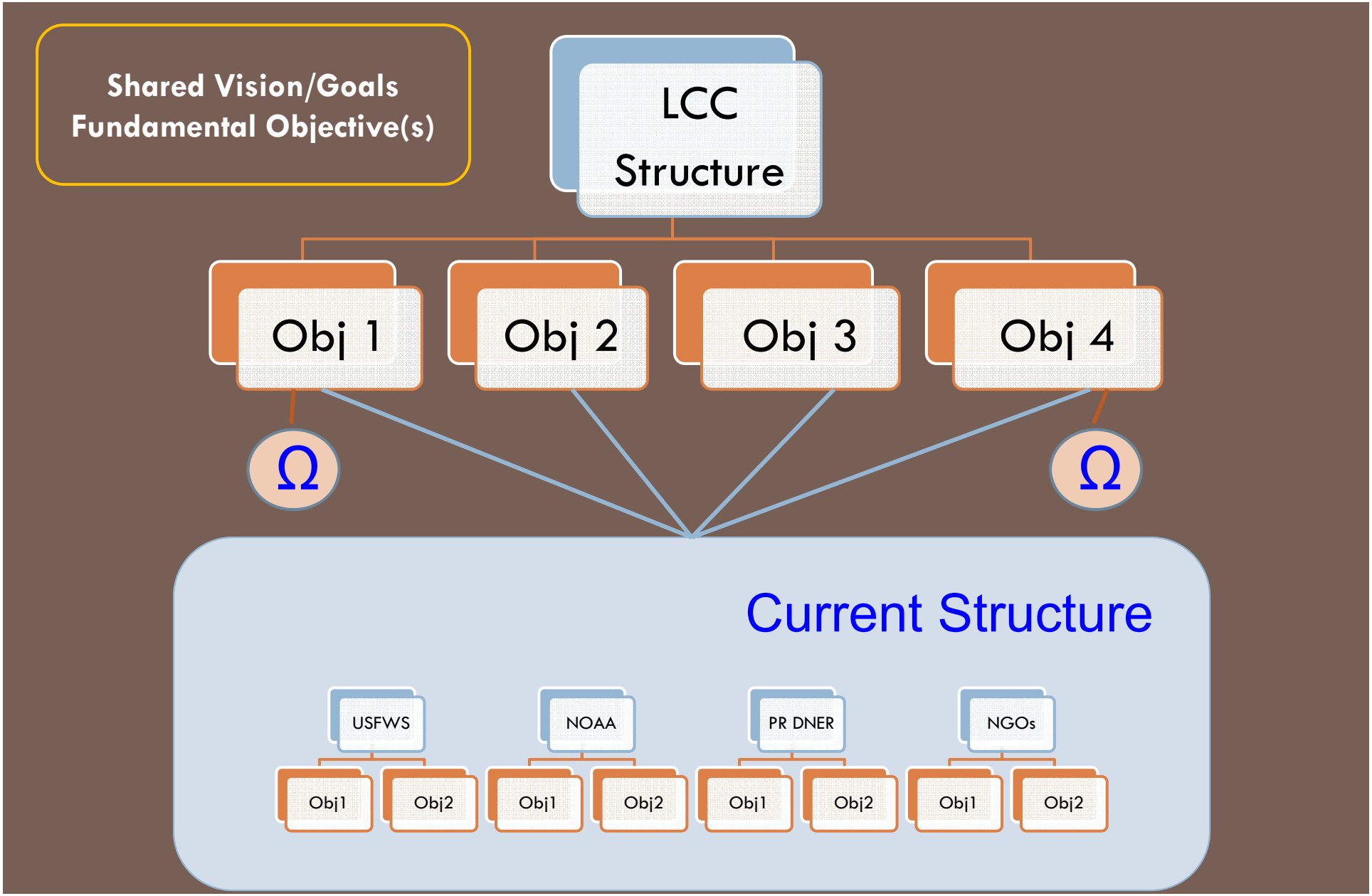
McDonald-Madden et al. 2011 (Nature Climate Change)



