# Resiliens - MK 2009

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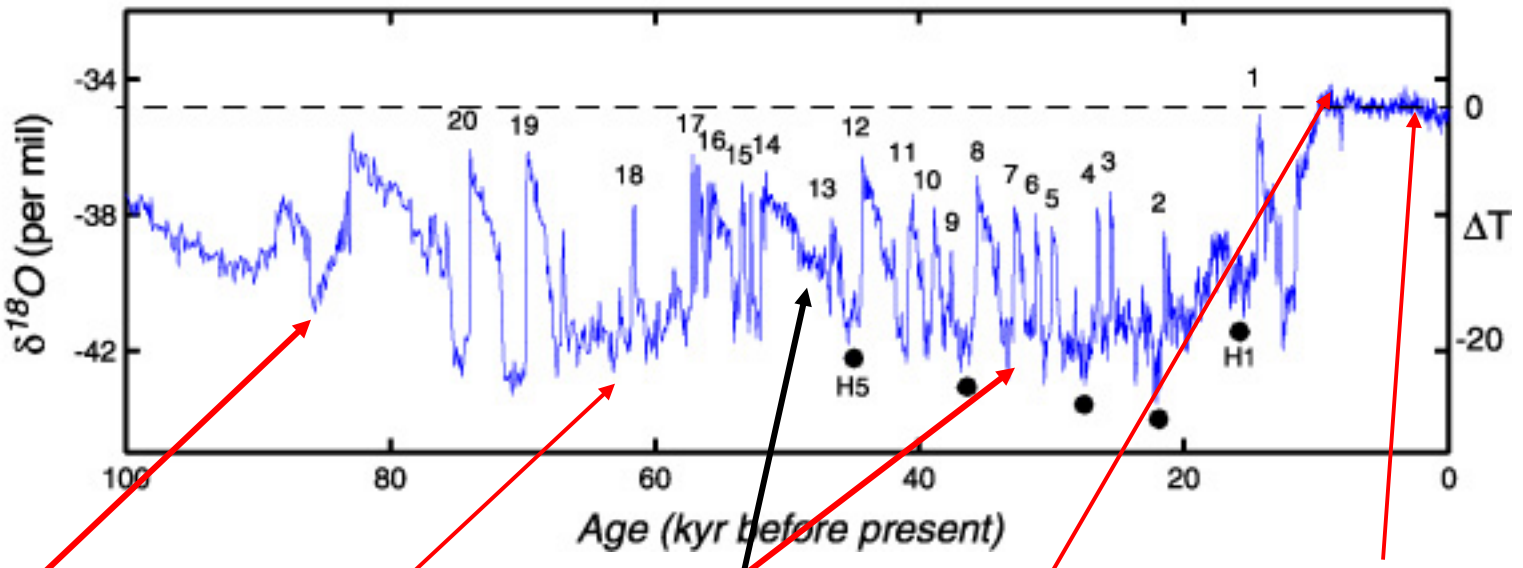
Systemekologiska institutionen

"As a function of **human dominance** and **rapid climate change**, ecosystems and species distributions will change, requiring **new forms of protected areas** and **new management strategies** in existing protected areas."

# Key Message: Climatic Trends

"Recent observations confirm that the worst-case IPCC scenario trajectories (or even worse) are being realised."

# The Holocene Basin




**First migration of fully modern humans out of Africa**

**Aborigines arrive in Australia**

**Migrations of fully modern humans from South Asia to Europe**

**Beginning of agriculture**

**European civilisations: Greek, Roman**

**Source: GRIP ice core data (Greenland)**
**And S. Oppenheimer, "Out of Africa", 2004**

# Störningar

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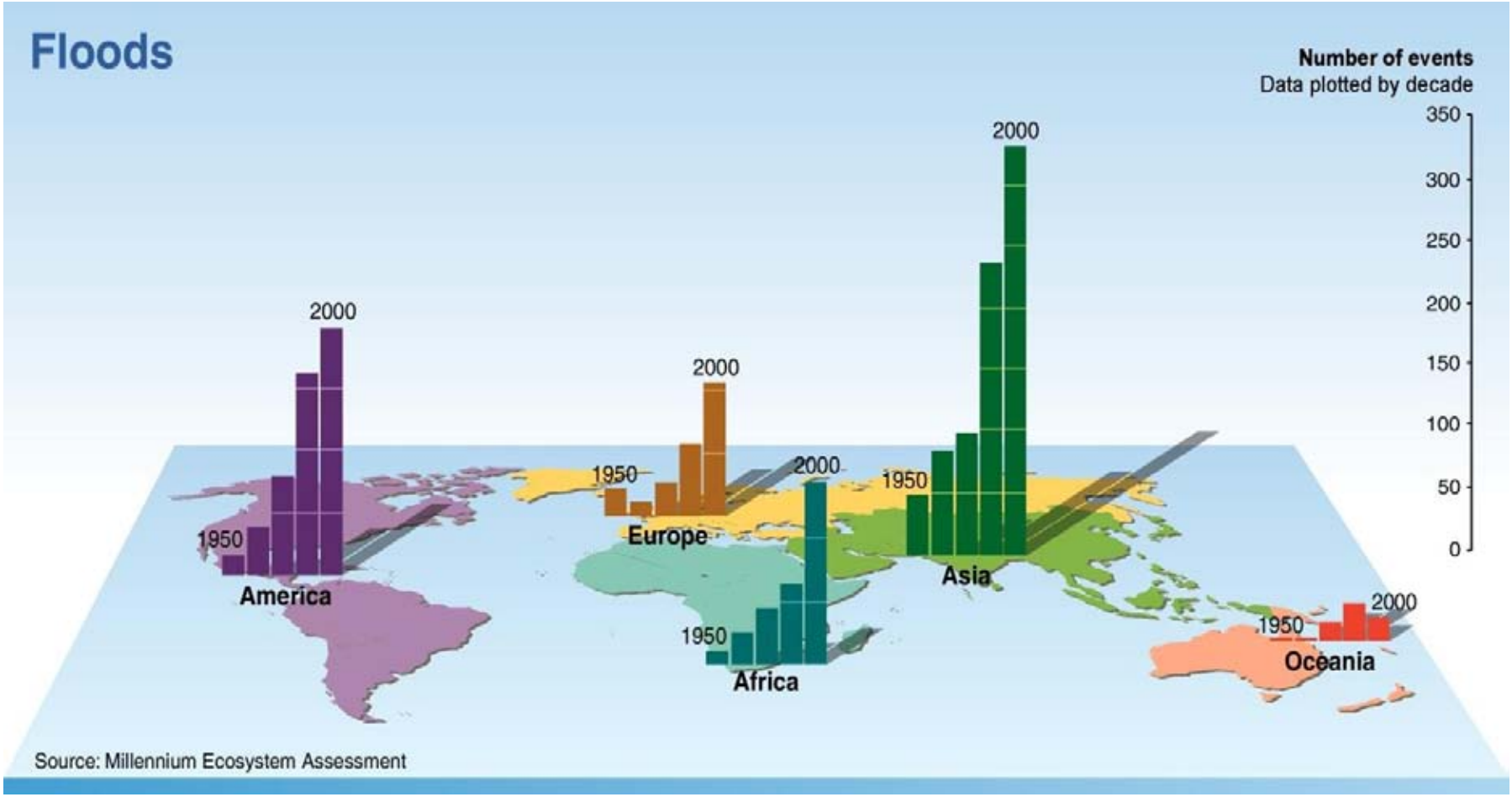

