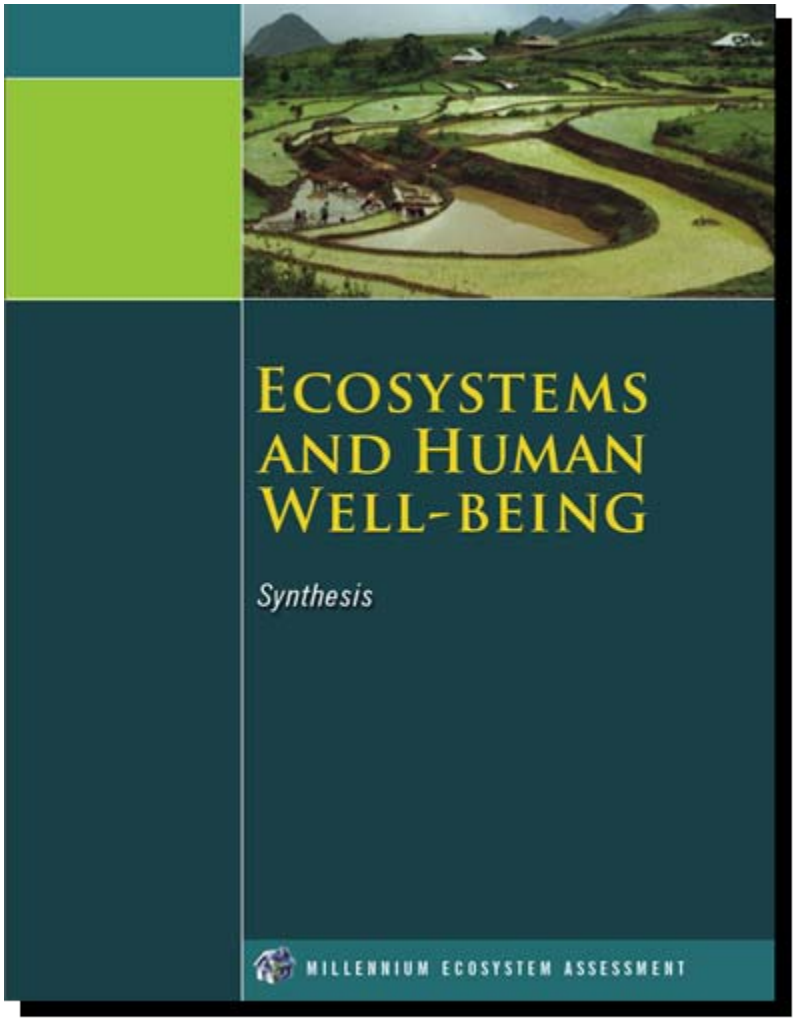
The Ecosystem Approach

BESSA training workshop, ICRAF, March 23-April 3, 2009

Millennium Ecosystem Assessment

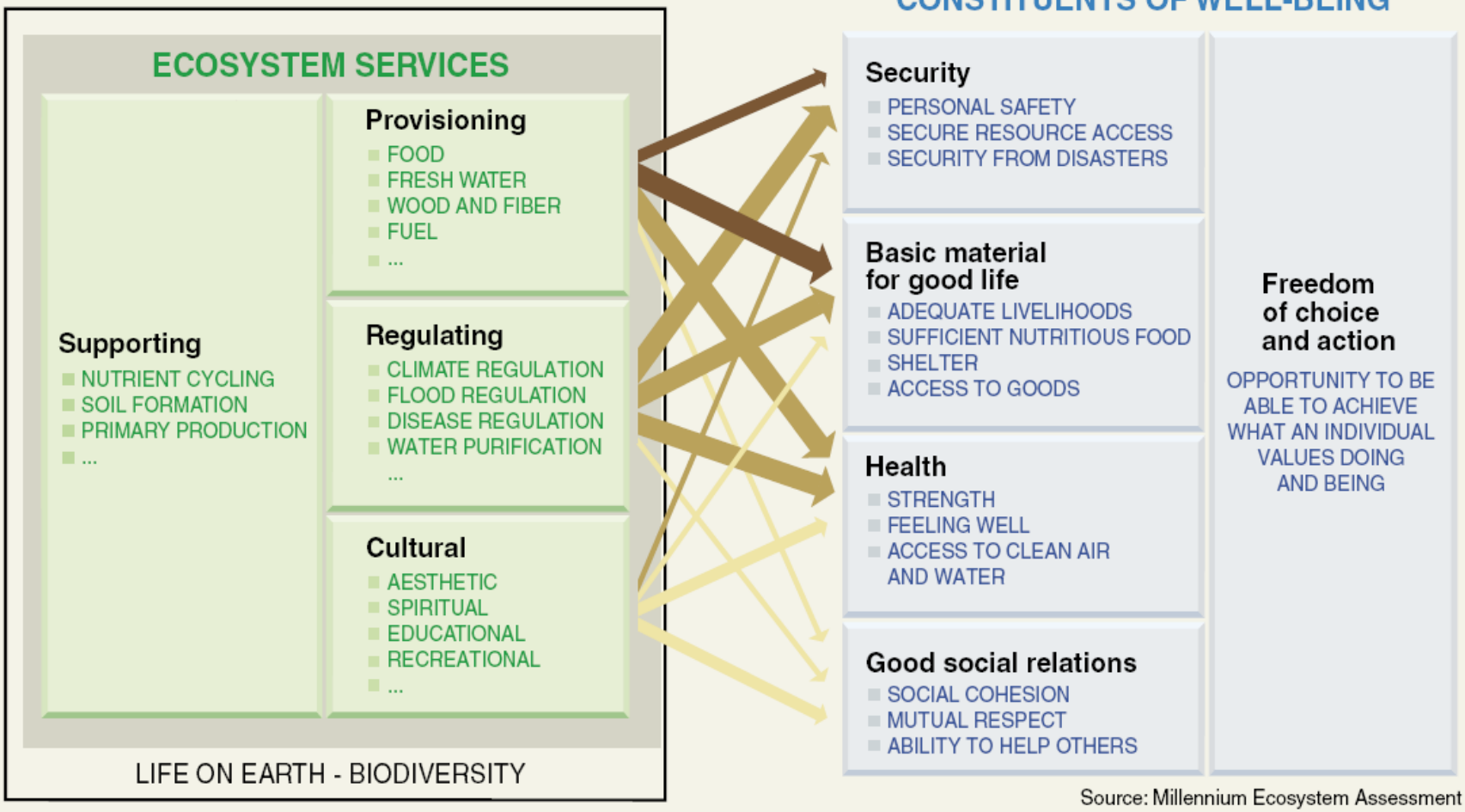


- Over the past 50 years, humans have changed ecosystems faster than at any other time
- Significant increases in human well-being, but at expense of ecosystem degradation
- Degradation is getting worse, and is a barrier to achieving MDGs
- Challenge is to reverse ecosystem degradation while meeting increased demands for services
- Need for policies, institutions & practices to reduce negative tradeoffs, and/or provide positive synergies