SOUTHWESTERN PUERTO RICO



FRAMING A STRATEGY – A FOUNDATION



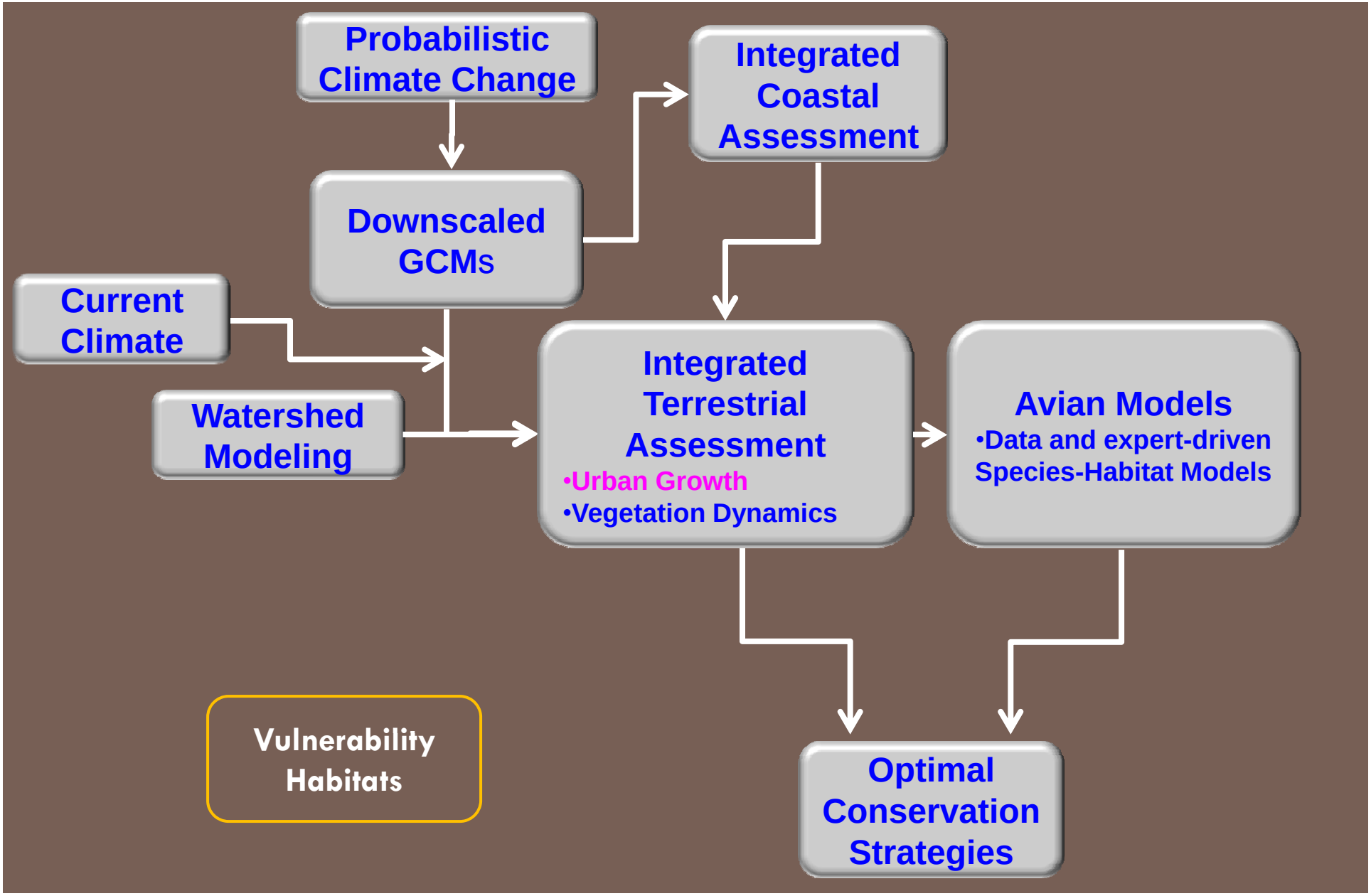
INTEGRATED OBJECTIVES

➢ Life History Traits and other pertinent attributes

- Breeding Habitat Obligate (or Habitat Specialization)
- Migration Status
- Dispersal ability
- Niche specialization
- Reproductive Potential (or Life-history Traits)
- Habitat susceptibility

