Seminario
Facoltà di Agraria - Università di Firenze - 31 maggio 2012

Managing forests as complex adaptive systems: From theory to practice

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Outline

- Background
- Scientific work
  - Thinning
  - Species mixture
  - Adaptability tradeoffs
- Upcoming book

Resilience

- **Ecologists**
  - **"respond to change in a ways that sustain fundamental functions, structure, identity, and feedbacks" (after Chapin et al. 2009)**

ilviculturists

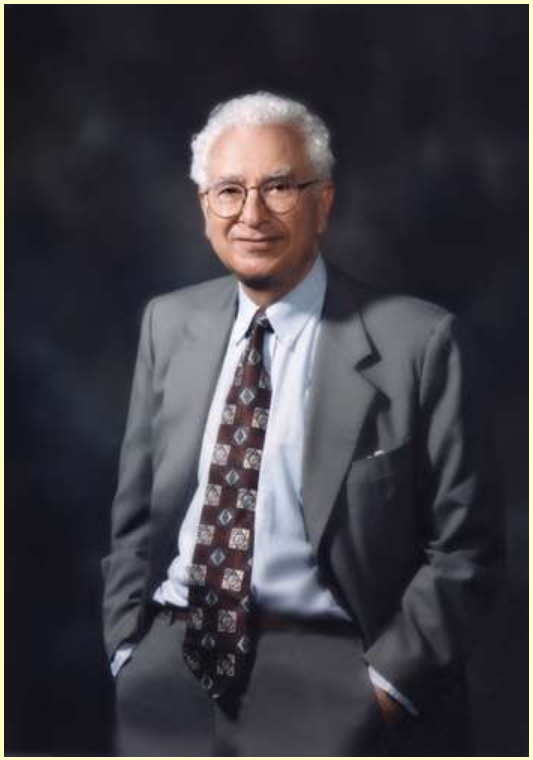
"… sustain ecc … ces"

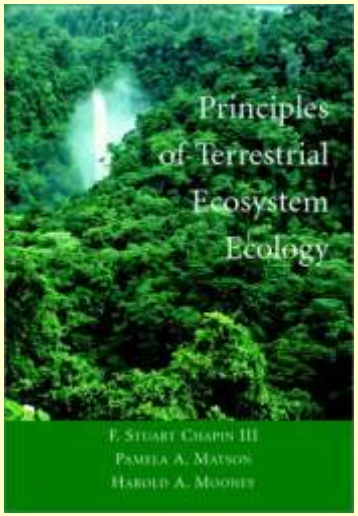
– ($, water, w …)