Millennium Ecosystem Assessment

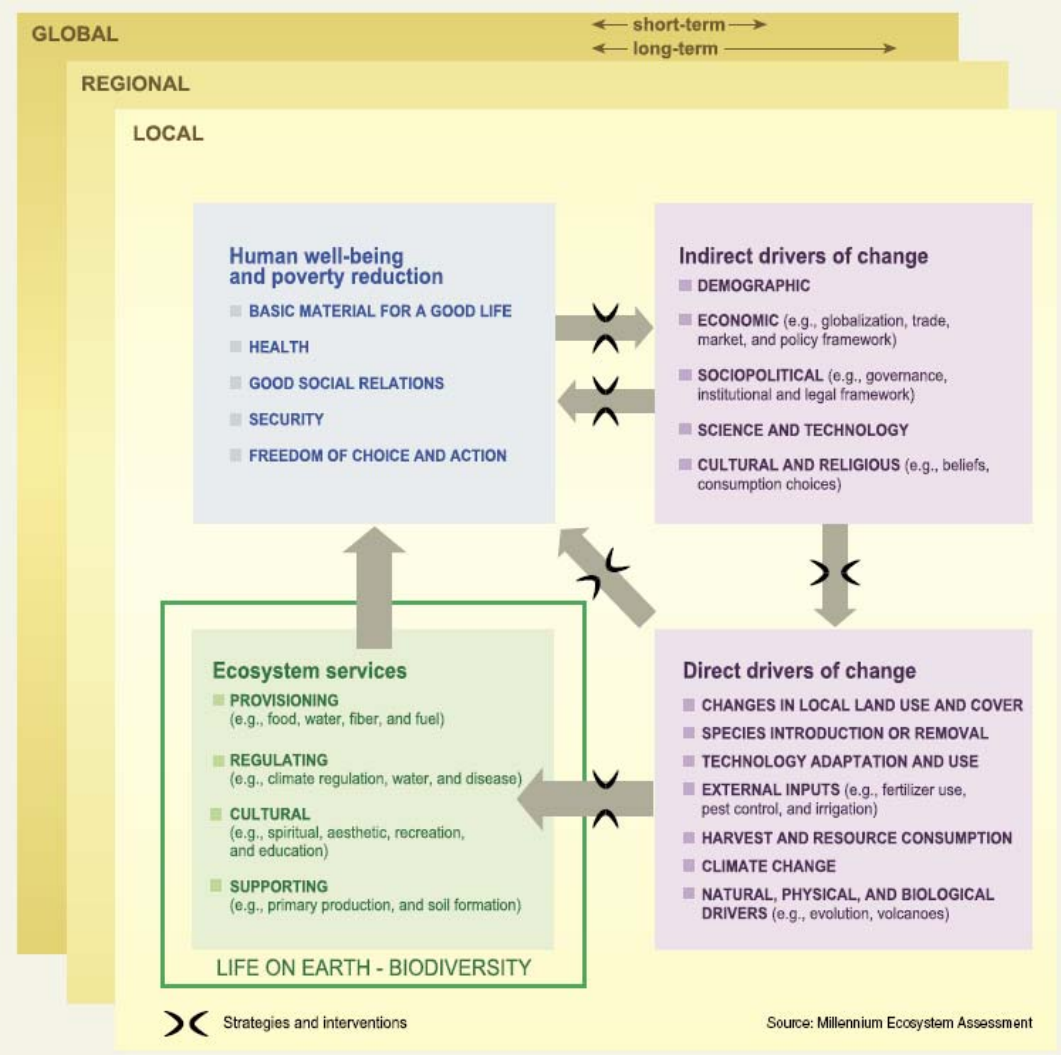
- Thresholds may be reached, beyond which change is irreversible
  - Disease
  - Water quality
  - Eutrophication
  - Fisheries collapse
  - Shifts in regional climate
- Changes are being borne disproportionately by the poor
  - Greater inequity
  - Social conflict
  - Poverty
- Use of ecosystem services often influenced by markets – non-market services ‘taken for granted’ – not valued explicitly

Ecosystem Services framework



Source: Millennium Ecosystem Assessment

Coupled human-ecological systems



The Ecosystem Approach

- Strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way
- Encompass the essential structure, processes, functions and interactions among organisms and their environment
- Humans, with their cultural diversity, are an integral component of many ecosystems
- Adaptive management to deal with the complex and dynamic nature of ecosystems – non-linear, time-lags, discontinuities
- No single way to implement the Ecosystem Approach – depends on local context

