

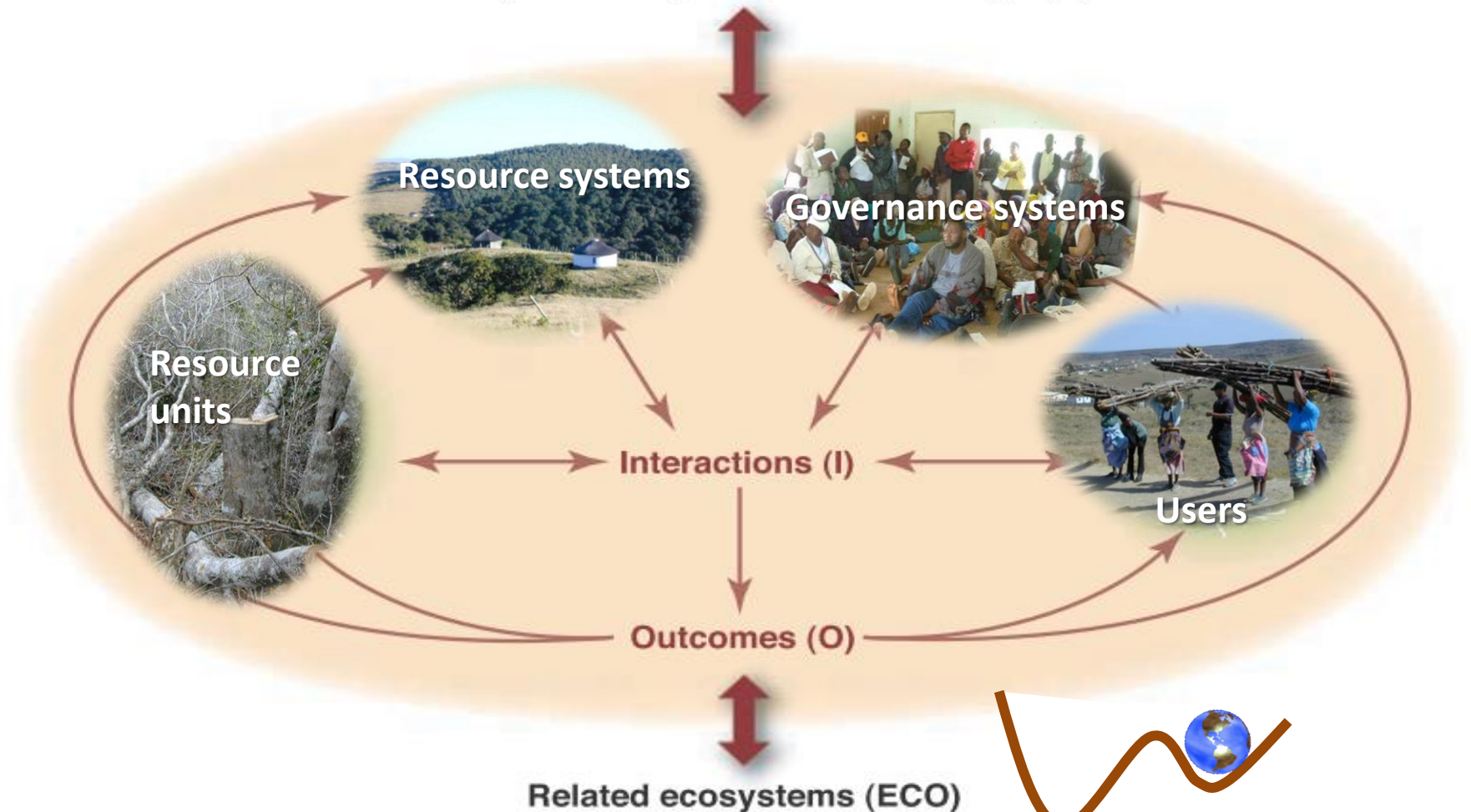


# Resilience Thinking and the Management of Thicket

Christo Fabricius

# People and ecosystems: an 'adaptive dance'

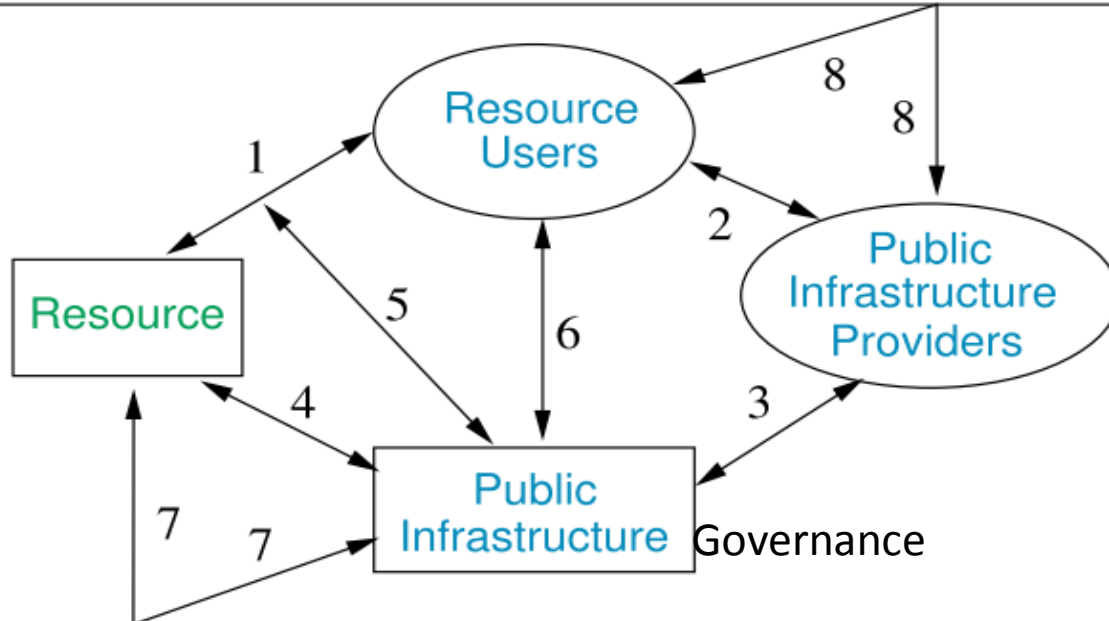
Social, economic, and political settings (S)



**'Social-ecological systems'**

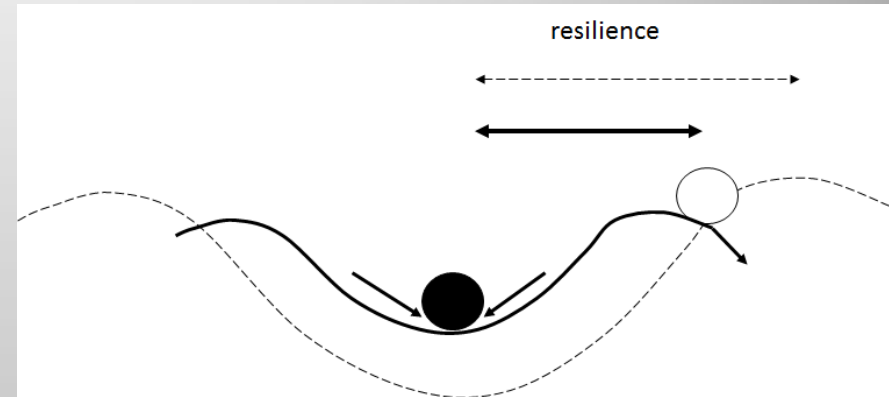
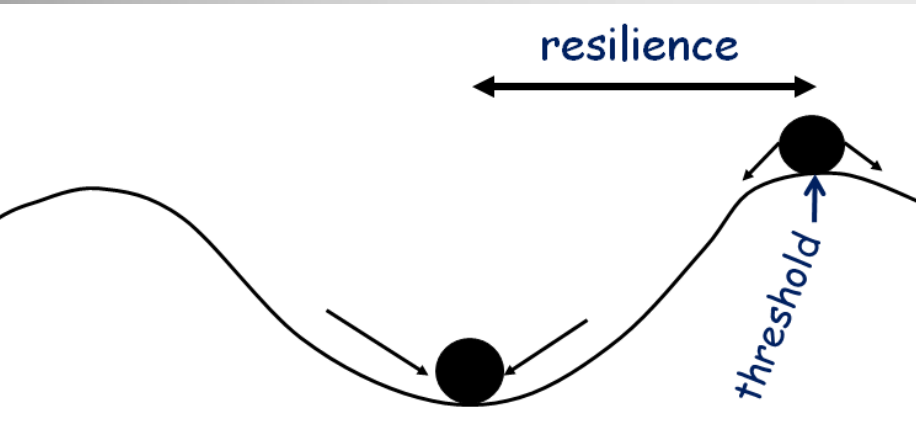
from Ostrom 2009. *Science* 235: 420

Exogenous drivers affecting social actors, e.g. *inputs from related social, economic, and political structures* in the SES framework.



Exogenous drivers affecting natural and human-made infrastructure, e.g. *inputs from related ecosystems* in the SES framework.

# The capacity to bounce back



The ability to absorb disturbances

To be changed and then to re-organise and still retain the same basic structure and ways of functioning

As resilience declines the magnitude of a shock from which it cannot recover gets smaller and smaller.