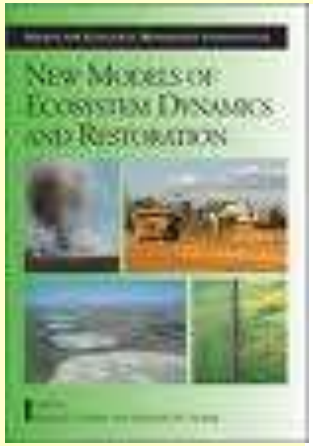
Phase change

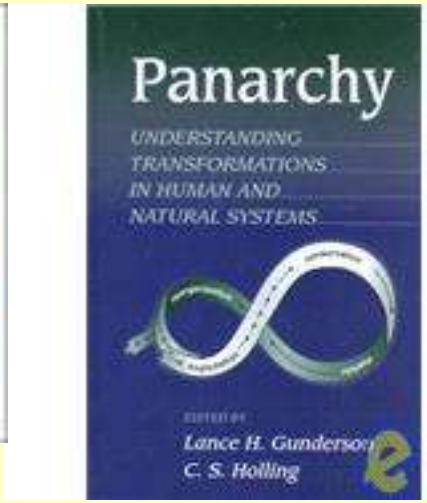
Resilience

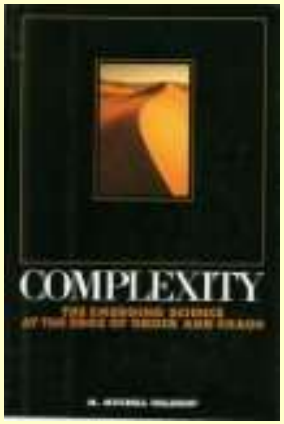
Complexity science

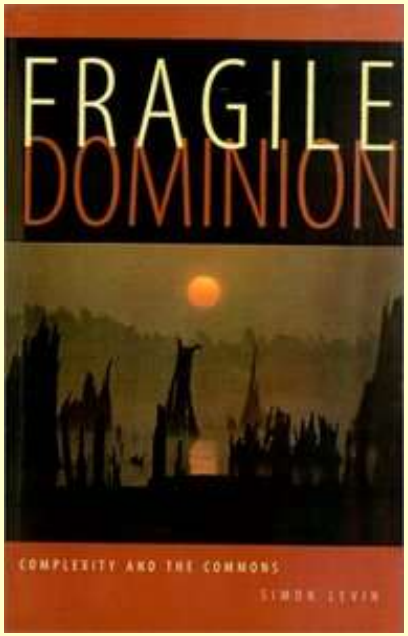


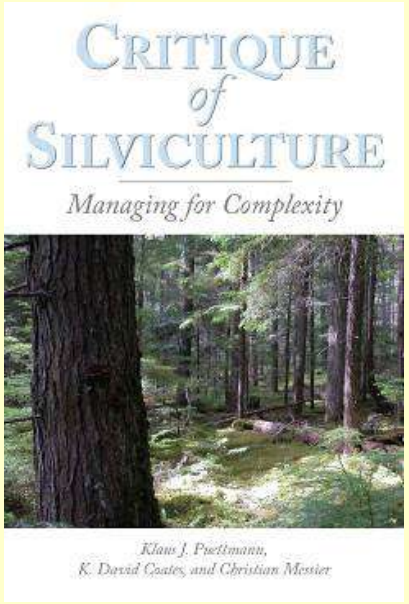