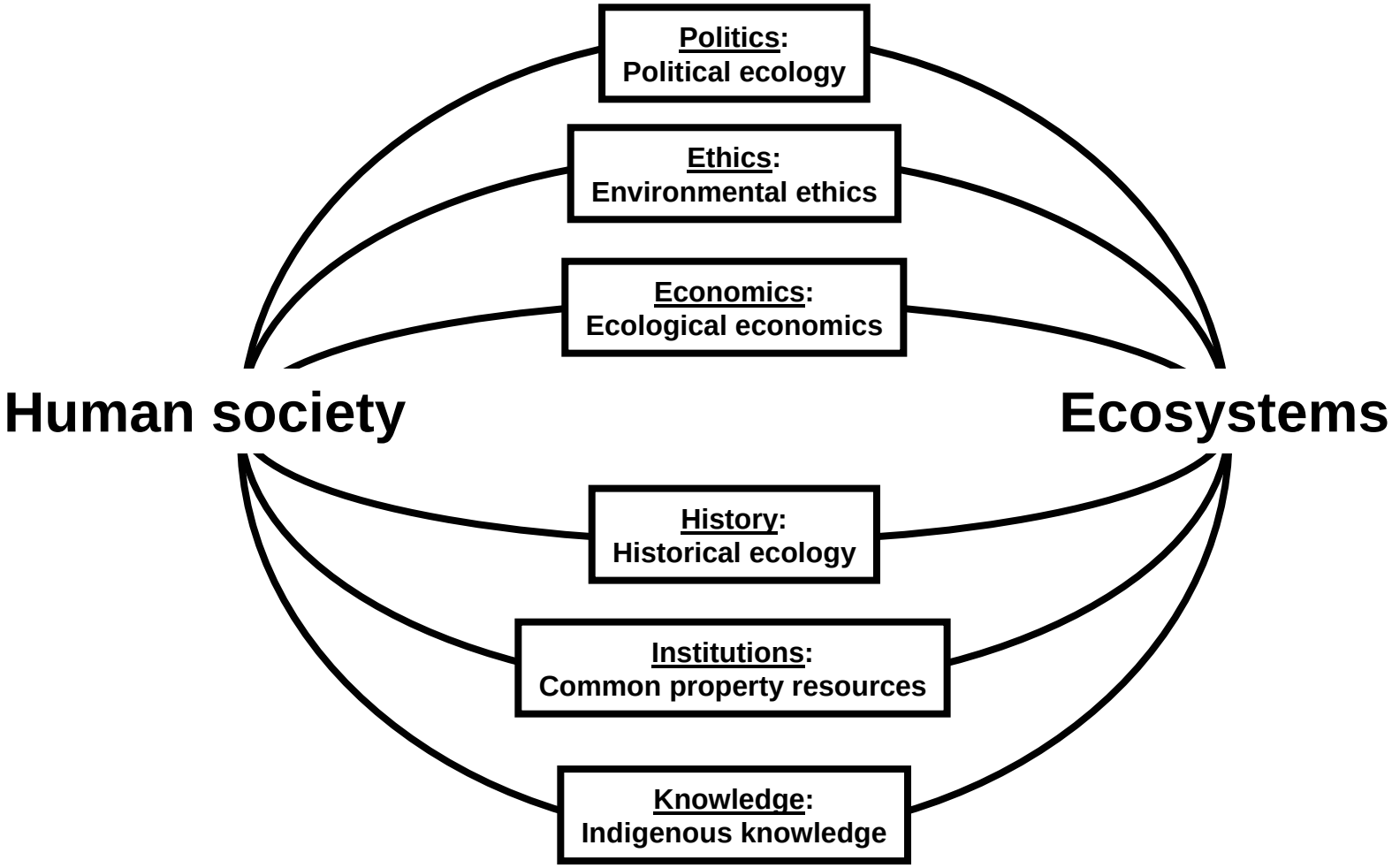
12 EA principles

1. The objectives of management of land, water and living resources are a matter of societal choices
2. Management should be decentralized to the lowest appropriate level
3. Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems
4. Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should:
   a. Reduce market distortions that adversely affect biological diversity
   b. Align incentives to promote biodiversity conservation and sustainable use
   c. Internalize costs & benefits in the given ecosystem
5. Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach

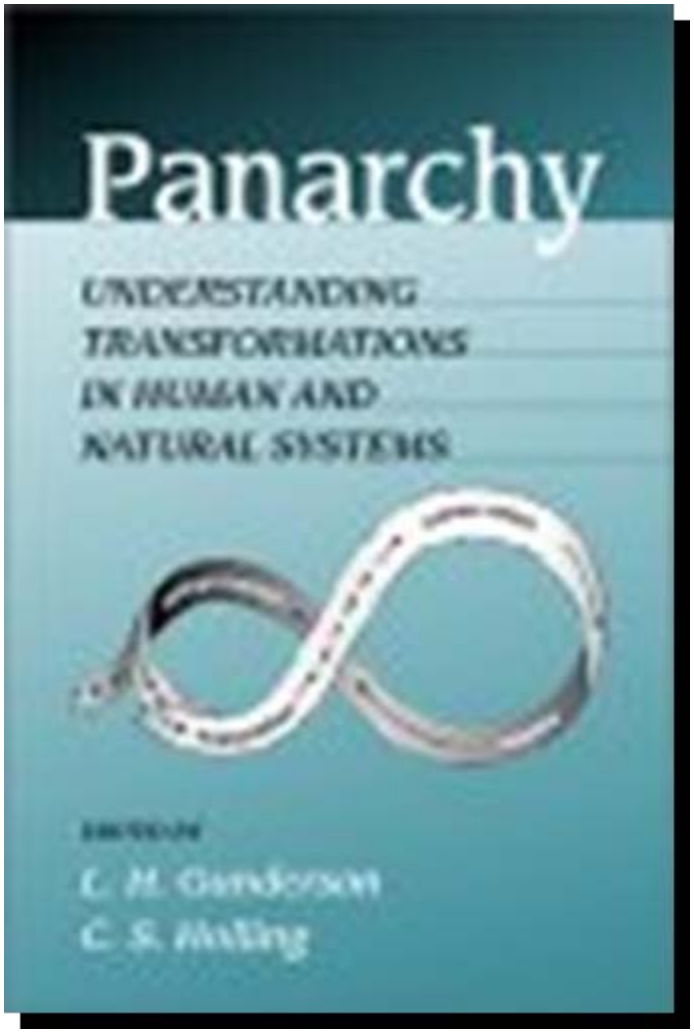
12 EA principles

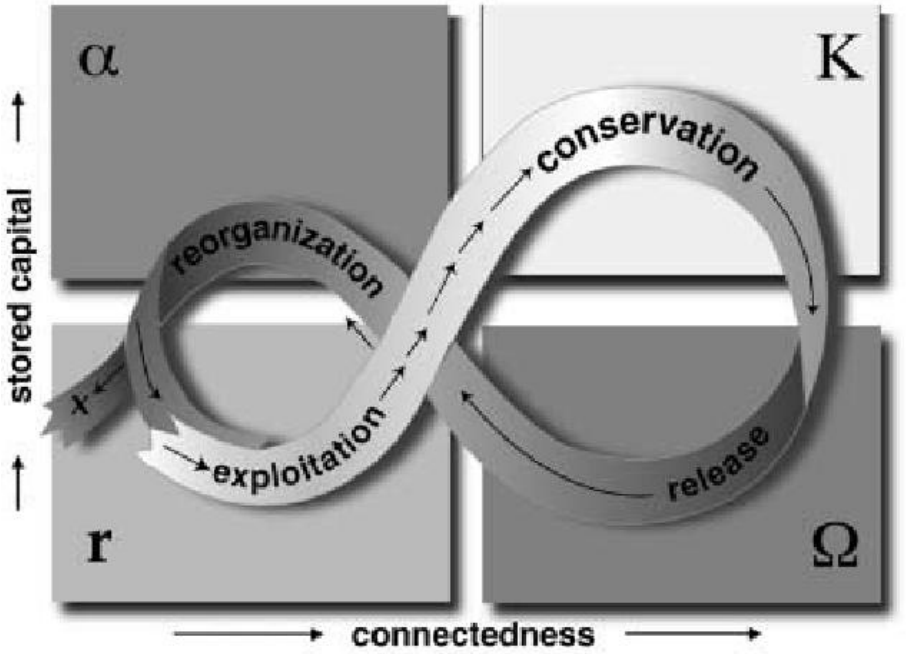
6. Ecosystem must be managed within the limits of their functioning
7. The EA should be at the appropriate spatial and temporal scales
8. Recognizing varying temporal scales and lag-effects, objectives for ecosystem management should be set for the long term
9. Management must recognize the change is inevitable
10. Appropriate balance between, and integration of, conservation and use of biological diversity
11. Consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices
12. Involve all relevant sectors of society and scientific disciplines