The shape and size of the basin can change

– thresholds move, and so resilience changes

# How resilient is Thicket?

## When viewed at one scale..

- Ancient origins – 65-45 Million years (Paleogene)
- Began as forests, invasions by other growth forms
- Persistence through wet, dry and glacial periods of the Miocene 1.8 M.a.
- Biomass similar to forests
  - 50-100 x that of Nama-Karoo
- *“a unique admixture of lineages spanning an enormous range of ages”*
- *“the mother of southern African vegetation”*

Cowling et al. 2005. S.A. J. Bot. 71: 1-23

- Resilience = *“To be changed and then to re-organise and still retain the same basic structure and ways of functioning”*

**But when viewed at another...**

# Thicket: the brittle biome

**Slow variables  
rule**

- Slow-growing species = “plodders”
- Ancient life forms

**A retirement  
village**

- Few seedlings
- Vegetative re-growth

**Sluggish  
metabolism**

- 4.5 tonnes of litter / ha
  - 35x that of arid savannas
- 70-87 tonnes / ha of stored Carbon

**Fragile  
foundations**

- Clay content ~15%



Resilience, *per se*, is neither 'good' nor 'bad'

Undesirable states of systems can be very resilient (dictatorships, saline landscapes)



A system state that once was desirable can become 'undesirable' through changes in external conditions (context)

Something which is resilient at one scale may be 'brittle' at another

# Systems may 'flip'





Alternate stable states are possible

when a **threshold** level of a controlling variable in a system is passed.

The nature and extent of **feedbacks** change,

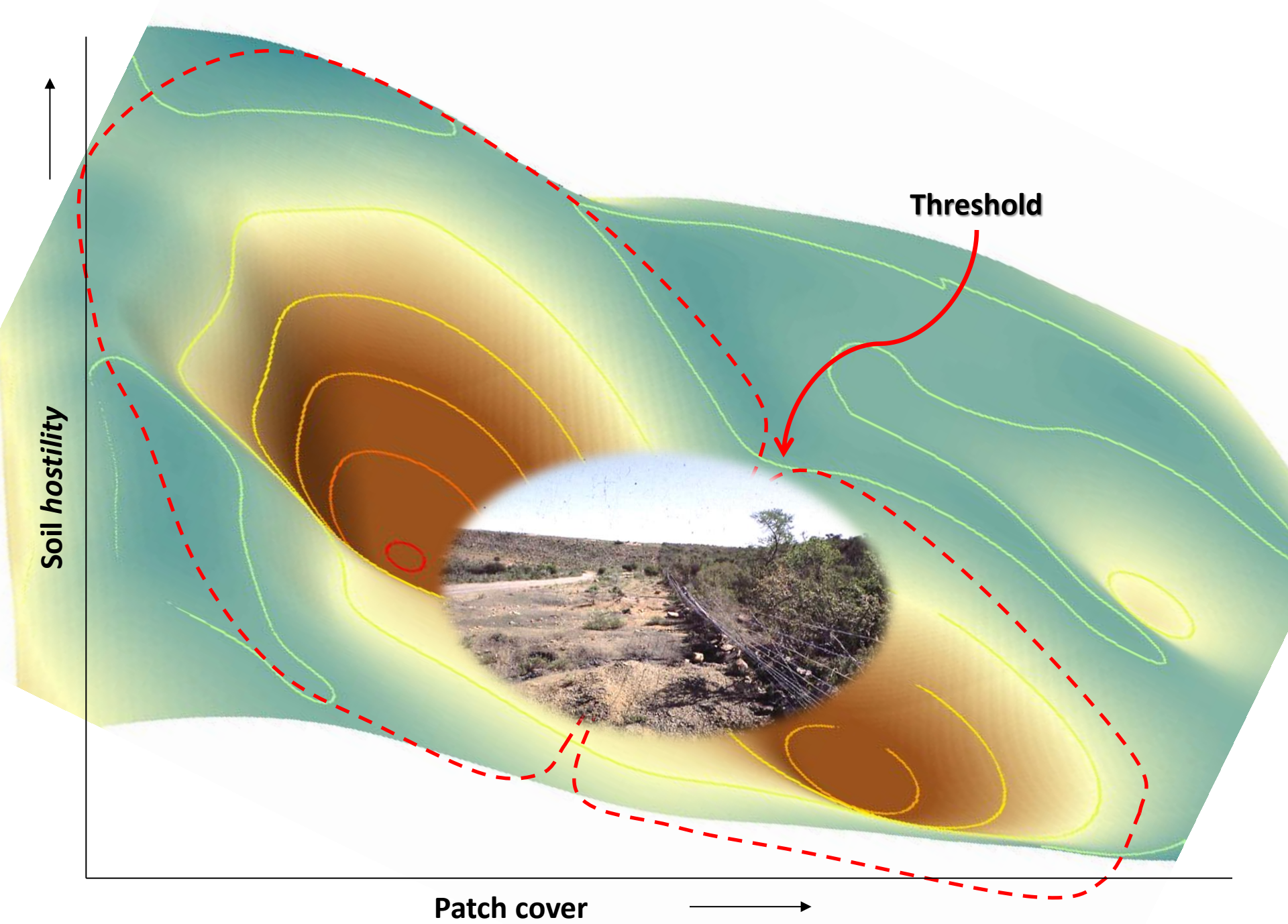
resulting in a change of direction (the **trajectory**) of the system itself.