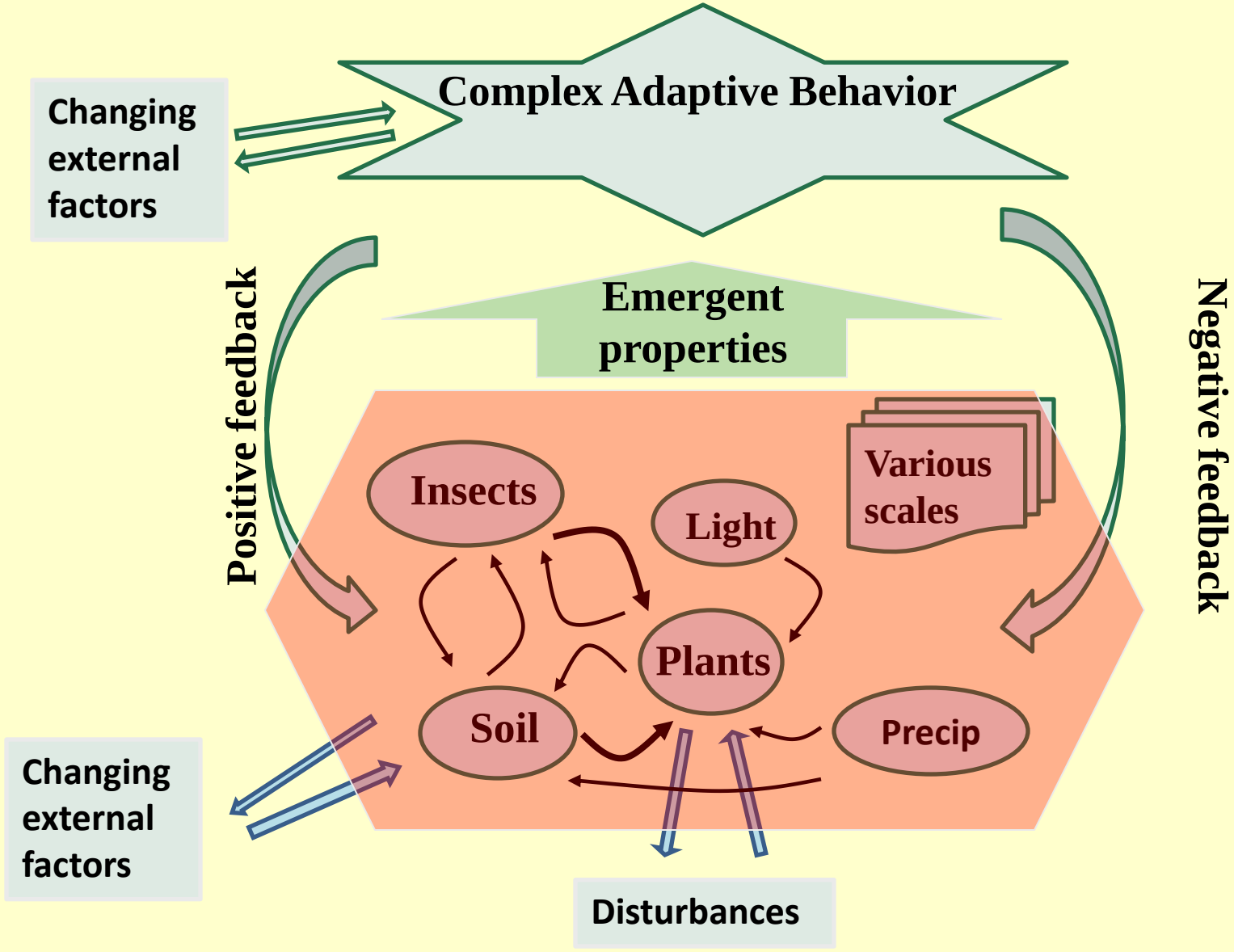








Complex Adaptive Systems



Complex Adaptive Systems

Complex, adaptive systems

- **stable states are the exception, rather than the norm**
- **can be unpredictable**