Socio-ecology



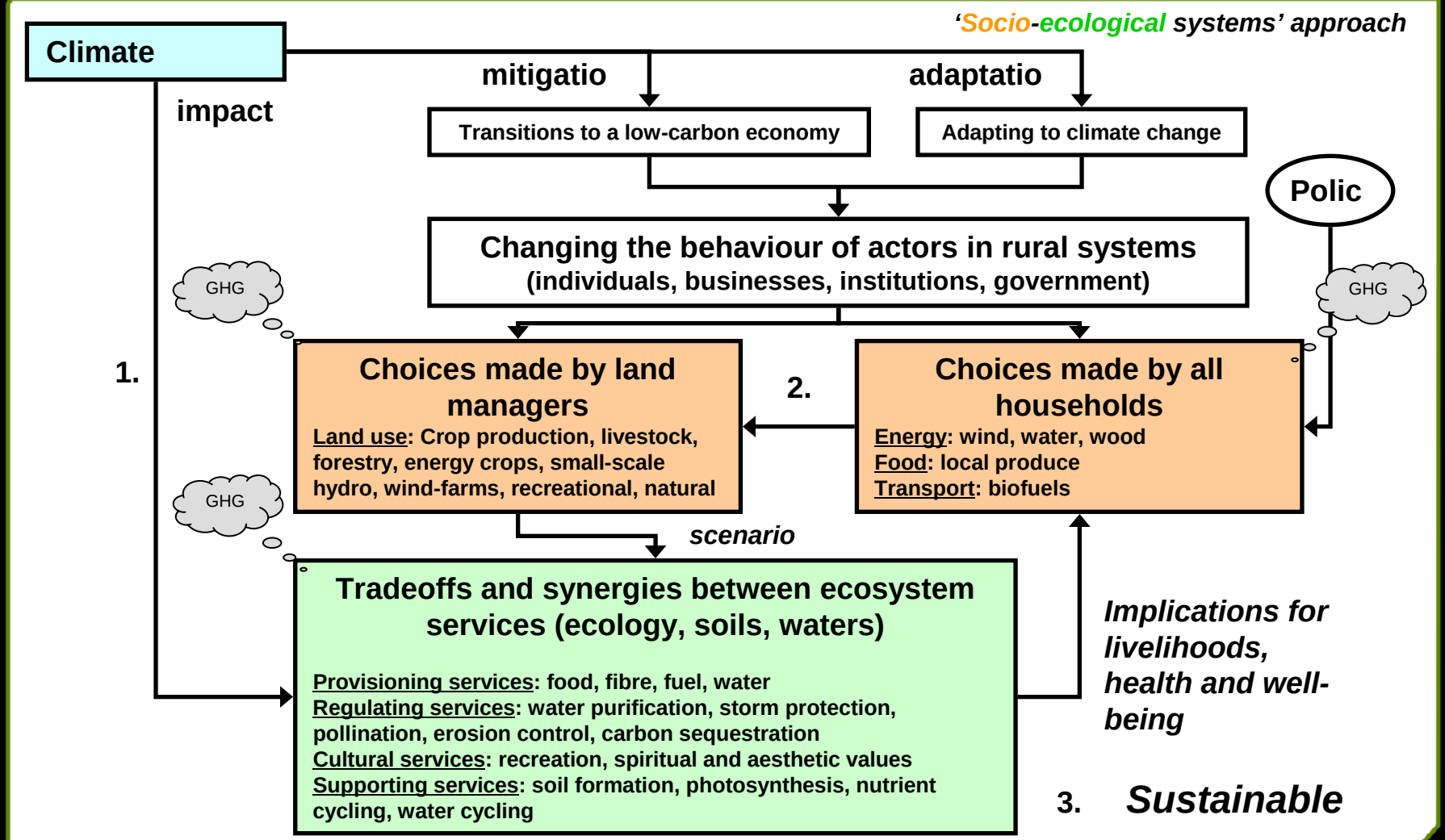
Human-environmental systems



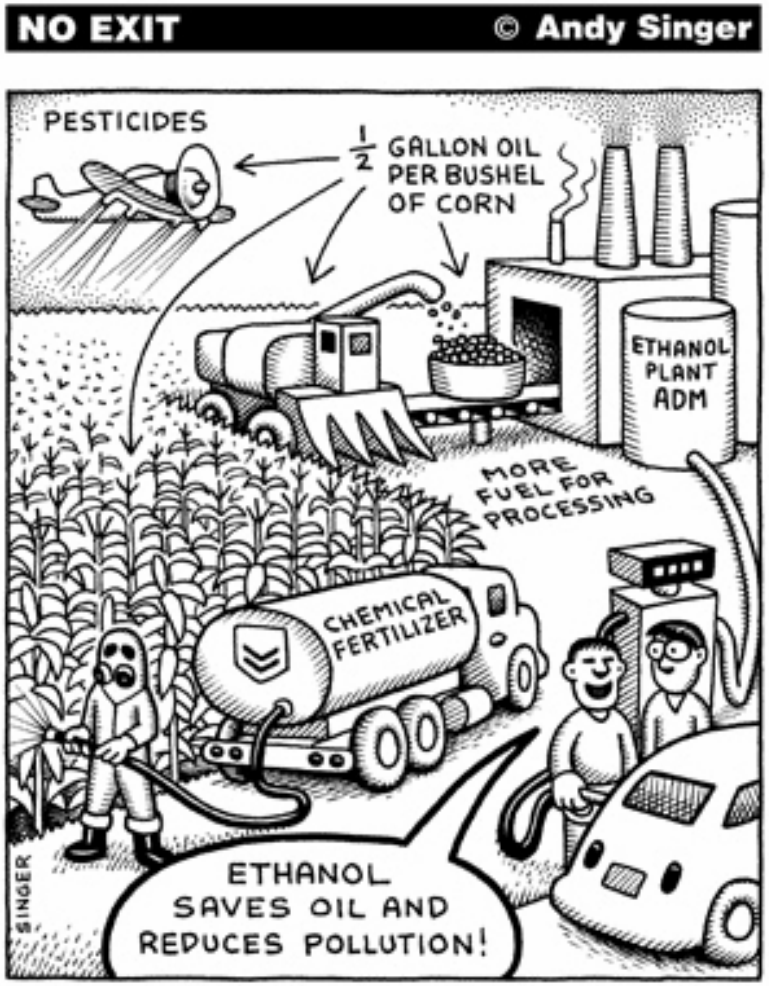


- Concepts of ‘capital’ and ‘connectedness’
- ‘Fast’ and ‘slow’ variables
- Interactions between different levels
- Multiple-equilibria systems
- Resilience
- Persistence and innovation

Socio-ecological processes



Are biofuels really green?