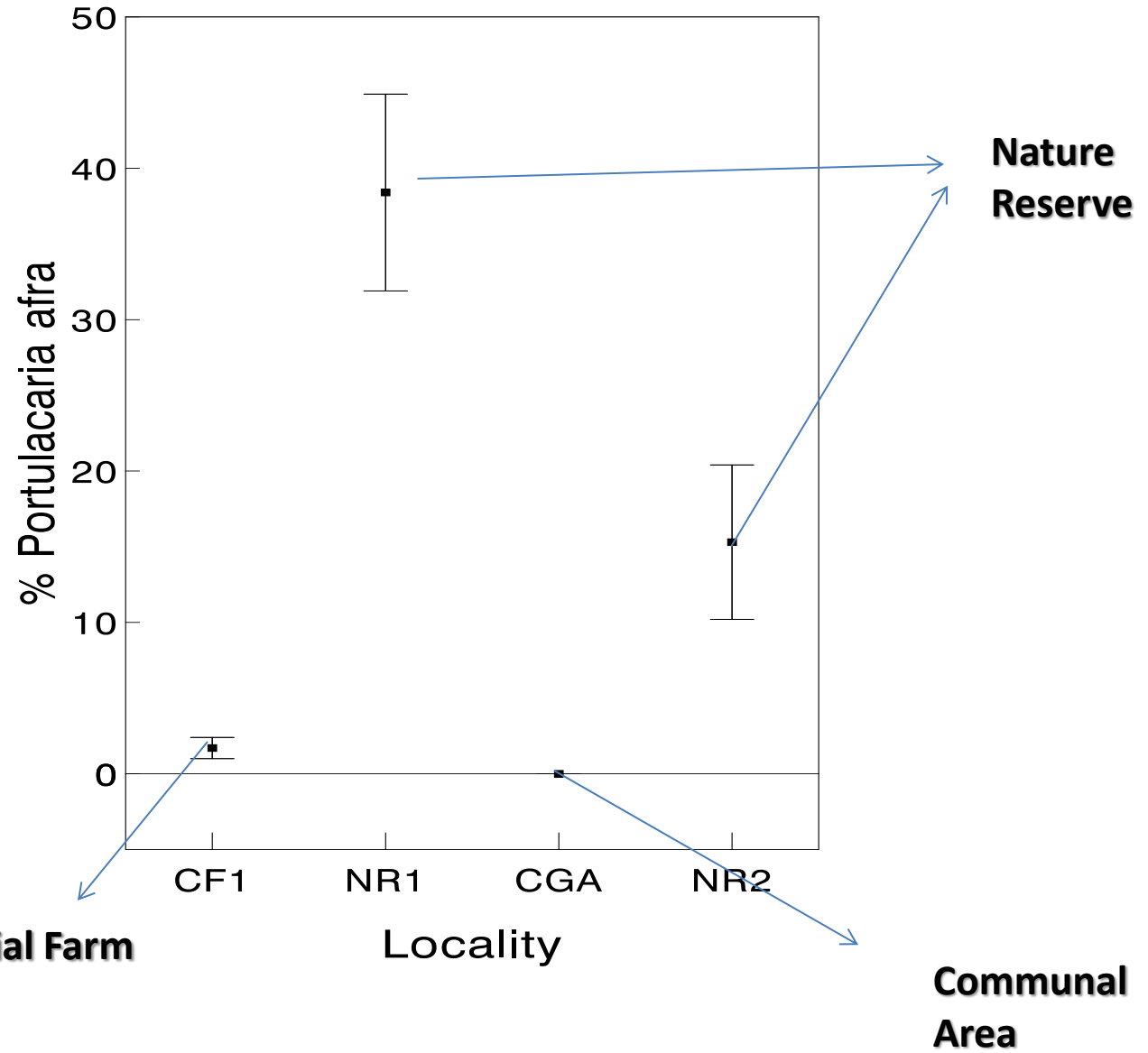
### A 'regime shift' takes place

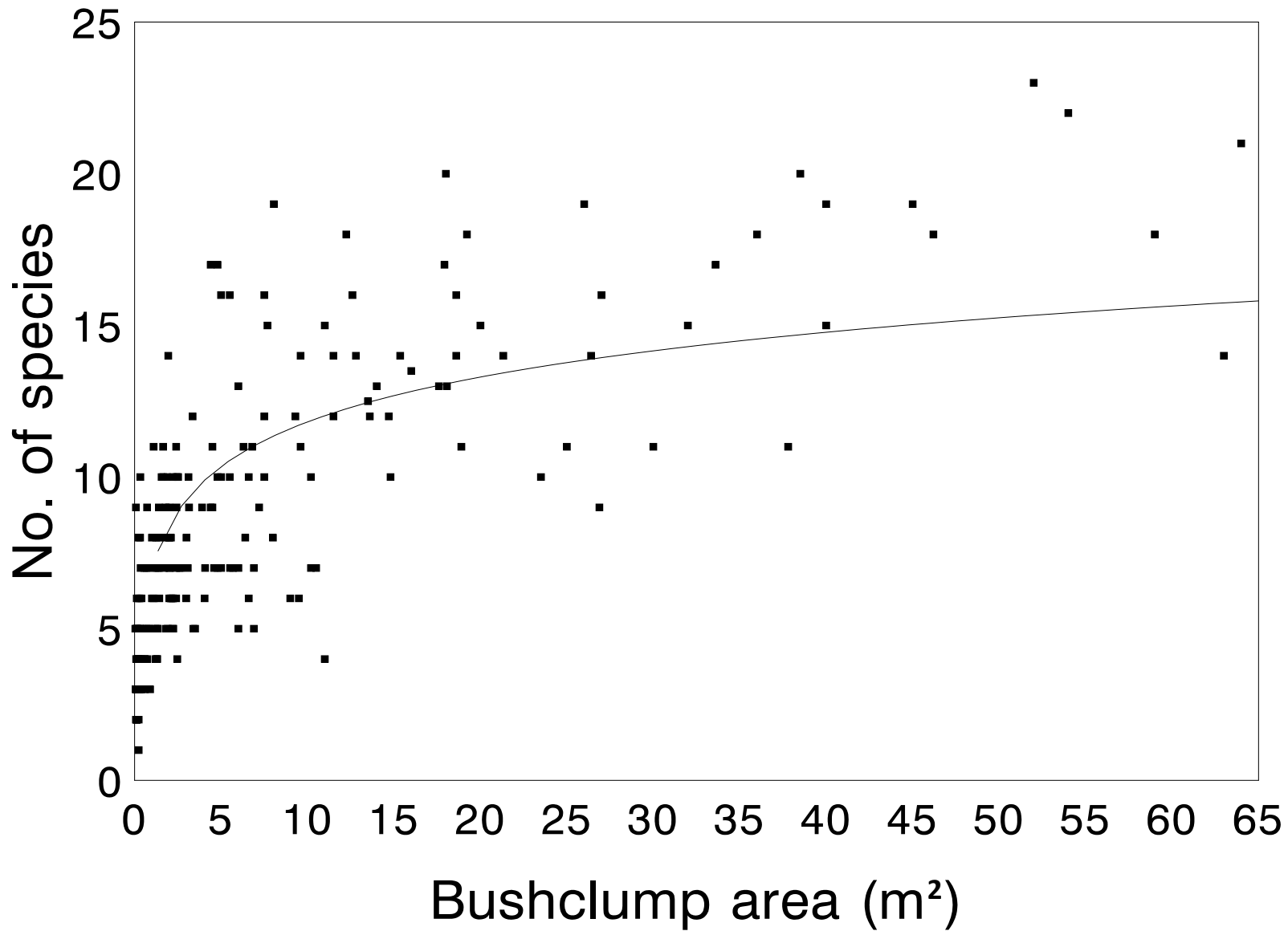
Scheffer & Carpenter 2003. *Trends in Ecology & Evolution* 18 (12), 648-656.

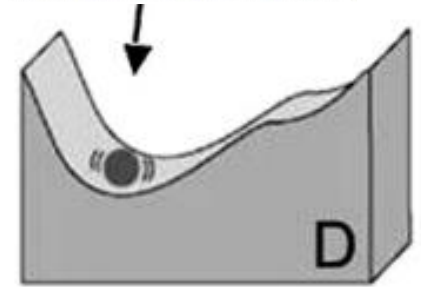