Vulnerability Species

VULNERABILITY ASSESSMENT



VULNERABILITY ASSESSMENT

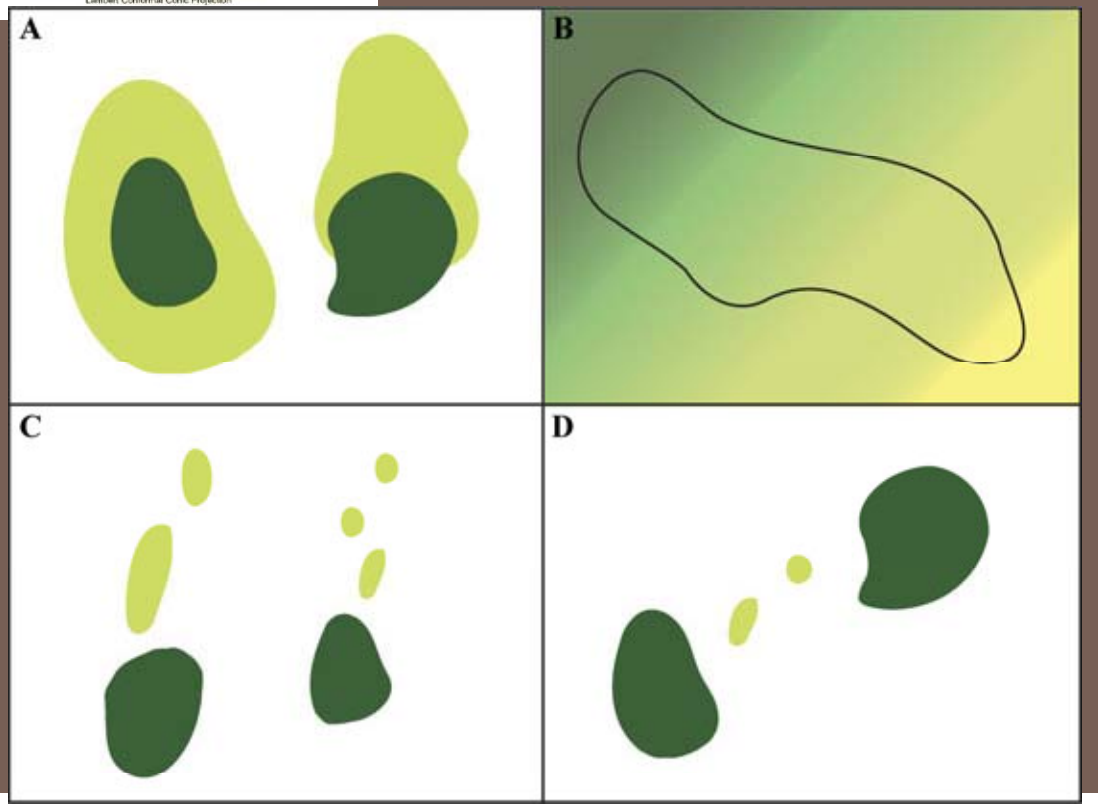
Focal Species (vulnerable)