# Störningar

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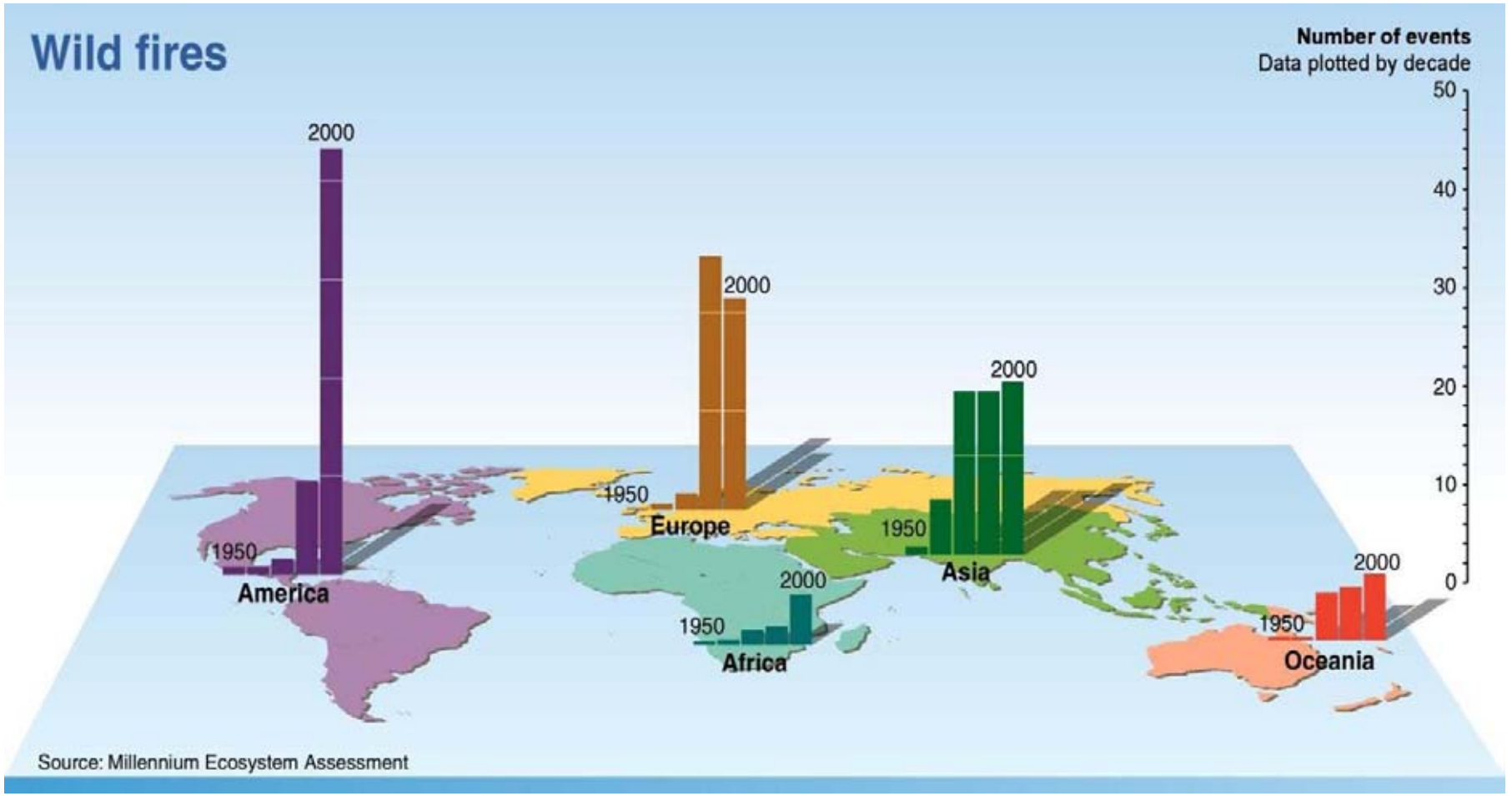

# Changing patterns of disturbance
(Canada's forests [1920 –1995])

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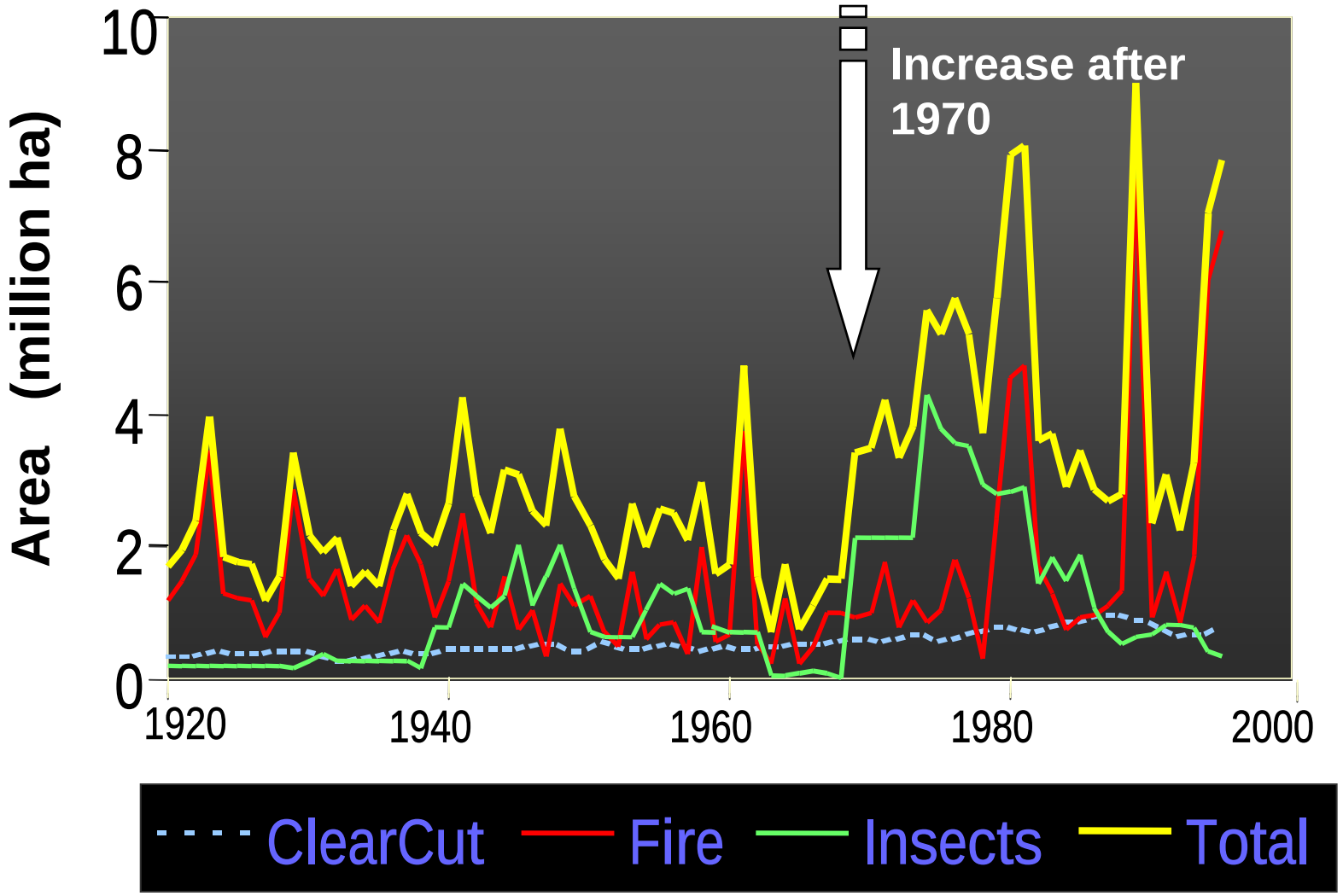