- **can withstand substantial perturbations, i.e., be remarkably robust (adapted to current conditions)**
- **can be quite responsive (adaptable) to perturbations (threshold)**

Modified from S. Page (U Michigan)

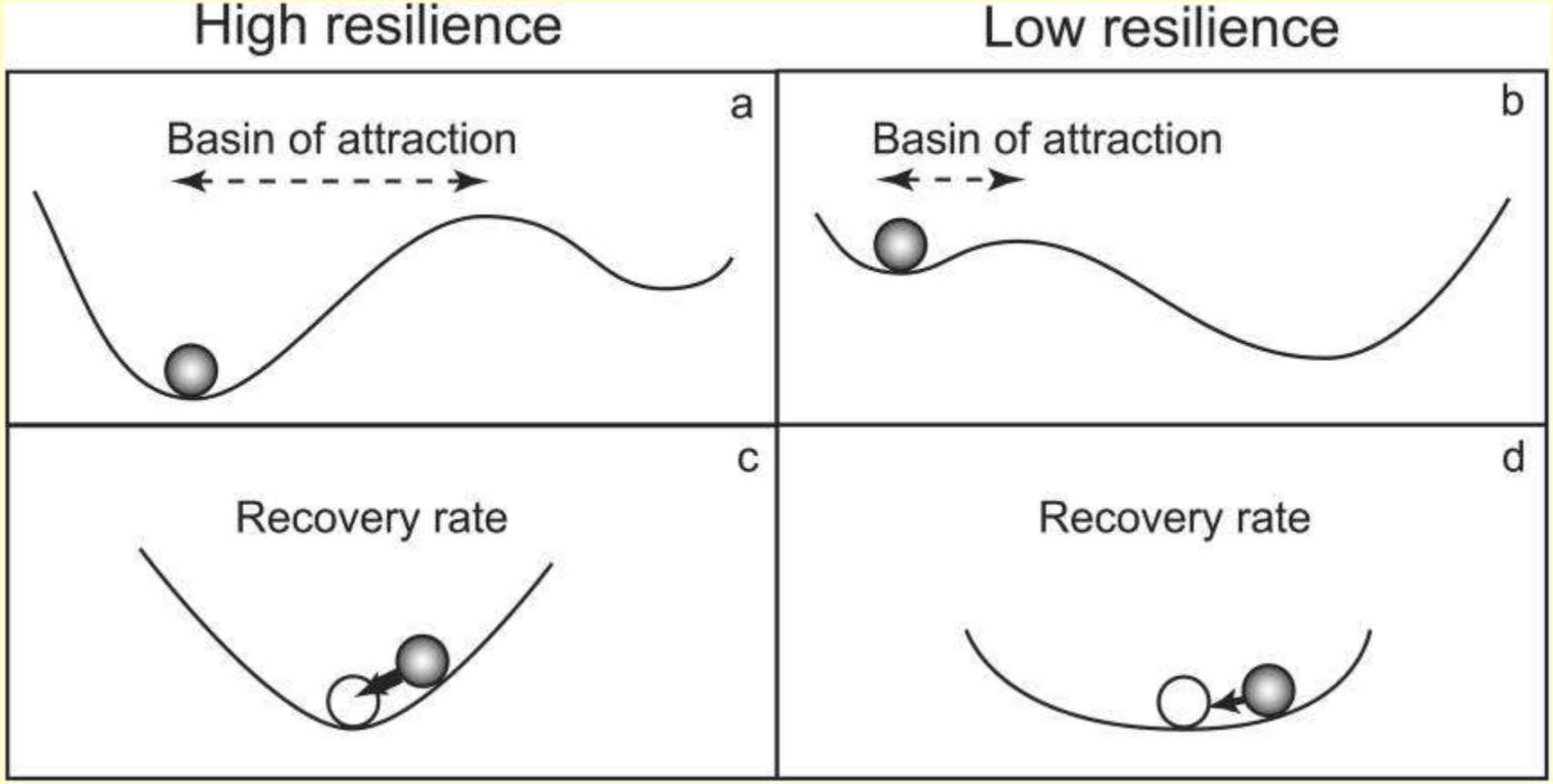
Scientific Progress:

- **Test hypotheses**
  - **Model prediction**
  - **Experiments**

H_0: Forests = Complex adaptive systems – better able to adapt to "surprises" and maintain ecosystem services

H_a: Forests = Alternative hypotheses

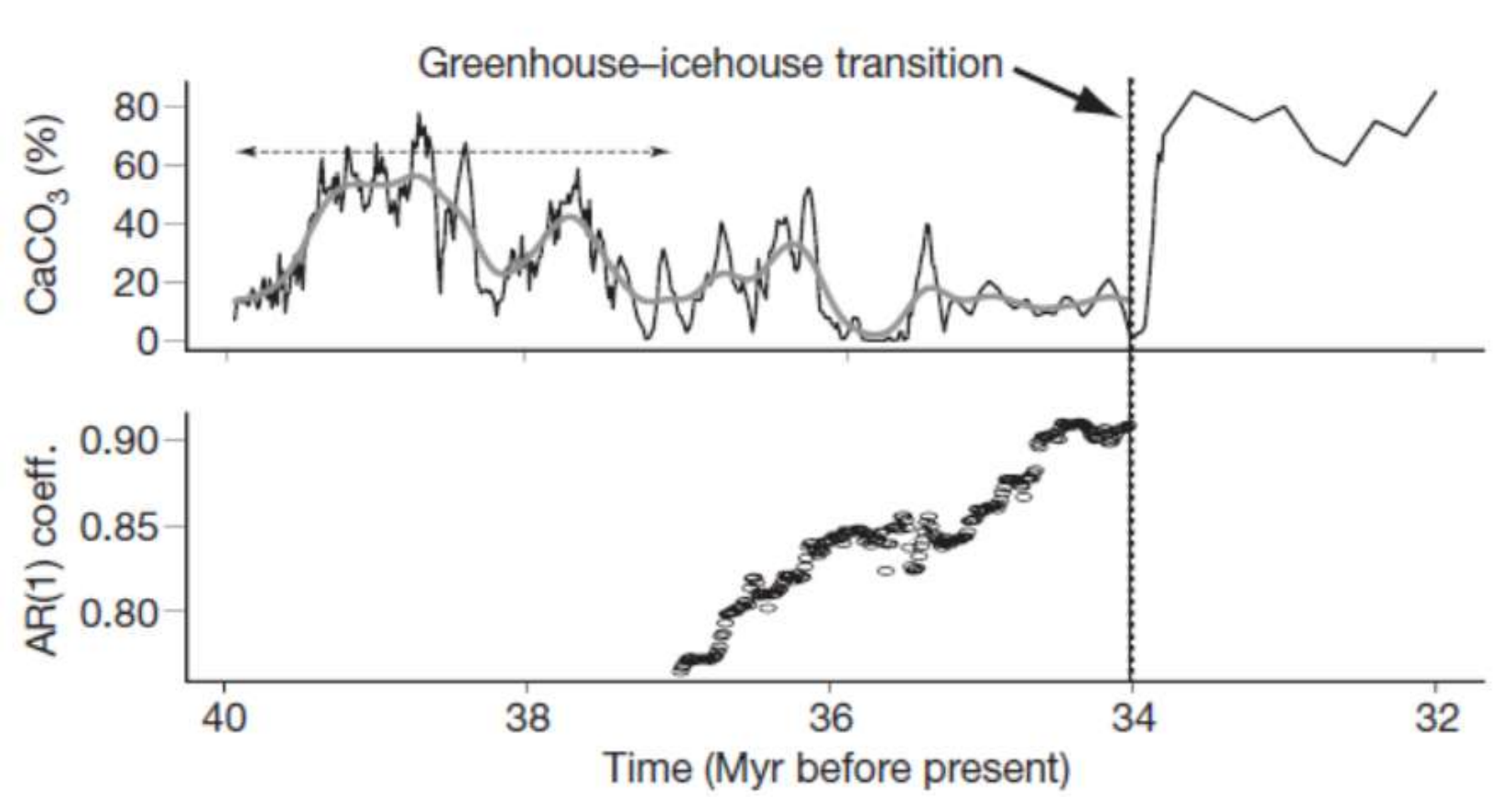
Threshold



Van Nes and Scheffer 2007 AmerNat

Critical slowing down = autocorrelation

Threshold



Scheffer et al. 2009, Nature

Ecosystem dynamics

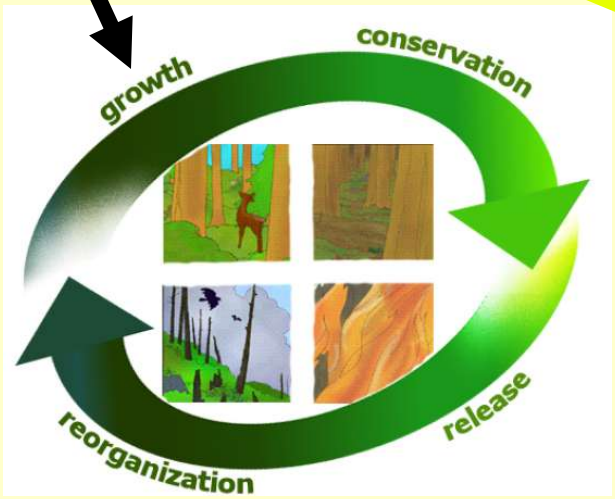
Panarchy (Holling, Gunderson, et al.)