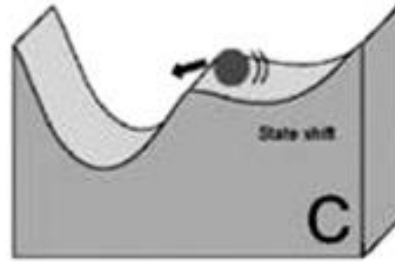
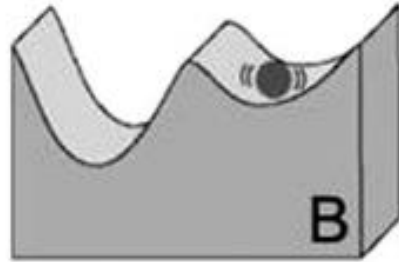
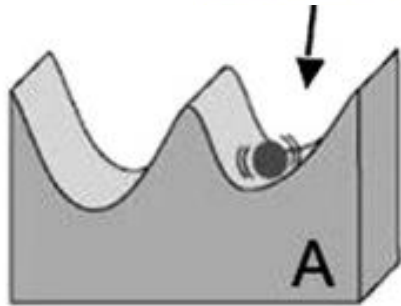


Images excerpted from Lechmere-Oertel, Kerley & Cowling 2005. *J Arid Env* 62: 459-474