Source: Kurz & Apps 1999

Skog

Gräsmarker/savann

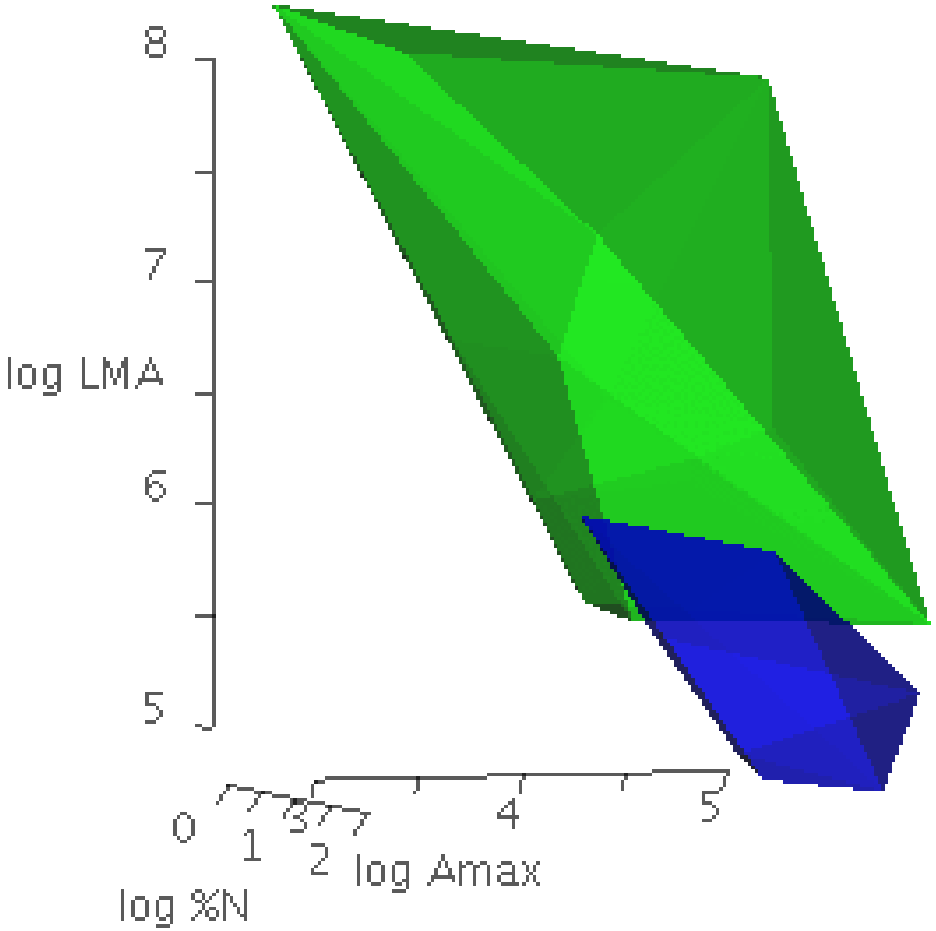




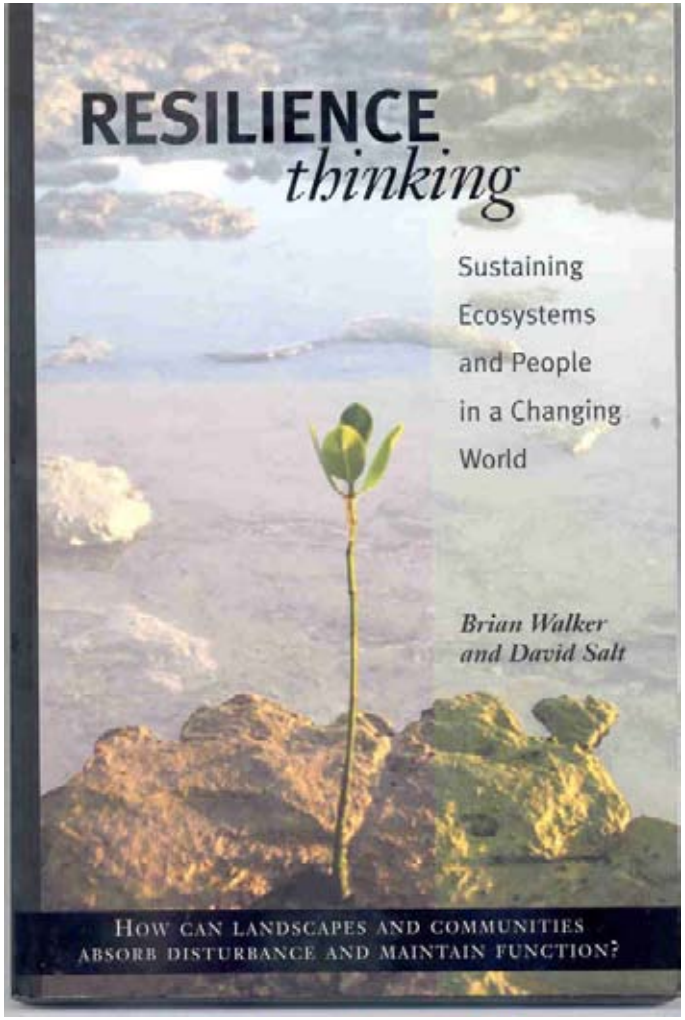





All Natives vs. All Agricultural Plants




Lin et al.




- förmåga att absorbera störningar och förnyas, upprätthålla samma struktur, funktion och identitet
- förmåga till lärande och anpassning

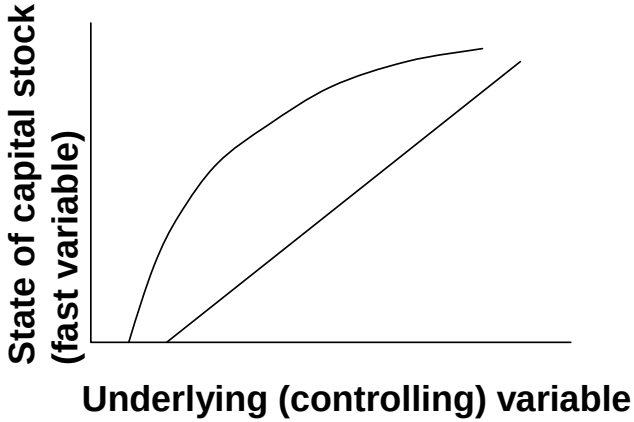
www.resalliance.org

# Resiliensbegreppet

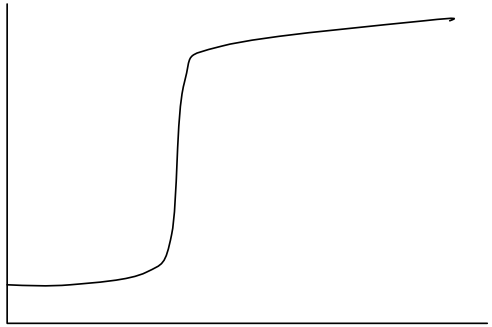
- betonar gränser för förändring
- att passera en tröskel kan vara irreversibelt (ur ett praktiskt perspektiv)
- förändring sker på en skala men kan orsaka att ett tröskelvärde passeras på en annan skala