- **3-5% of N applied as fertiliser ends up in the atmosphere as N_2O**
- **Biodiesel from oilseed rape emits 1-1.7 times more GHGs than it saves through replacing fossil fuels**
  - ***Crutzen et al., 2007. Atmos. Chem. Chem. Phys. Discuss., 7:11191–11205.***

ESPA Programme
Ecosystem Services for Poverty Alleviation

- Millennium Ecosystem Assessment
- Joint initiative between
  - DFID (UK Department for International Development)
  - NERC (Natural Environment Research Council)
  - ESRC (Economic and Social Research Council)
- Three phases
  - Situation analyses
  - Capacity building/network establishment
  - Research projects

Situation analyses

- China
- Semi-arid sub-Saharan Africa
- Amazon basin & Andean catchment
- India-Hindu Kush-Himalayas
- Cross-cutting: urbanisation, marine/coastal

BESSA: Building Ecosystem Services for Semi-Arid Africa

BESSA training workshop, ICRAF, March 23-April 3, 2009

Objectives of the Project

1. Strengthen capacity to formulate research agenda, write successful proposals, manage research projects, use the outputs
2. Develop approaches, methods, tools, datasets & networks
3. Create a demand for research

Partners

- Macaulay Land Use Research Institute
- ICRAF
- University of Aberdeen
- University of York
- CEEPA, University of Pretoria
- Jomo Kenyatta University of Agriculture and Technology

Work plan

- Training workshop
- Case studies
- Exchange visits
- Follow-up workshop to write proposal for Phase II

Outputs

- Workshop summary
- Network of researchers on ecosystem services
- Journal article reviewing approaches and the limitations to capacity building in ecosystem services research
- Proposal for future funding

ESPA Situation Analysis for Arid and Semi-arid Africa

BESSA training workshop, ICRAF, March 23-April 3, 2009

Aims

- Which ecosystem services are important for the well-being of the poor?
- Trends & drivers of these ecosystem services?
- What capacity exists for ecosystem management?
- What knowledge gaps exist?
- What success stories are there from the region?

Important ecosystem services

- **Provisioning services**
  - Agricultural production – home consumption, income generation, safety-net (incl. livestock)
  - Energy: Fuelwood, hydropower?
  - Forest/agroforestry products?
  - Water – but water per capita has declined – pollution, invasive plants, wetland degradation, soil erosion
- **Regulating services**
  - Flooding, drought, poor air quality, degraded soils
  - C sequestration?
  - Human health?
- **Cultural services**
  - traditional norms, taboos and practices – ecosystem management
  - Ecotourism
  - Traditional medicine?
- **Supporting services**
  - Soil – nutrients (N, P, K)
  - biodiversity

Drivers of change

- Ultimate
  - Global markets
  - Population increase
  - Climate change
  - Governance
  - HIV/AIDS
  - Poverty itself?
  - Development/industrialisation?
- Proximate
  - Land use change
  - Lack of options?
  - Climate change/variability?
  - Changes in consumption habits?
  - Declining water quality?
  - Human health: malaria, HIV/AIDS
  - Overuse of resources
  - Urbanisation
  - Tourism

Capacity gaps

- Improving policy and institutional environment
- Resources, infrastructure?
- Limitations of skill base
- Capacity at district and local level
- Lack of integrated planning and management
- Capacity in civil society
- Capacity for monitoring
- Lack of action on climate change
- Capacity to manage selected ecosystem services for poverty alleviation
- Need to integrate local knowledge into research?

- Few scholarly networks to promote good social and ecological science, integrate science into policy-making

Research gaps

- Empirical data and methods to collect them
- Need to understand socio-ecological processes
- Need to promote knowledge development and knowledge sharing
- Monitoring to enable adaptive management

Conclusions

- Managing ecosystem services needs to be part of broader poverty alleviation initiatives
- Ecosystem management agencies need to consider poverty alleviation
- Social welfare and economic development agencies need to consider management of ecosystem resources
- Provisioning services a major component of livelihood strategies – need to strengthen and diversify
- Management of ecosystem resources will benefit all inhabitants in a region, especially the poor

Sustainability & resilience

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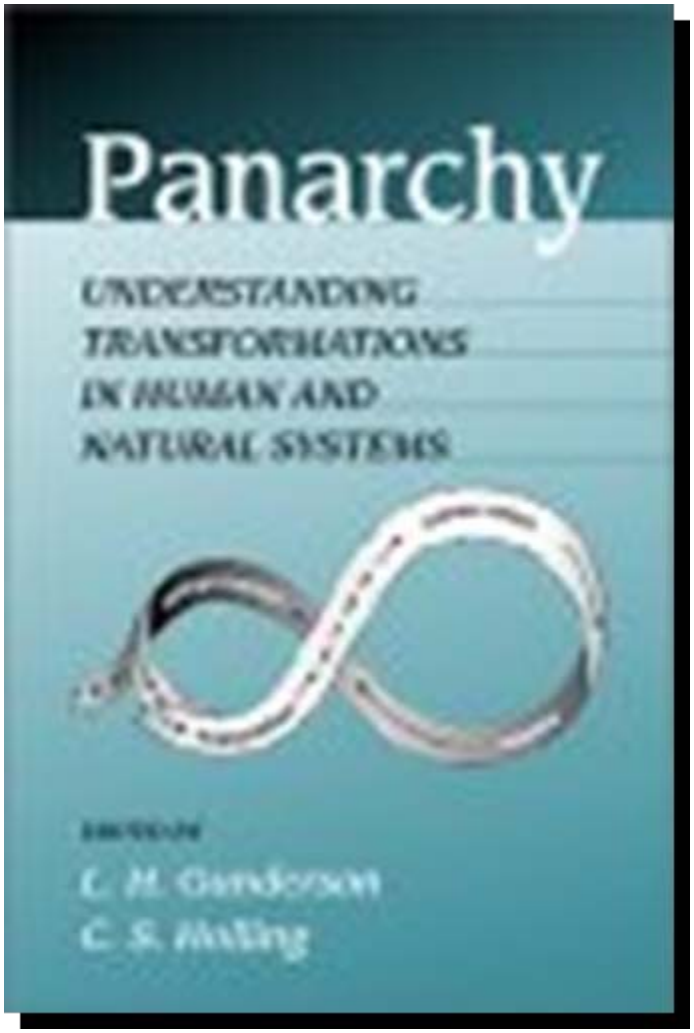
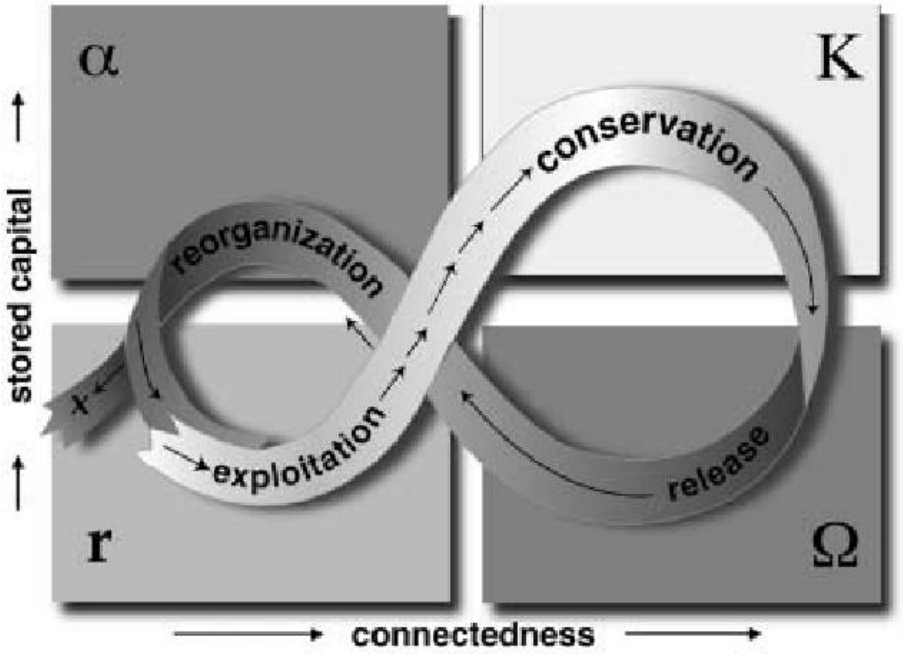
Adaptive cycles