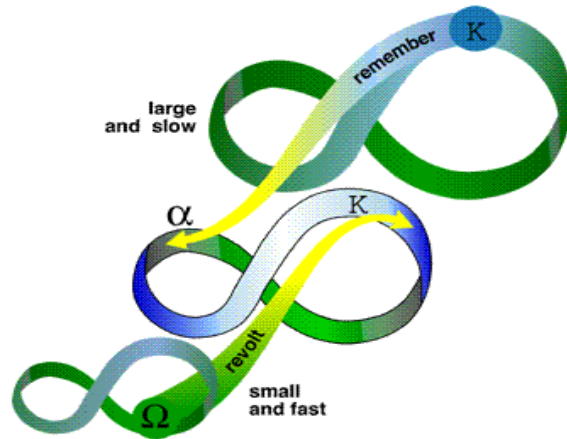
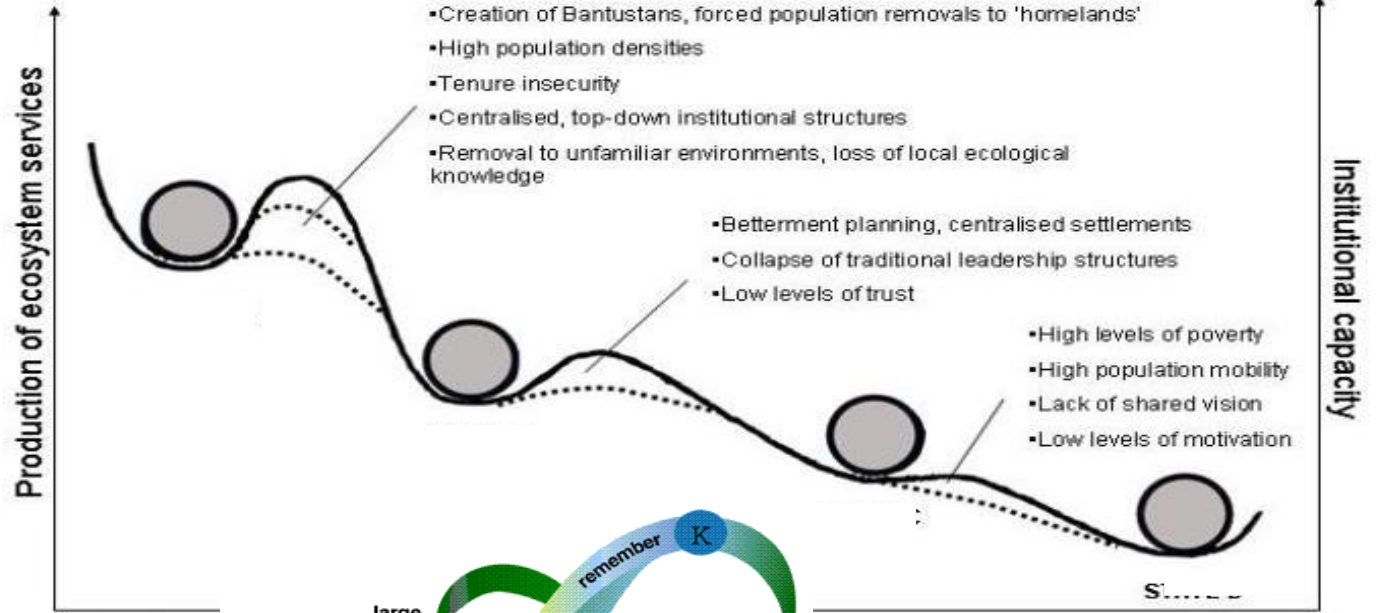
**A functioning Spekboom matrix**  
 - Patches of Spekboom & diverse shrubs

**Heavy browsing by domestic herbivores**  
 Loss of stability.  
 Patches contract.  
 Bare ground increases.

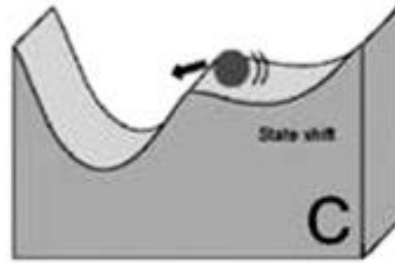
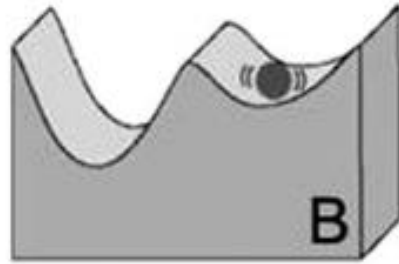
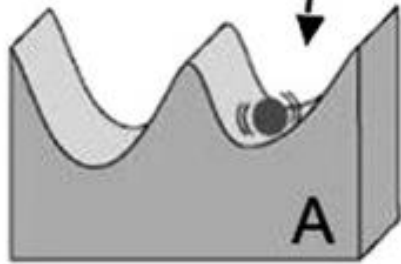
**Hostile soil conditions**  
 Litter, soil C ↓  
 Mycorrhizae ↓  
 Build-up of K, Na  
 Soil temp. ↑  
 Soil moisture ↓