# Typer av tröskelvärden och alternativa tillstånd

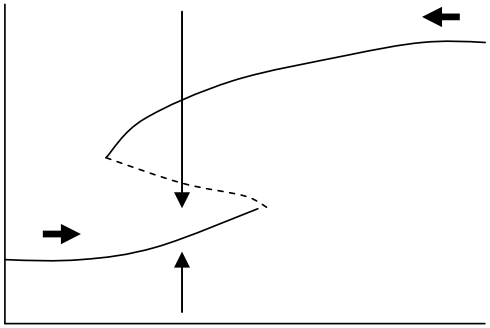
(a) **No threshold effect**



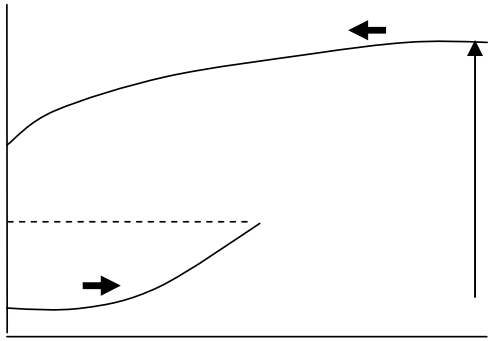

(b) **threshold, no alternate attractors**



(c) **threshold, alternate stable states**

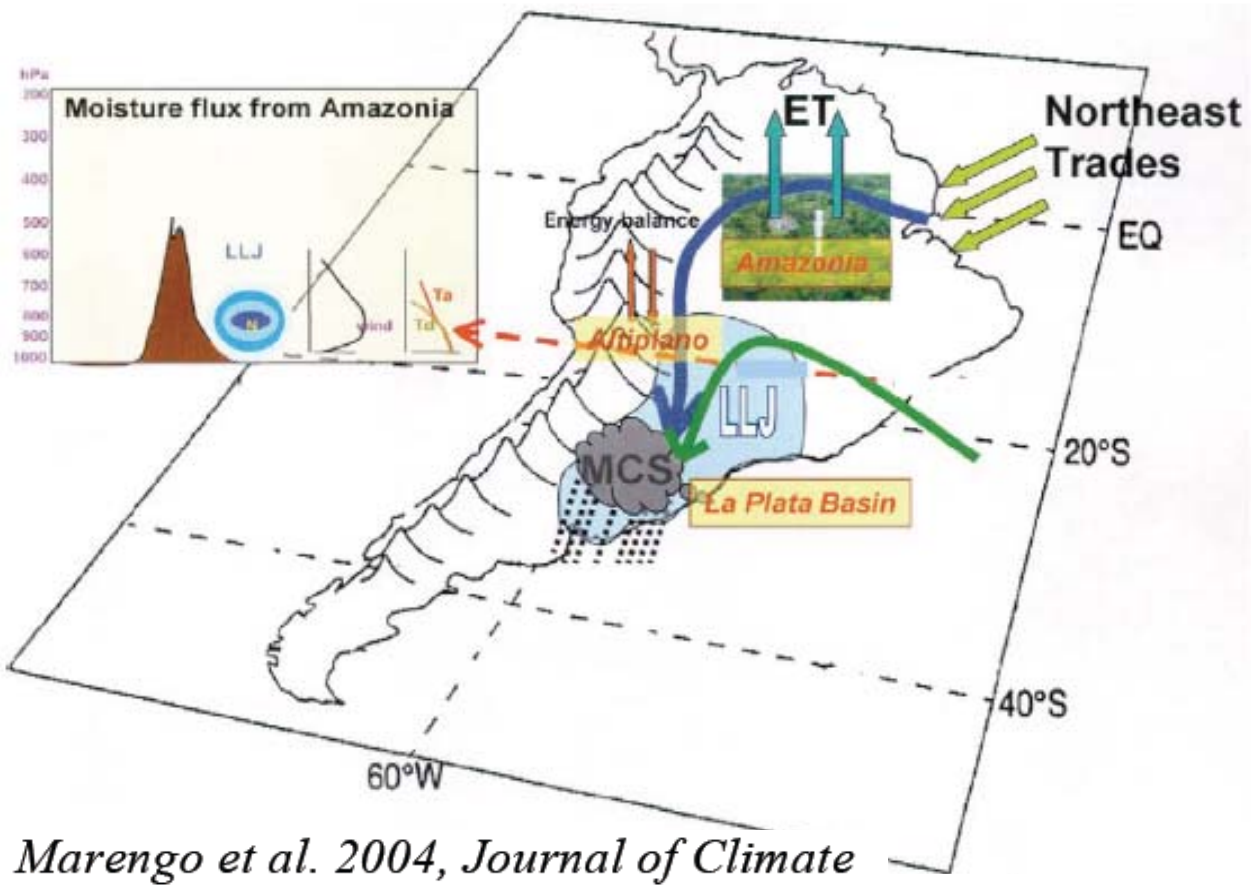


(d) **irreversible threshold change**



Walker and Salt 2006

# Agricultural Dependence on Conservation of Amazonas Ecosystem




*Marengo et al. 2004, Journal of Climate*

## Amazon Rainforest "Water Pump"

**Evapo-transpiration puts 20 billion tonnes of water into the atmosphere daily, some of which falls as rain in the Rio Plata Basin…**

*(Global Canopy Programme & Canopy Capital Ltd, 2008)*

*A Trillion-dollar agricultural economy in Latin America (Mato Grosso/ Brazil, Argentina, Uruguay, Paraguay ) depends on this "Water Pump"*

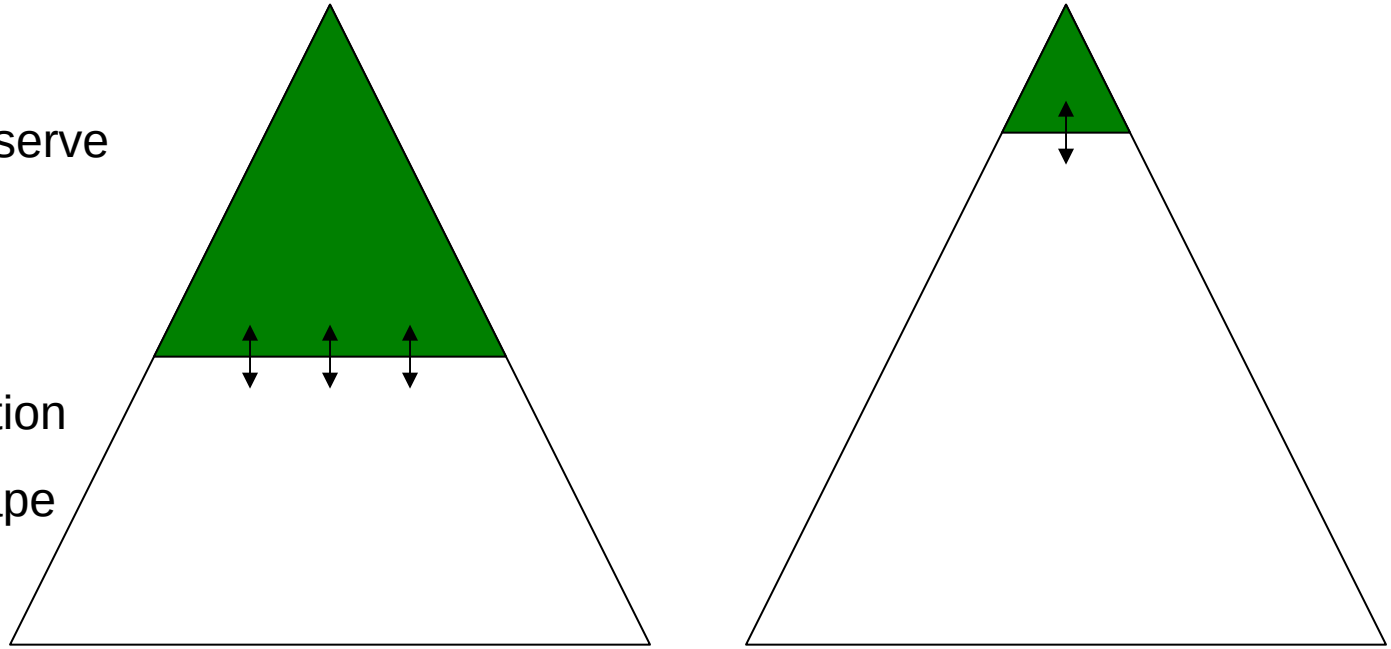
# Reservatens roll för att bygga resiliens i landskapet