Other species of interest

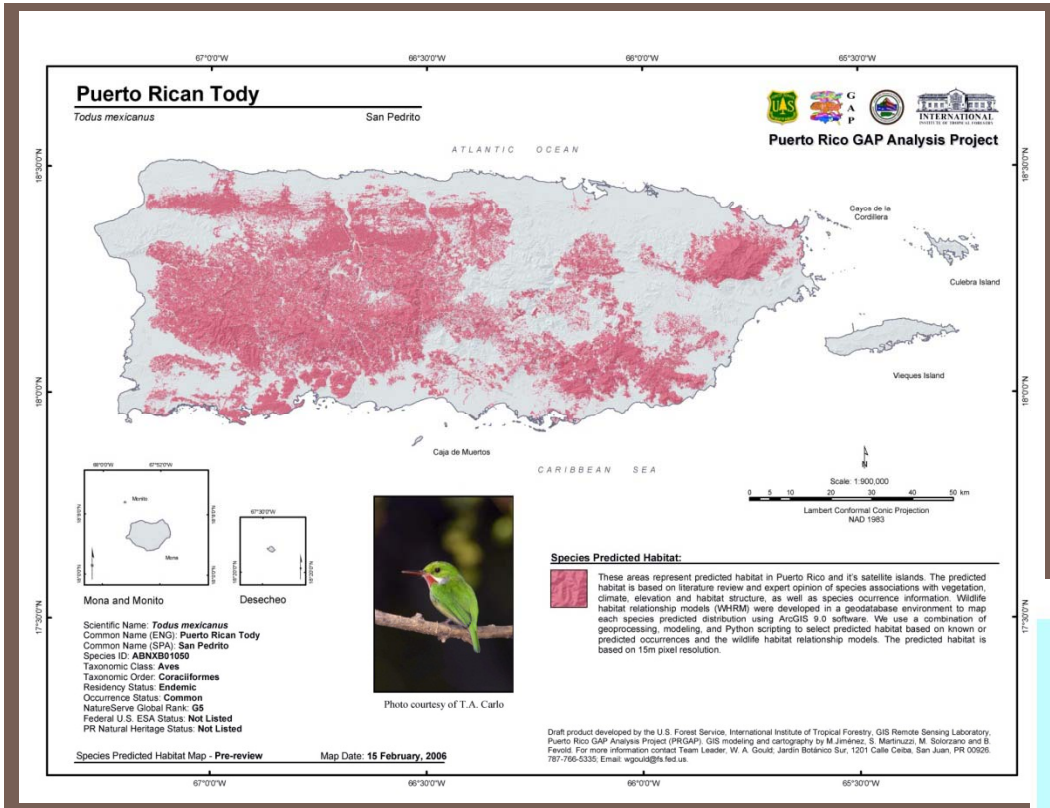
REFINED OBJECTIVES

Link Objectives-Actions Consequences

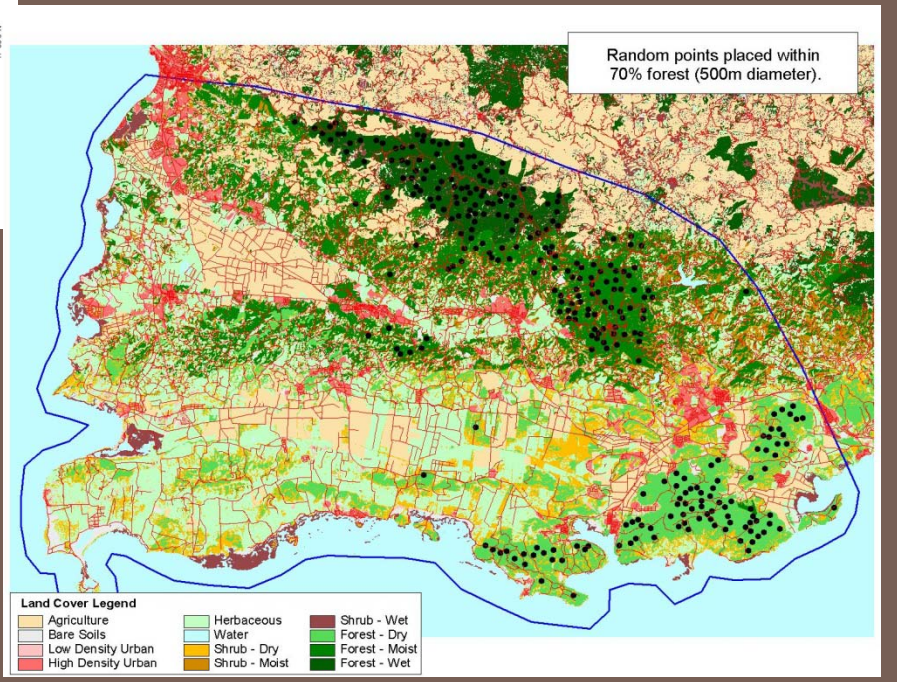
A. Enlarge Existing Reserves
B. Span gradients
C. Facilitate movements
D. Connect existing reserves