Ecosystem dynamic

Thinning

Encourage tree growth

Increase tree vigor



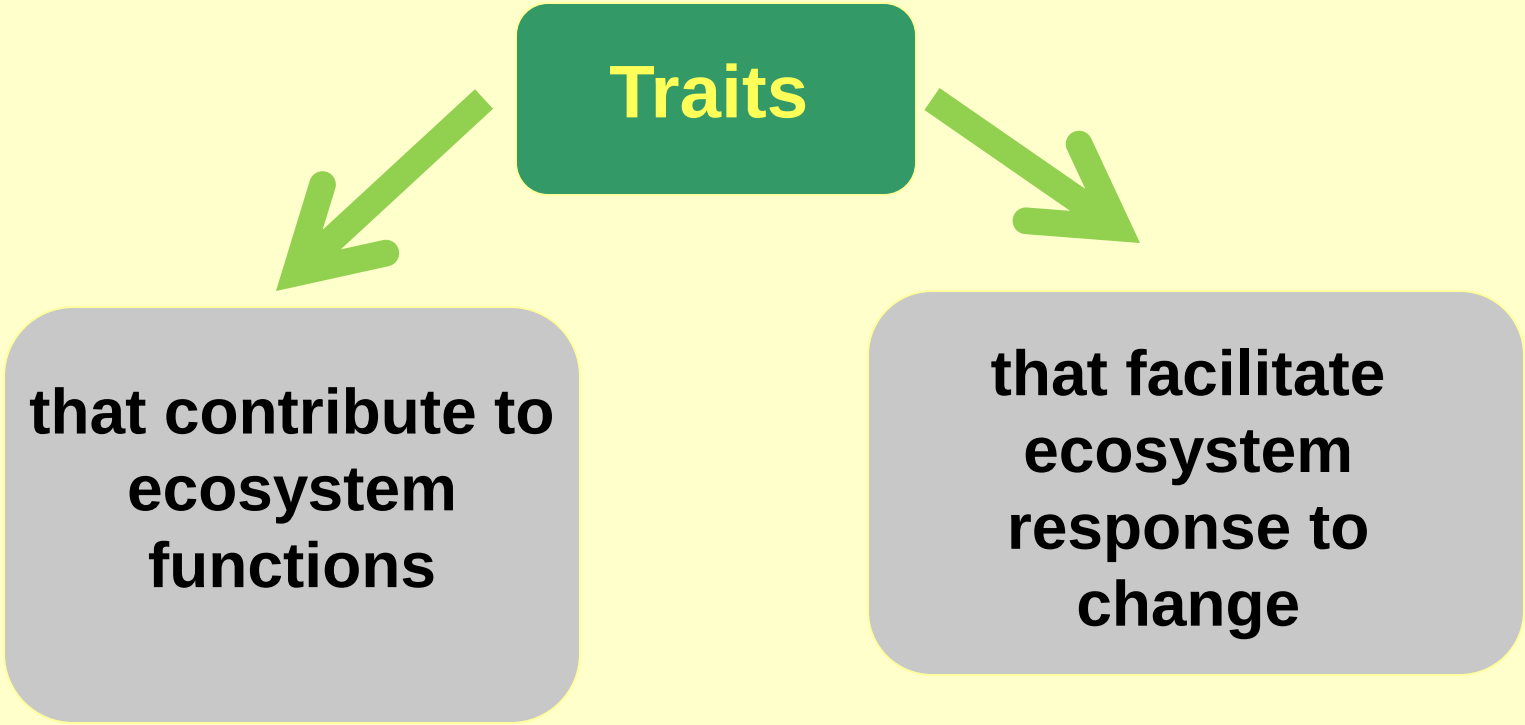
Increase understory vegetation

Encourage seed production and/ or sprouting

Modified from Drever et al. 2006

Mechanistic view of "adaptability"

"Species don't matter - What species do matters"