# " Ideal"

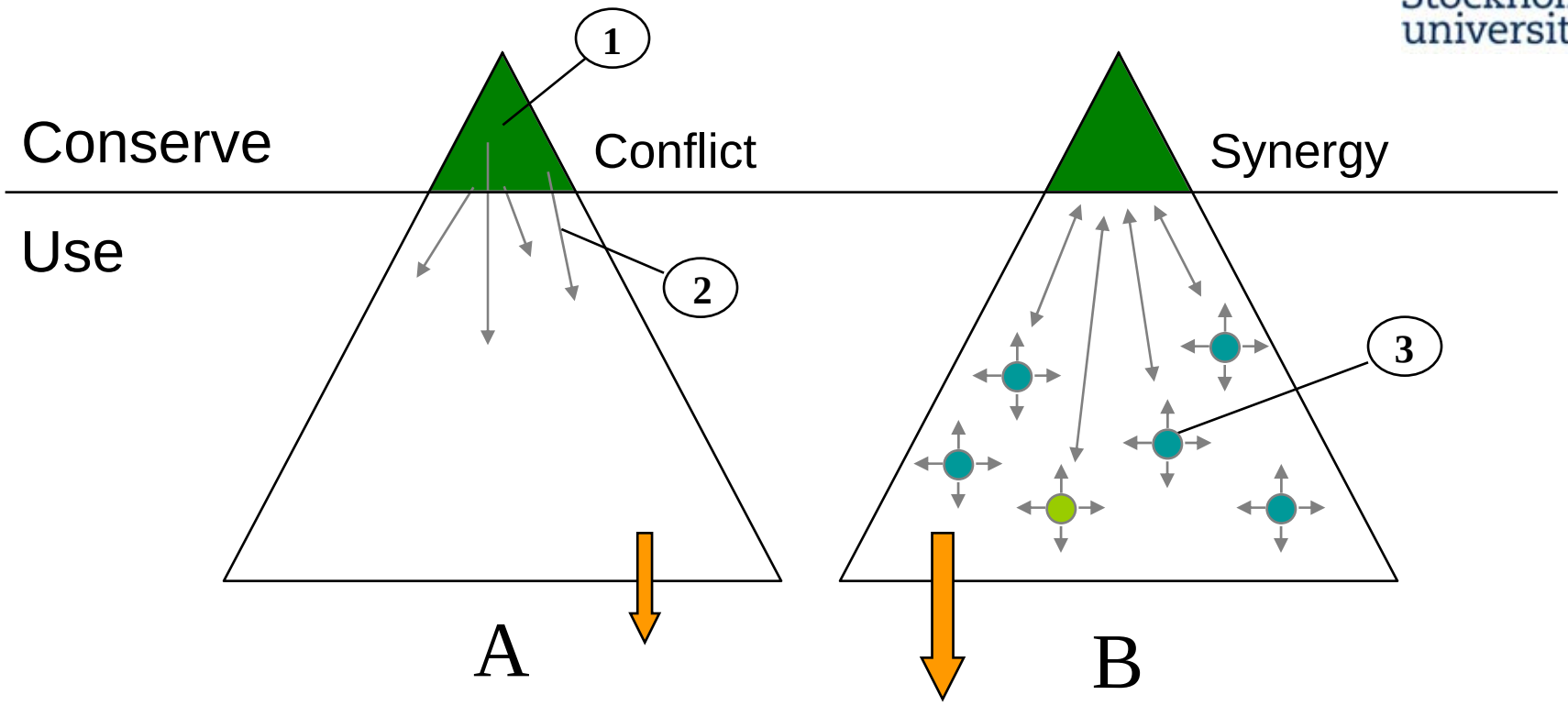
# Present

Preserve

Production landscape



Bengtsson et al 2003




# Ecosystem Services

Bengtsson et al. 2003

# Resilienstänkande i praktiken


- *Upprätthåll diversitet*
- *Upprätthåll modularitet*
- Korta återkopplingsmekanismer
- Bygg socialt kapital
- *Uppmuntra experiment och innovation*
- Bygg överlapp i ”governance”

www.stockholmresilience.su.se

# Diversitet

## Effects of biodiversity on the functioning of trophic groups and ecosystems

Bradley J. Cardinale[1], Diane S. Srivastava[2], J. Emmett Duffy[3], Justin P. Wright[4], Amy L. Downing[5], Mahesh Sankaran[6] & Claire Jouseau[7]

Over the past decade, accelerating rates of species extinction have prompted an increasing number of studies to reduce species diversity experimentally and examine how this alters the efficiency by which communities capture resources and convert those into biomass[1,2]. So far, the generality of patterns and processes observed in individual studies have been the subjects of considerable debate[3–7]. Here we present a formal meta-analysis of studies that have experimentally manipulated species diversity to examine

consequences of biodiversity loss are likely to be idiosyncratic, differing quantitatively and qualitatively between trophic groups and ecosystems[20–23].

After more than a decade of research, a sufficient number of studies have now emerged to permit rigorous testing of whether there are indeed general effects of biodiversity on ecosystem functioning. Here we present a formal meta-analysis of 111 field, greenhouse and laboratory experiments that have manipulated the diversity of species for a

Nature, 443: 989-992 (2006)

"…our finding that key aspects of ecosystem functioning decline consistently with the average species loss suggests that a precautionary approach to preserving as much biodiversity as possible is warranted."