ALTERNATIVE ACTIONS - DESIGN

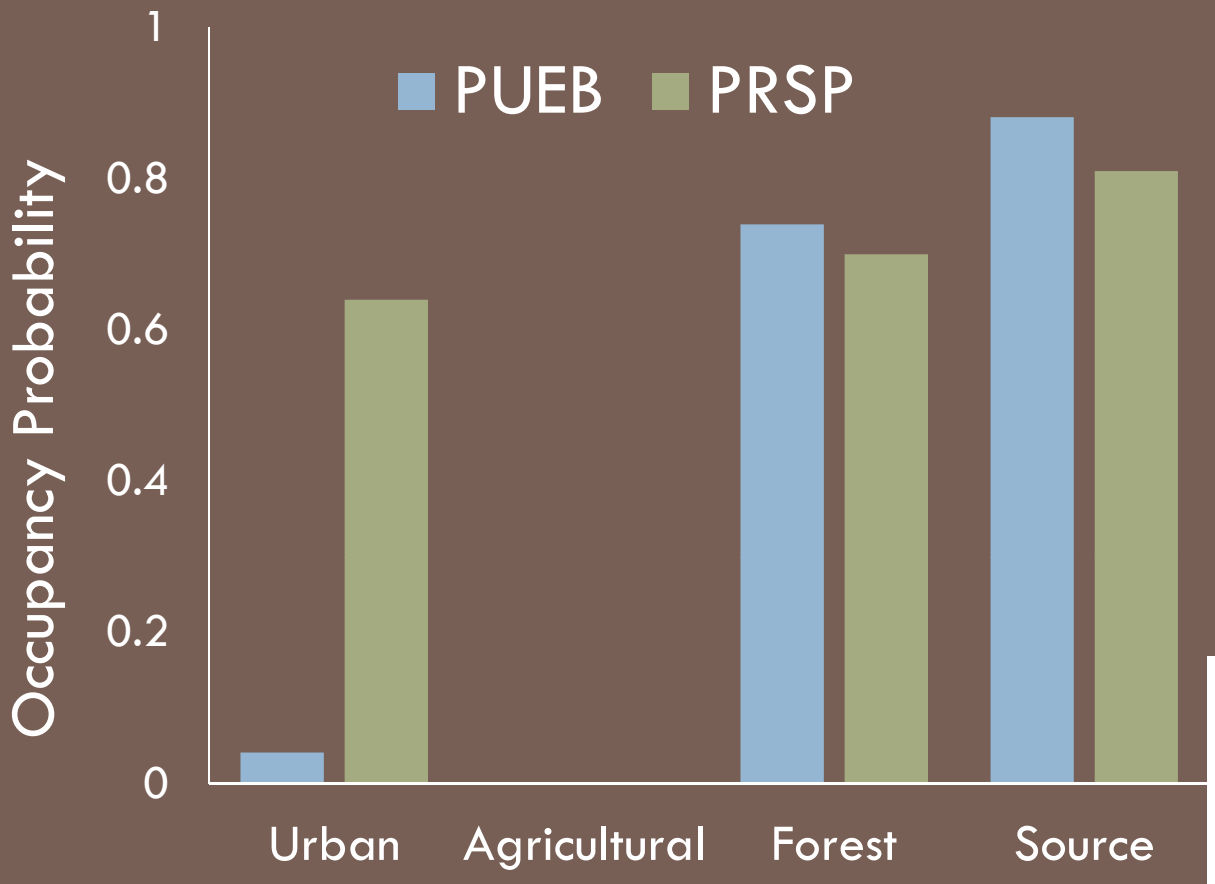


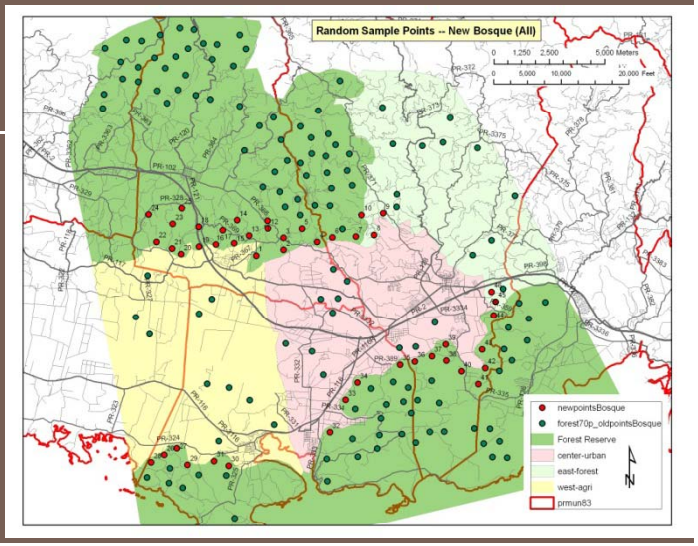
Link Objectives-Actions Consequences



Patch Occupancy (Psi) is defined as the probability that a site is occupied. It is conditioned by fact that a species is not always detected with certainty, even when present ($p < 1$).