Plant traits

Fleshy fruits and seeds

Insect pollination

Palatable leaves

Functional type

Drought tolerance

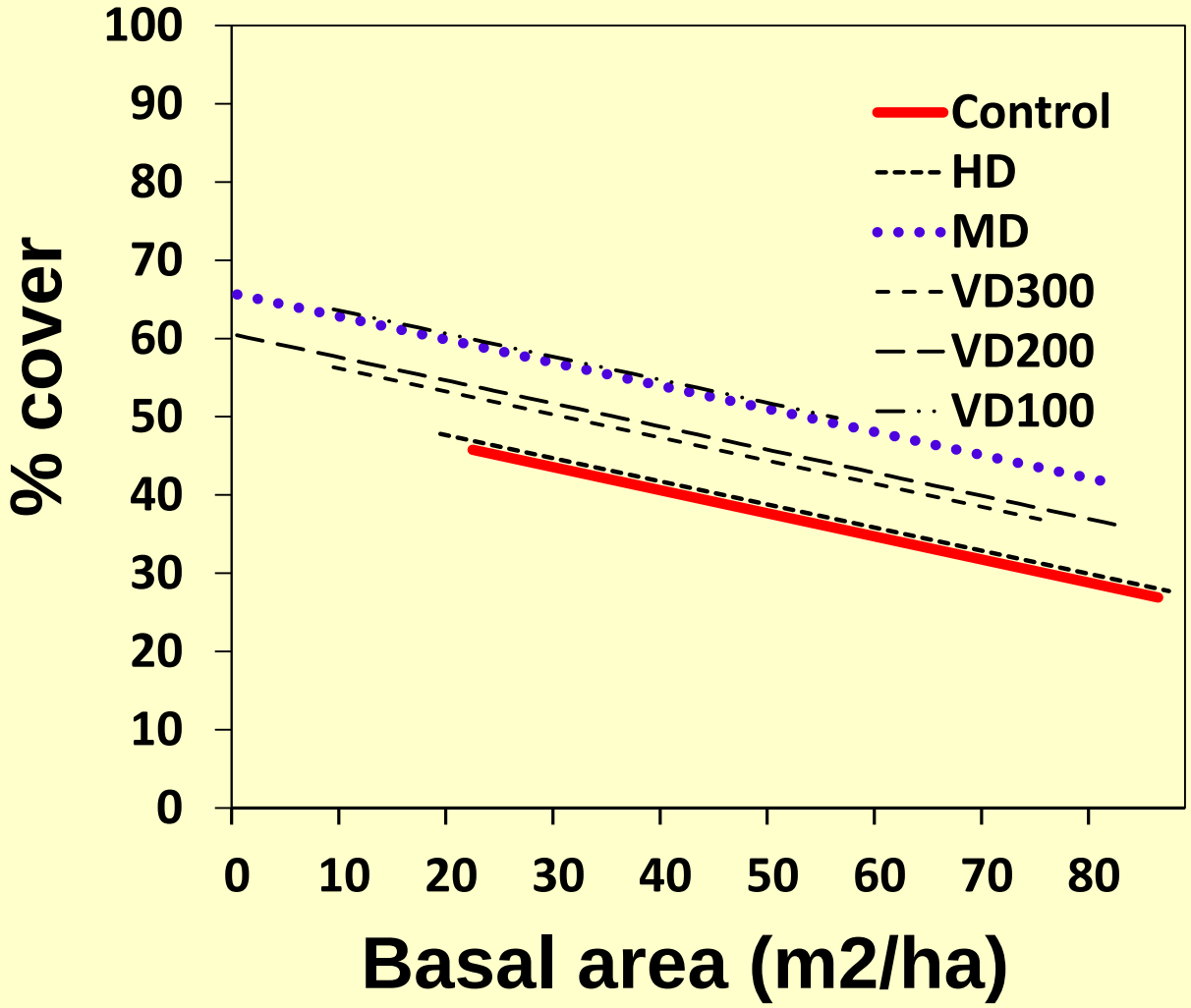
Sprout. ability

Temp. tolerance

Response type

Plant traits: Functional group

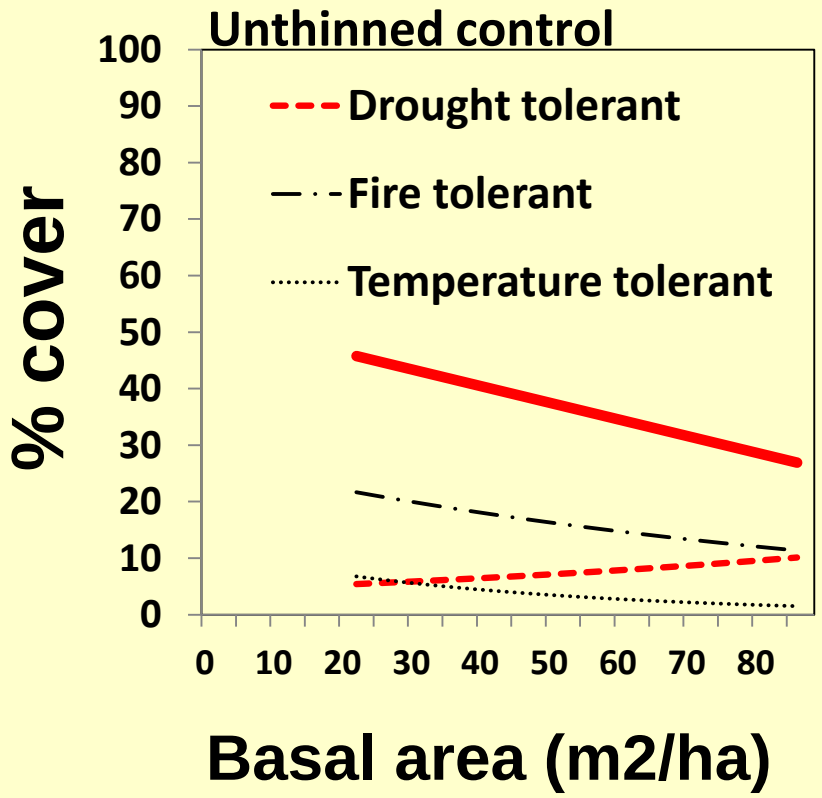
Insect pollinated species



A. Neill, in prep.

Plant traits: Response types

Insect pollinated species



A. Neill, in prep.

Plant traits

Thinning increases likelihood that selected wildlife habitat functions are maintained in light of climate change.