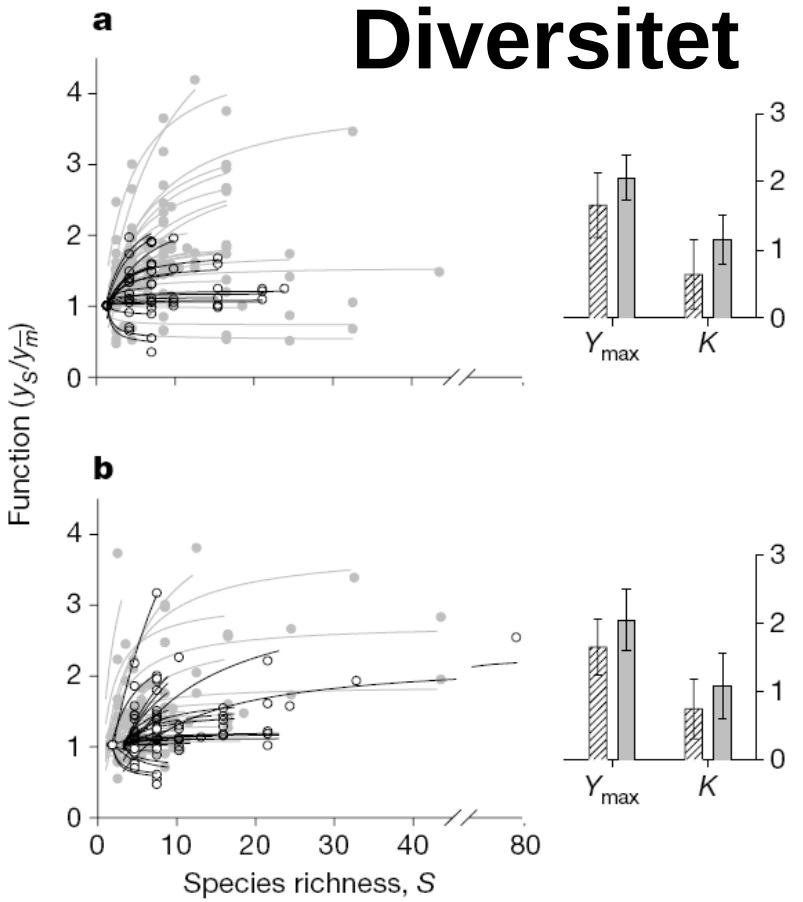
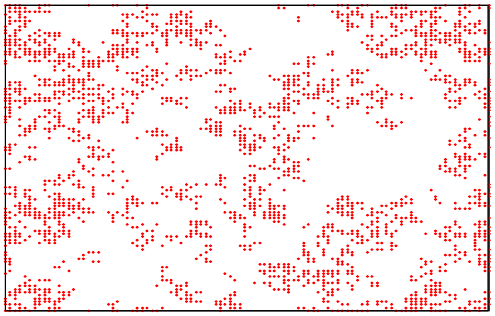
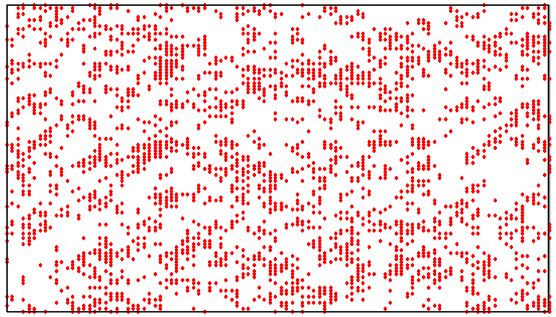


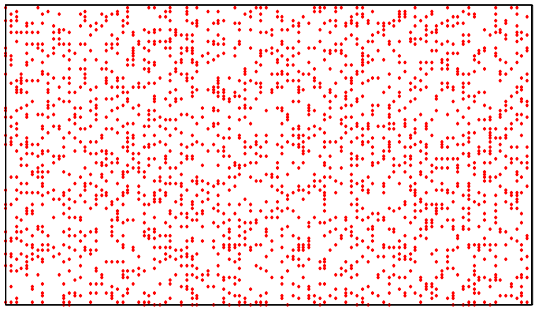

**Figure 2 | The general form of the diversity–function relationship.** Effects of species richness on the standing stock abundance or biomass of trophic group $t$ (**a**), and the depletion of resources consumed by $t$ (**b**). Each curve corresponds to data from a single study fitted to $Y = Y_{max}S/(K + S)$, where $Y$ is the proportional change in the dependent variable with increasing richness $S$, $Y_{max}$ is the asymptotic estimate of $Y$, and $K$ is the value of $S$ at which $Y = Y_{max}/2$. Sample sizes are 18 and 27 aquatic (black circles and lines), and 37 and 23 terrestrial studies (grey circles and lines) in **a** and **b**, respectively. Insets show the mean and 95% CI for the maximum-likelihood parameter estimates (hatched, aquatic; grey, terrestrial).

# Modularitet

Increased robustness







**High modularity**
**Low connectivity**
(highly connected locally)

**Intermediate modularity**

**Low modularity**
**High connectivity**
(highly connected globally)

Intermediate modularity assumed to contribute to the robustness of an ecosystem by limiting the spread of e.g. disturbances or disease
(e.g. May 1972, Pimm 1979, Rozdilsky et al. 2004, Teng & McCann 2004, Webb and Bodin 2008).

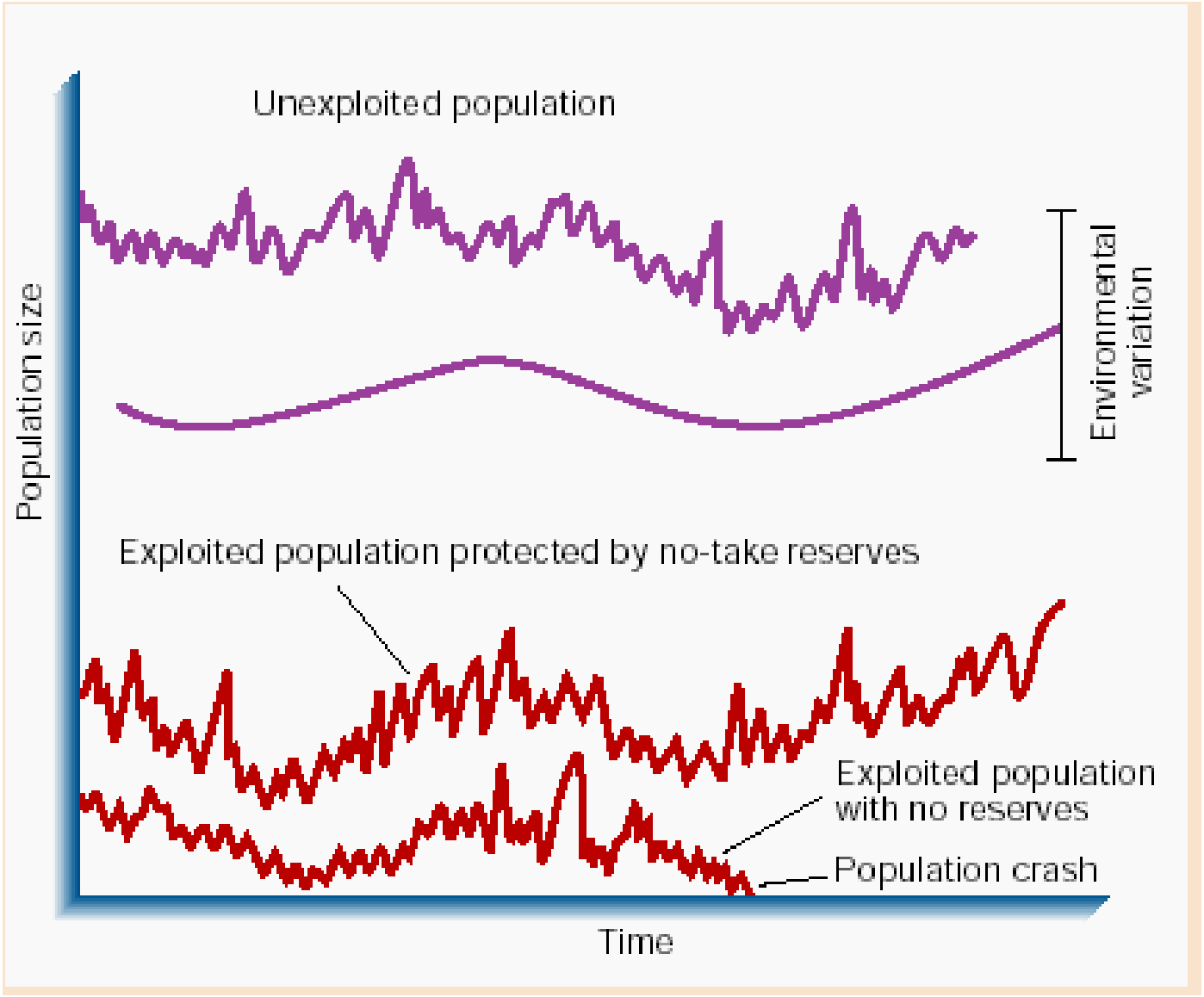
Montoya, J. M., Pimm, S. L., & Sole´, R. V. (2006). Ecological networks and their fragility. Nature, 442, 259–264.