- Concepts of ‘capital’ and ‘connectedness’
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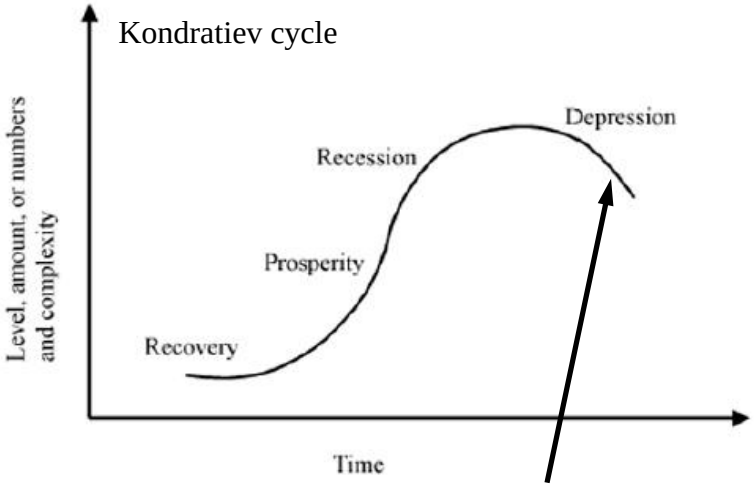
Economic cycles

Cycle	Approximate duration (years)
Kitchin, or business cycle	3–7
Juglar	8–10
Kuznets	15–25
Kondratiev	45–60

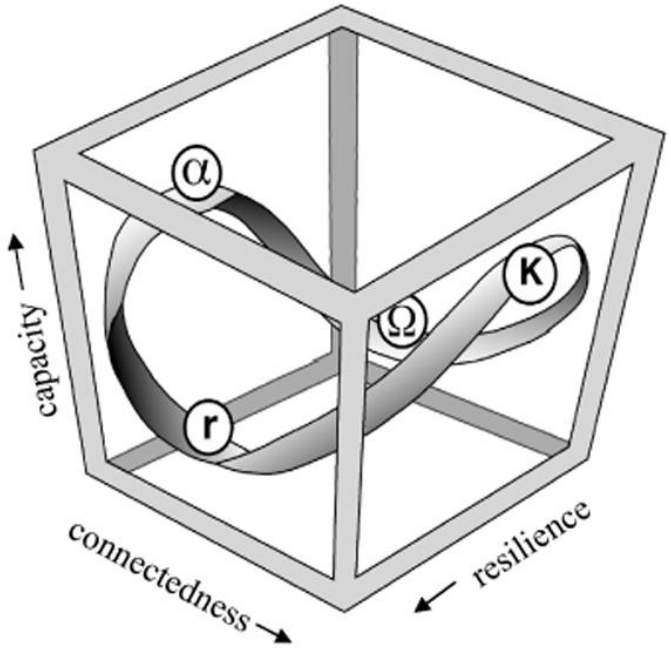
Kondratiev cycle



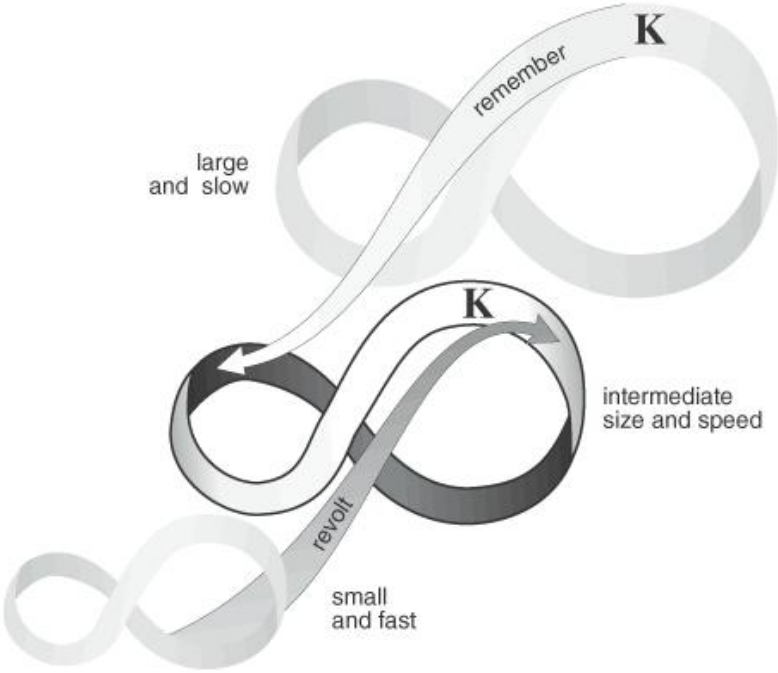
Kondratiev Cycle	Adaptive Cycle
Recovery	α–r
Prosperity	r–K
Recession	K–Ω
Depression	Ω– α

Schumpeter (1950): 'Creative destruction'

Resilience and scale interactions



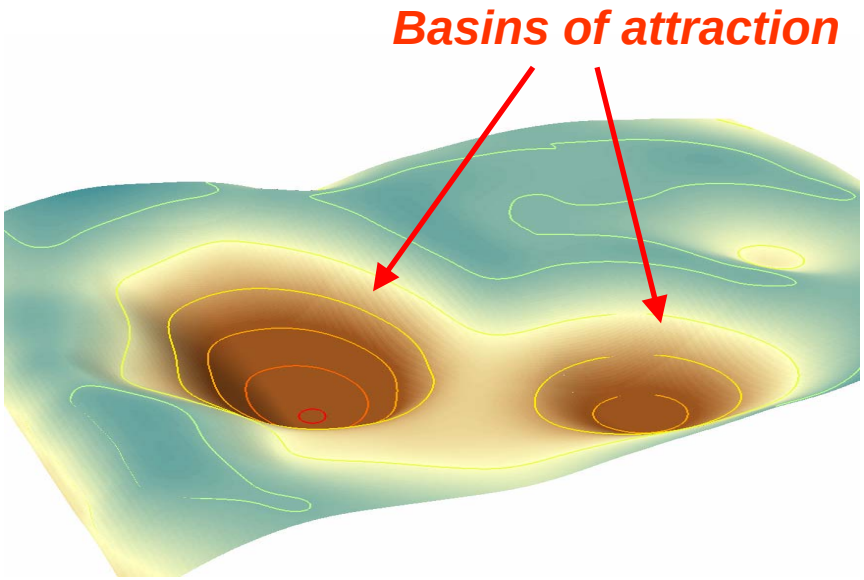
(from Allison & Hobbs, 2004)