Plant traits

Mixed species stands – redundancy ?

Species choice:

- Compatibility of growth patterns
- Overyielding

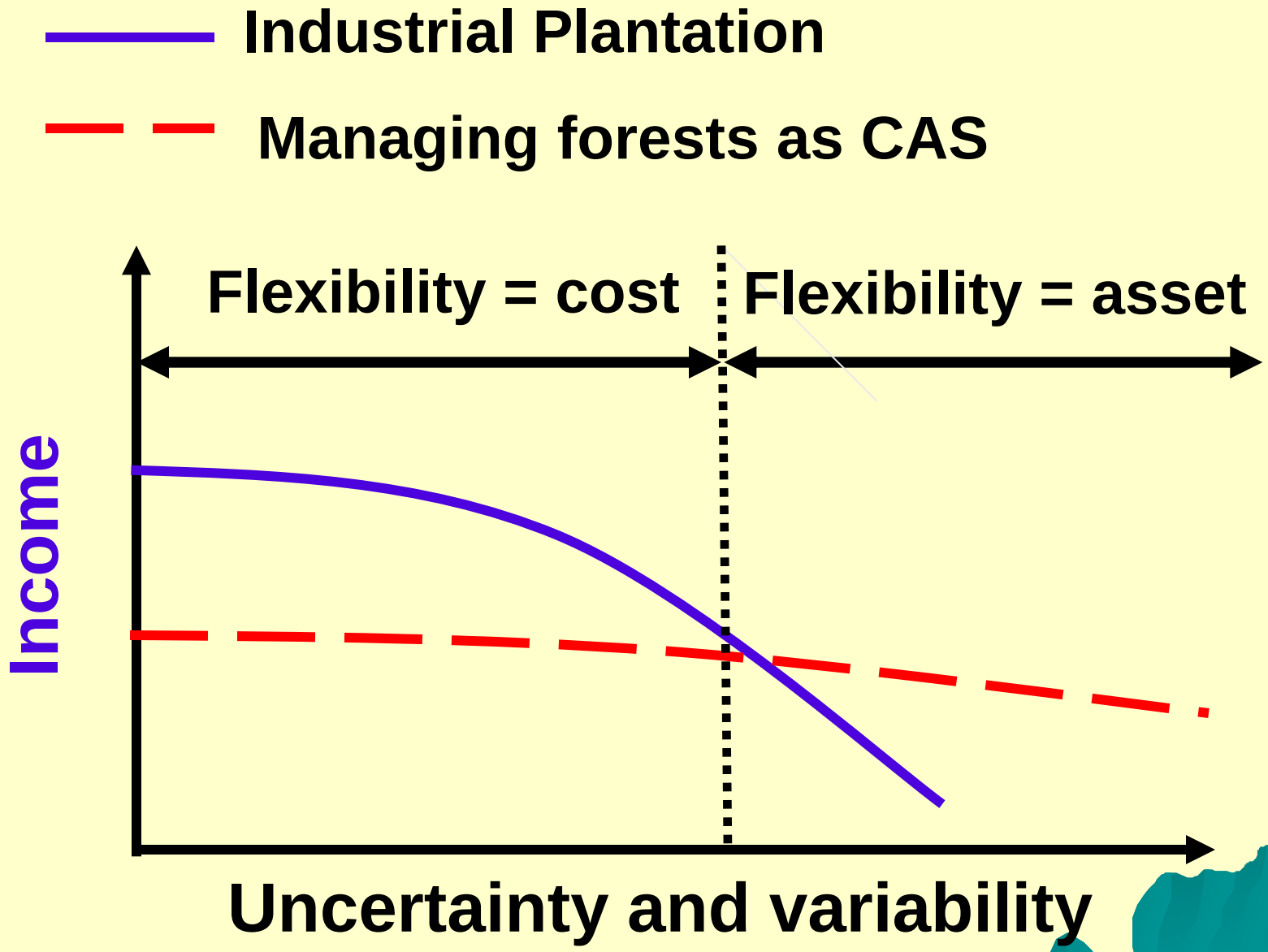
= focus on functional type

Plant traits

Criteria for species choice include enhancing response type diversity, e.g.:

- **sprouting ability,**
- **drought tolerance,**
- **disease resistance**

Managing forests as CAS



Managing forests as CAS