# Experiment

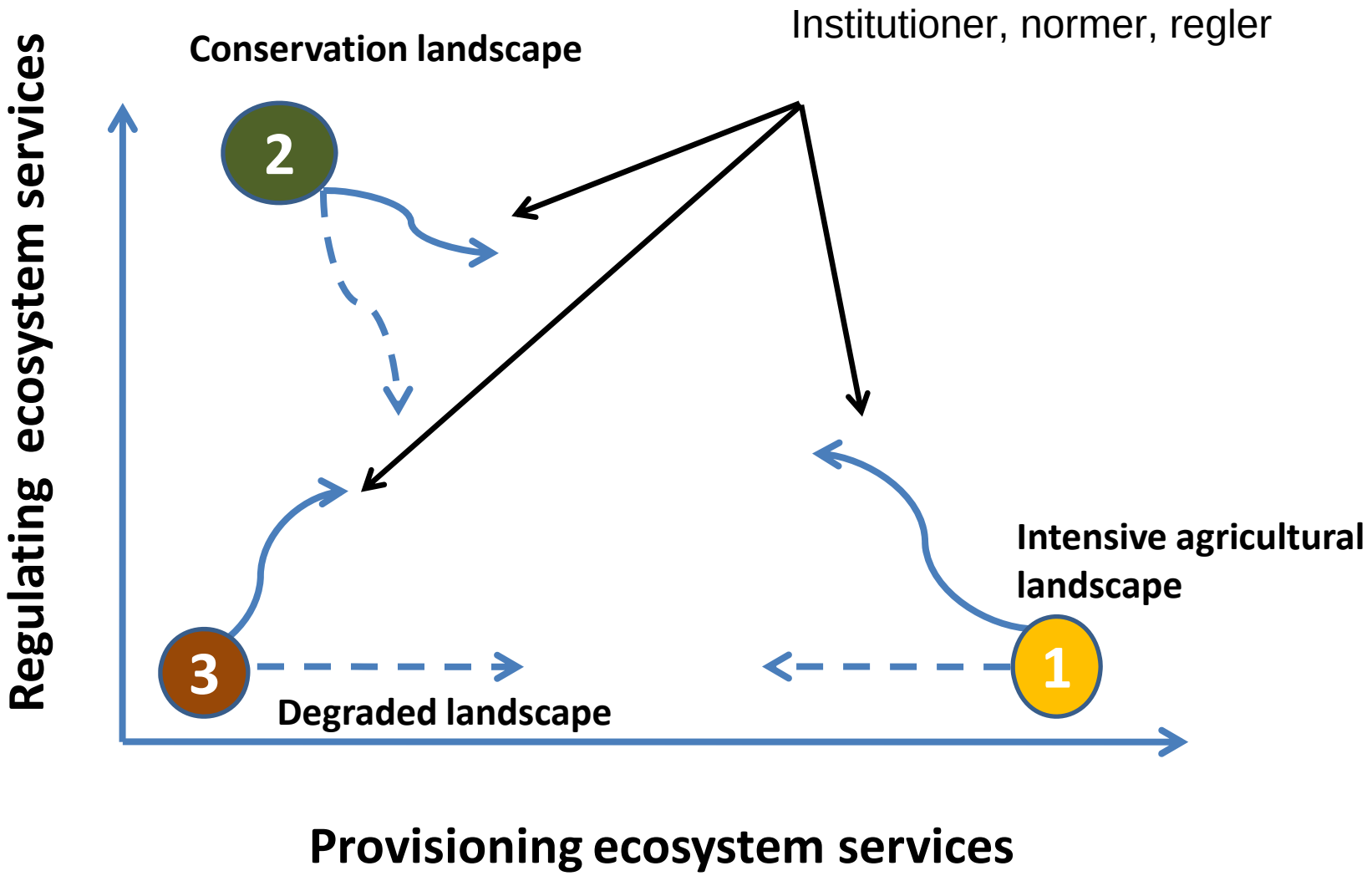
## Box 2
## Potential design of a social component of a biodiversity enhancement experiment

- Form an advisory group for each forest garden that would represent different stakeholders (e.g., forest scientist, social scientist, forest industry representative, forest owner representative, conservation representative, and community representative).
- Measure social variables to assess local perceptions of risk.
- Forest owners should design their own experiments associated with each experimental garden, based on their own experience and concerns about risks.

Chapin et al. 2007




Pauly et al. 2002, Nature vol 418


Institutioner, normer, regler
Conservation landscape
2
Intensive agricultural landscape
1
3
Degraded landscape
Regulating ecosystem services
Provisioning ecosystem services