(from Gunderson & Holling, 2001)

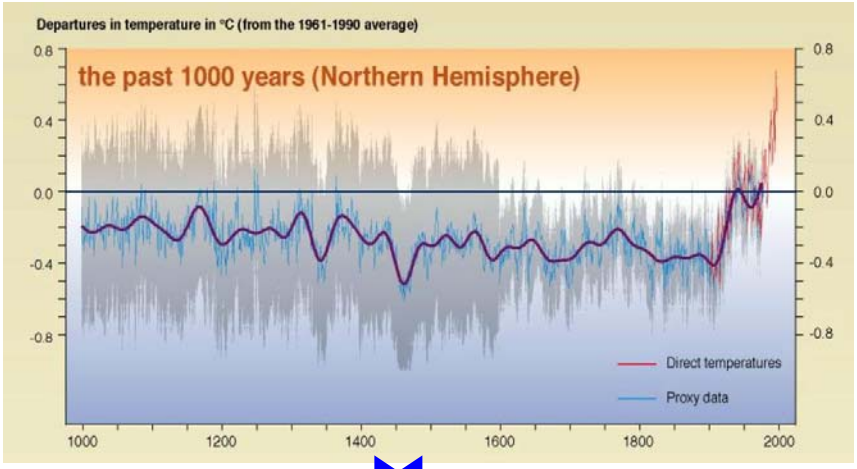
Resilience

- **<u>Engineering Resilience</u>: The capacity to resist a perturbation, or return to equilibrium after a shock**
- **<u>Ecological Resilience</u>: Capacity of a system to absorb perturbations and remain in functionally similar state**
- **‘Surprise’ perturbation may move system into another ‘basin of attraction’**

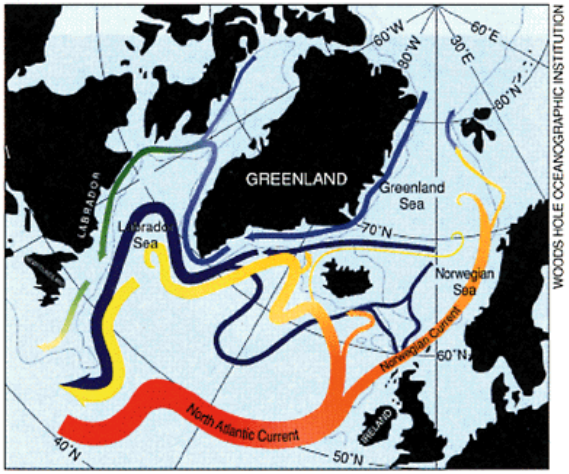


Mulga rangelands, Australia (Walker, 2002)

Surprises



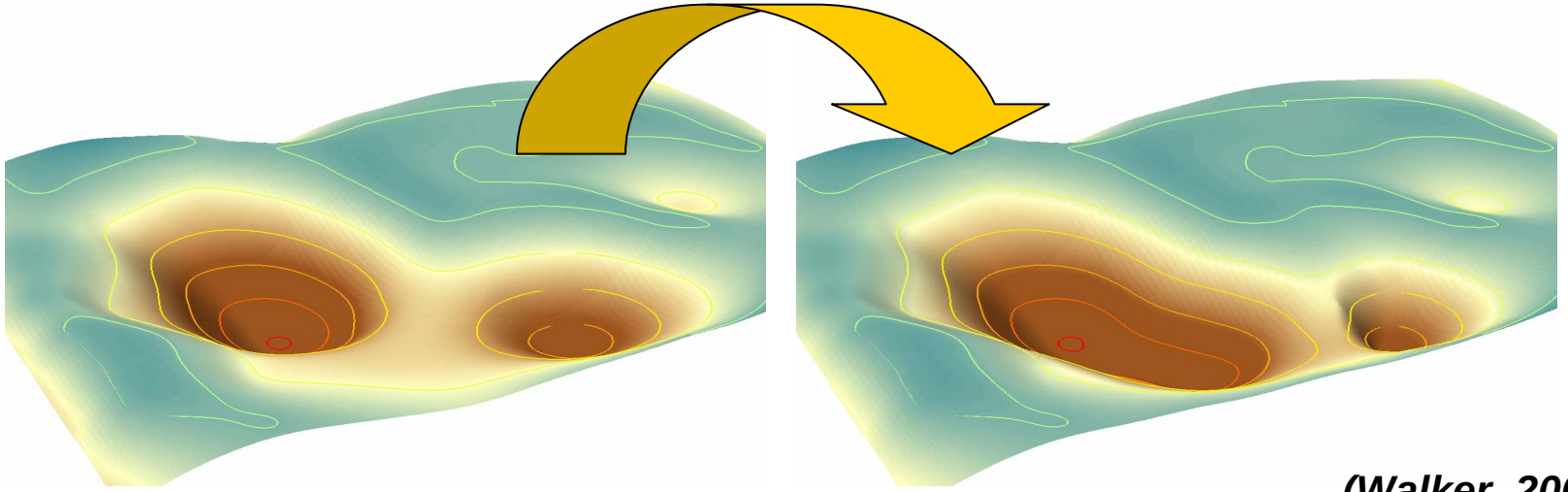
Rising temperatures



Thermo-haline circulation (THC) shutdown

Adaptive capacity

- **The capacity of actors in the system (i.e. people) to manage resilience to achieve desirable outcomes:**
  - **by changing the stability landscape – move basins of attraction**
  - **by influencing the trajectory of the system itself – either avoid crossing into another basin, or engineer such a crossing**
  - **new technologies, institutional change**
  - **preserve the elements that enable the system to renew and reorganise**



(Walker, 2002)