**New 'stable' regime**  
 Canopy trees replace Spekboom  
 Karroid shrubs, weedy ephemerals

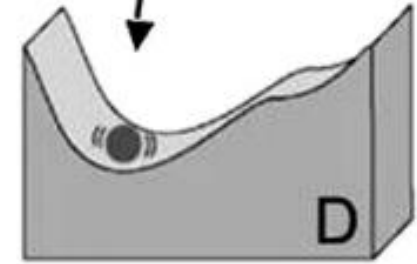
# Cross-scale feedbacks



Desired state

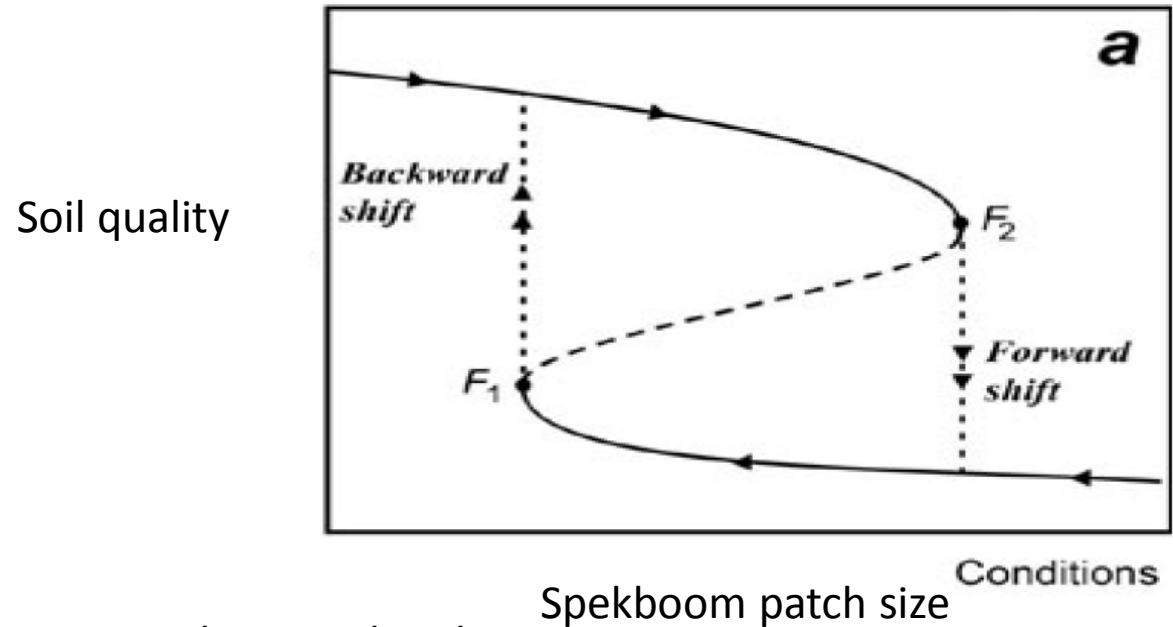


Undesired state



# System 'memory': the lag effect

- moving back along a *different* trajectory



The return path is not the same as the causal path

## Hysteresis:

retention & memory  
of a past state



Return to a desired state is only possible  
if conditions are reversed far enough ( $F_1$ )

# Transformation

- Transformability: *“The capacity to create a fundamentally new system when ecological, economic, or social (including political) conditions make the existing system untenable”*

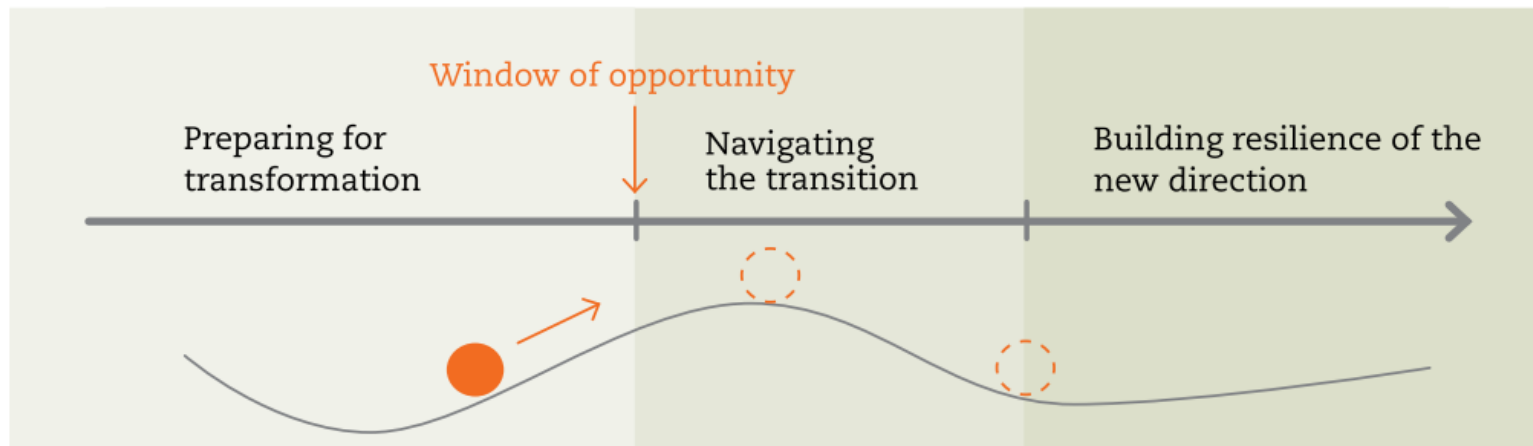
Walker, B., C. S. Holling, S. R. Carpenter, and A. Kinzig. 2004. Resilience, adaptability and transformability in social–ecological systems. *Ecology and Society* 9(2): 5.