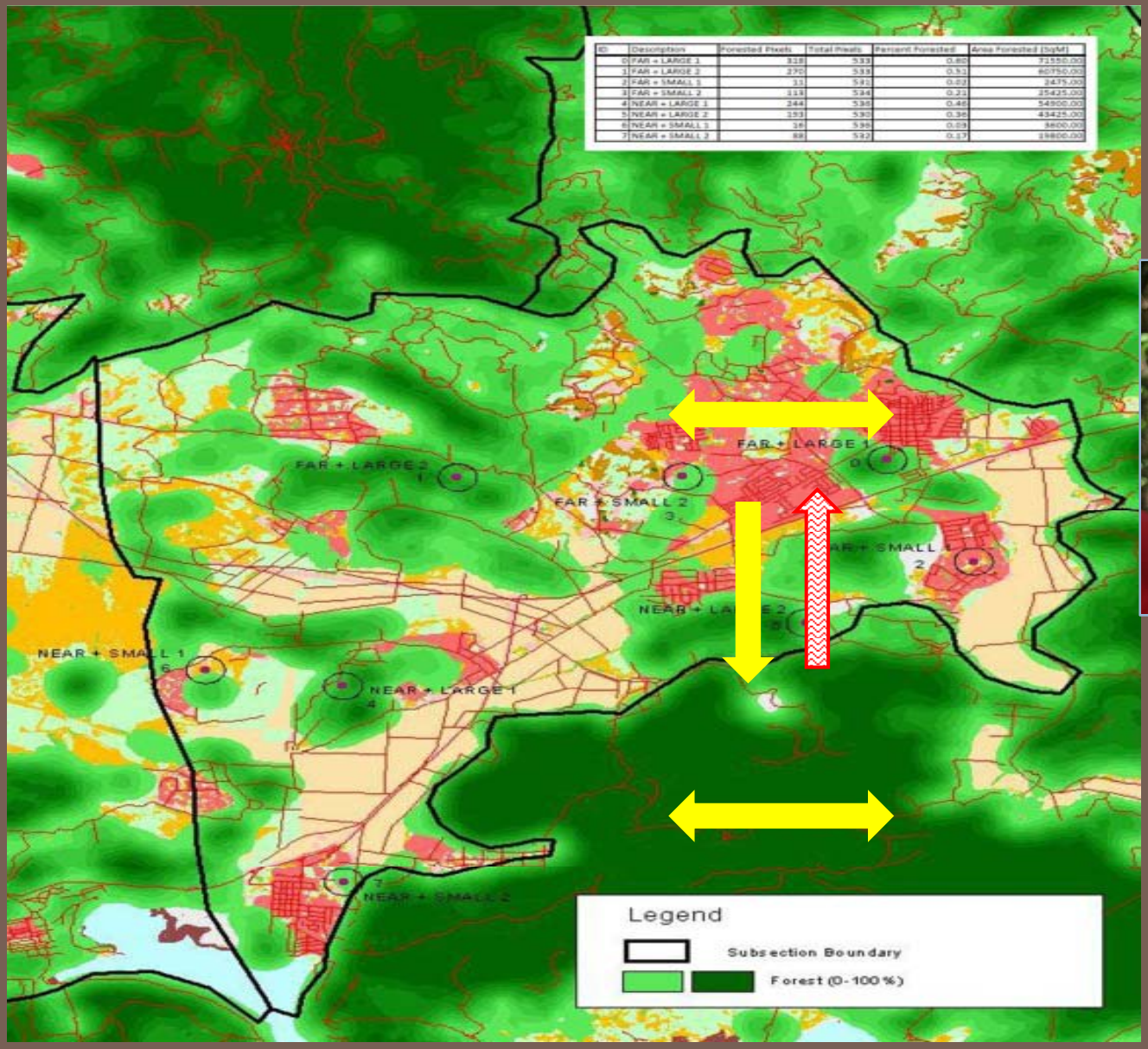
Predictive models at landscape scales





Link Objectives-Actions Consequences

HABITAT MATRICES



Link Objectives-Actions Consequences

URBAN MATRIX - PERMEABILITY

Decision Analysis

- Stochastic Dynamic Programming – possibly?
- Robust or Heuristic Approaches – large problems
  - Sequential Reserve Selection
  - Max either species retention in landscape or representation in reserves
  - Protection (e.g., acquisition) done over number of years, limited budgets and some sites might become unavailable during planning period.

RESERVE SELECTION

MOILANEN AND CABEZA 2007, BIOL CONS

WHY MONITOR?

- State-dependent decision making: To assess the current state of the system, in order to determine which action to take
- Evaluation of management performance
- Learning, to increase understanding of ecological dynamics and the effects of management on them
- Future Modeling, to develop new predictive models as needed