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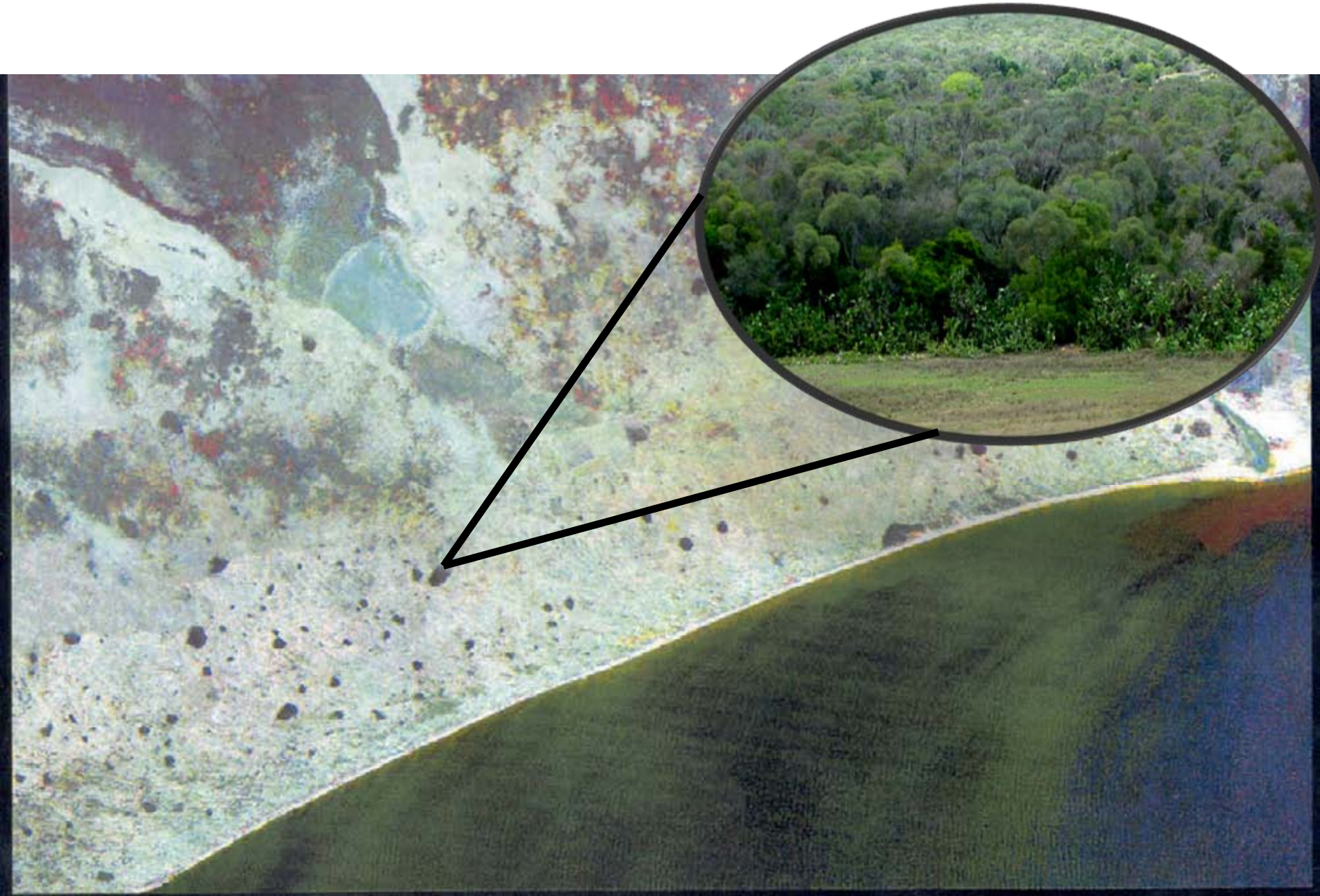
"Building *resilience thinking* into policy and practice will be a major task for all of the world's citizens throughout the new century".

UN Secretary General, September 24, 2007

# Androy, Southern Madagascar



# Spatial Network Analyses

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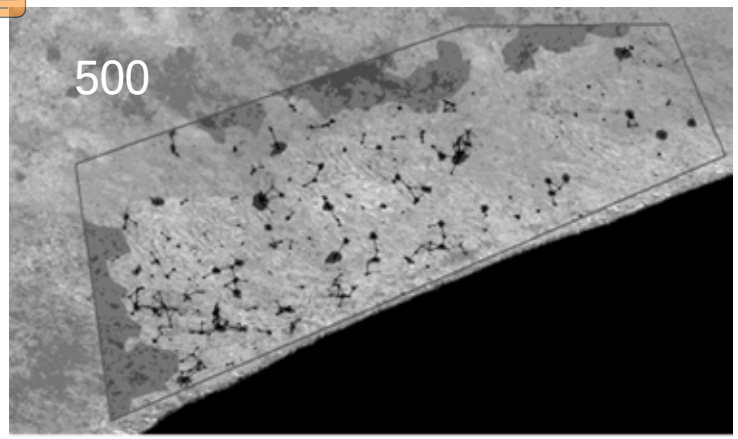
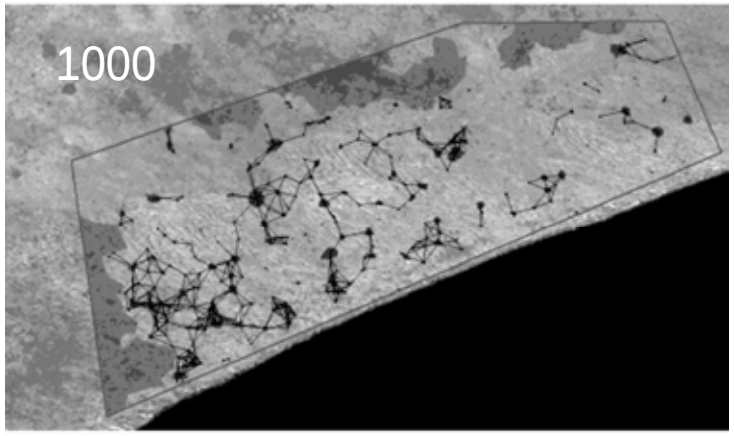
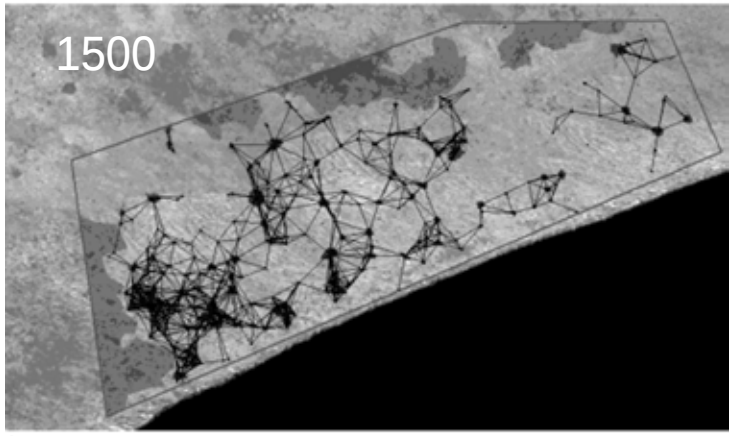
## Removal of patches – thresholds in spatial structure



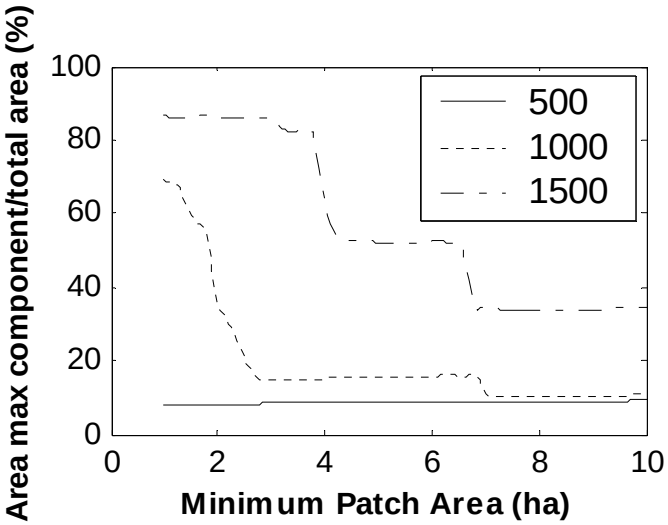

a




b




c




Bodin et al. 2006

# TEEB Message to EU policy-makers:

- Continued loss of biodiversity and ecosystem services represent an annual global loss of welfare equivalent to **7 % of GDP** up to 2050
- A need for an urgent reform of national income accounting, incl.
  - Mapping the stock of natural capital in Europe
  - Develop indicators of ecosystem services to measure flow and trajectories
- Benefit/cost ratio of restoration of degraded ecosystems often very high, **but** in some cases degradation is practically irreversible