Resilience: timescale dependence

Brian Fagan (2004): Short-term resilience, long-term vulnerability

Mesopotamia: Key to success was well developed agricultural irrigation …

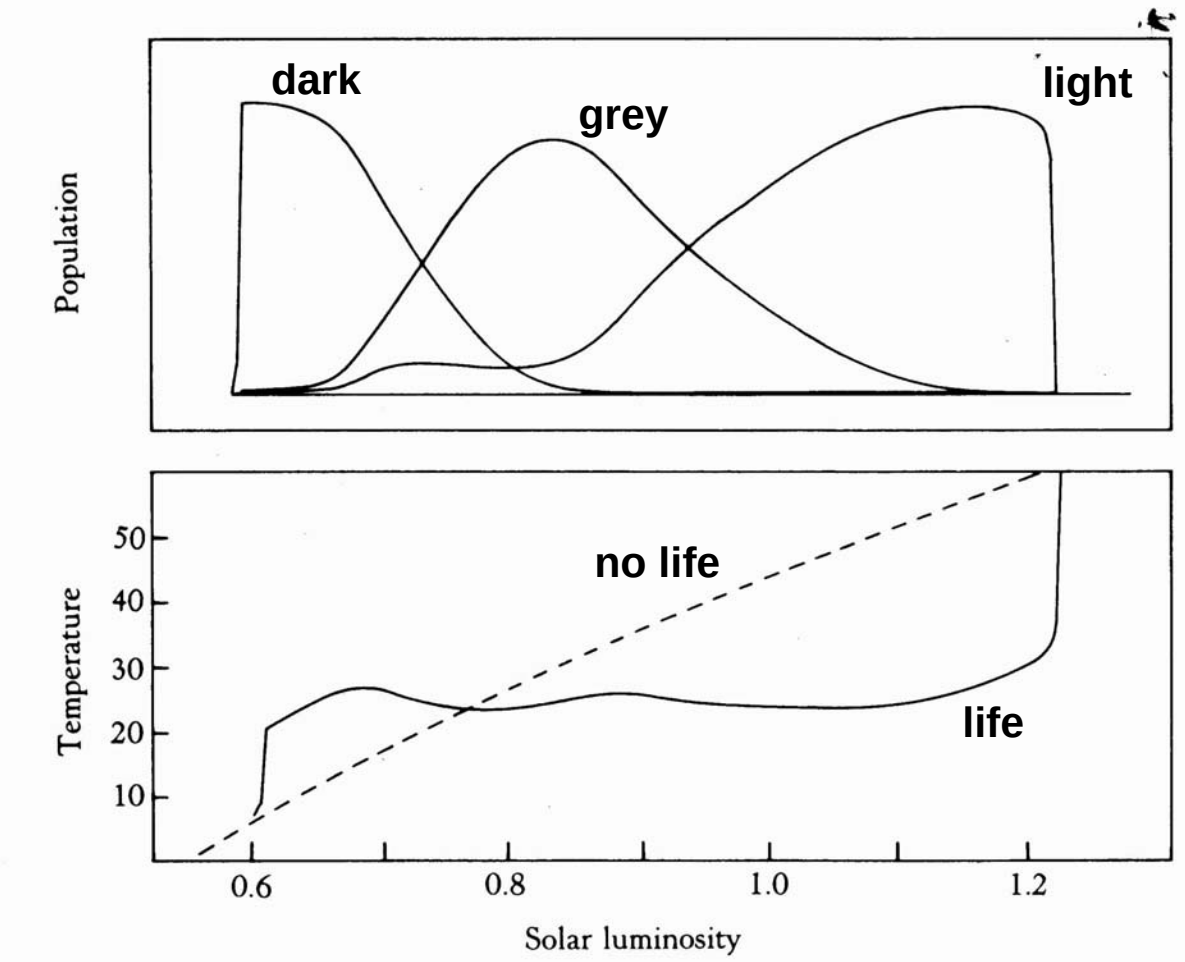
… but salinization led to political collapse, abandonment, and desertification

(from Redman, 2002)

GAIA Daisyworld

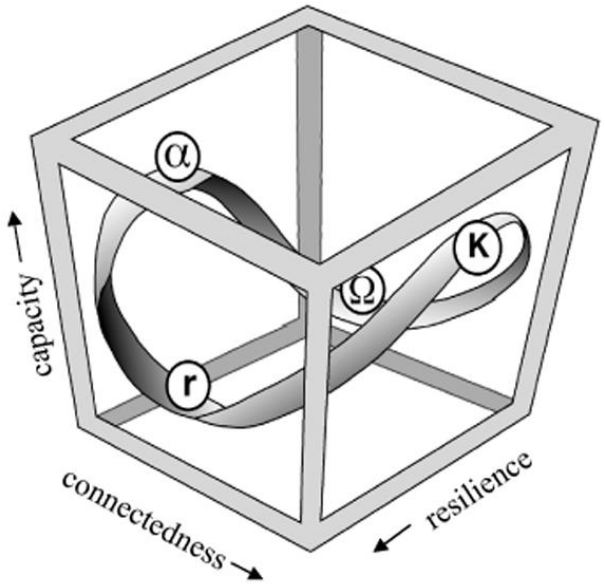
Three species of daisy

Solar luminosity is a fraction of our own sun



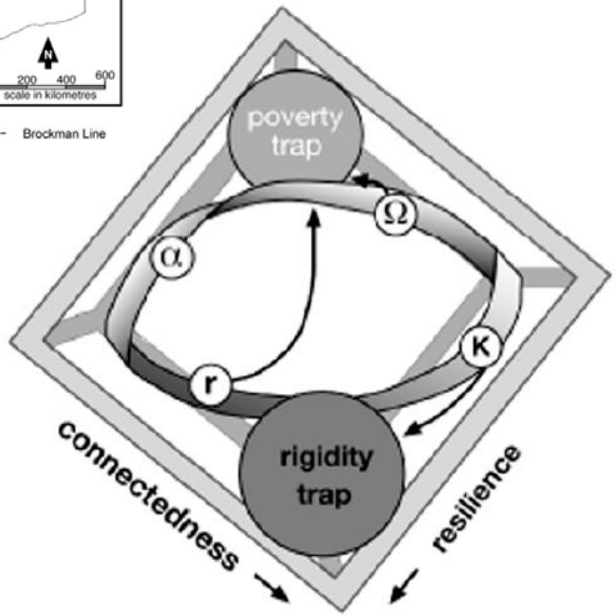
(Lovelock, 1990)

Adaptive cycles in W Australia



(Allison & Hobbs, 2004)

	Potential	Connectedness	Resilience
R (exploitation)	L	L	H
K (conservation)	H	H	L
Ω (release)	L	H	L
α (reorganisation)	H	L	H
Poverty trap	L	L	L
Rigidity trap	H	H	H
Lock-in trap	L	H	H
?	H	L	L



Socio-ecological systems

- System-level characteristics
  - Emergent behaviour
  - Resilience
  - Adaptive capacity
  - Size (no. of components)
  - Connectance
  - Multiple ‘basins of attraction’
  - Non-equilibrium
  - Self-organisation
  - Cross-scale interactions
  - Surprises!

- Biophysical processes
  - climate, soils, plants, animals (H_2O, C, N, P)
- Economic processes
  - Financial flows
  - Markets
  - Profit maximisation
  - Risk minimisation
- ‘People’ processes
  - innovation
  - communication
  - memory/learning/knowledge
  - perception/mental models
  - planning/foresight
  - decision-making
  - actions/behaviour
  - institutions and social organisation