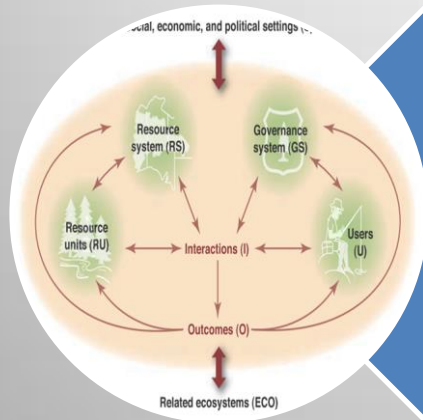
# Transformability

- preparedness to change
  - getting beyond the state of denial
- options for change
  - new 'trajectories' - emerge from support for experiments, novelty, continual learning
- capacity to change
  - levels of capitals (including 'social capital'), higher-scale support - **governance**

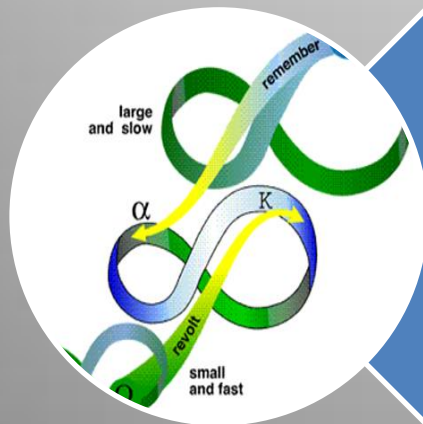
## Capacity to make use of 'windows of opportunity'



# Managing for resilience (1)

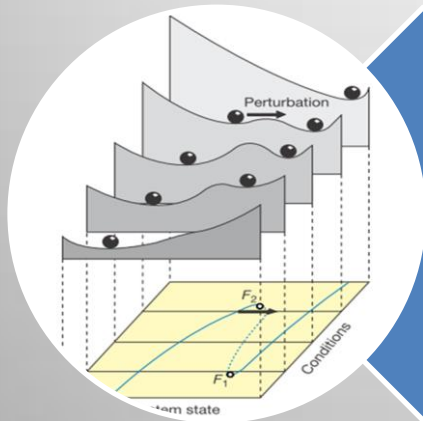


*Use a social-ecological lens*  
Focus on the interplay between governance, resource users, resource systems and public infrastructure  
Manage all of them

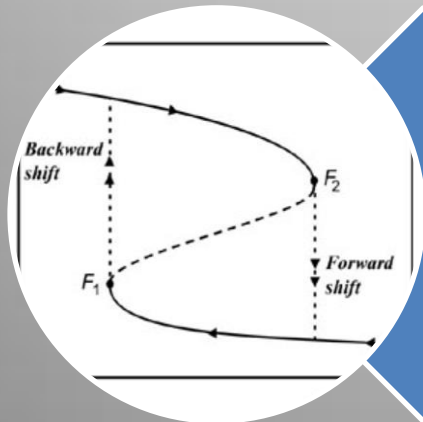


*Understand feedbacks across scales –*  
**Focal scale:** vegetation patches  
**Scale above:** regional land use patterns, policy changes.  
**Scale below:** changes in soil properties, cognitive processes and mental models of users and decision makers

# Managing for resilience (2)



*Manage slow-onset changes*  
Understand the thresholds  
Monitor the control variables



*Be prepared to overcome the lag effect*

Reversal must be far enough to overcome the system's 'memory'

Time

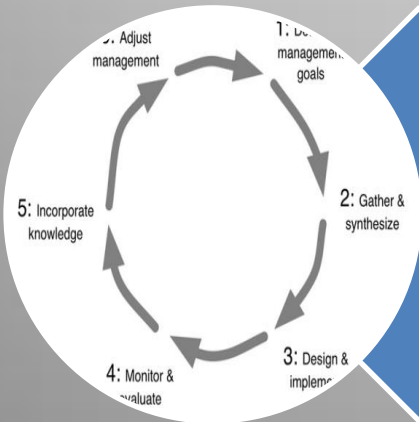
Funding

# Managing for resilience (3)



*Manage connectivity*

Patch:gap ratio  
Continuity of functional landscapes  
Knowledge exchange, social learning



*Foster learning and reflection*

Communities of practice  
Adaptive management

# Resilience resources:

- [www.resalliance.org](http://www.resalliance.org)

- information and news
- workbooks (free, downloadable)

- Ecology and Society

- [www.ecologyandsociety.org](http://www.ecologyandsociety.org)

- Twitter:

@resilienceSci





# RESILIENCE *practice*

Building  
Capacity  
to Absorb  
Disturbance  
and Maintain  
Function

*Brian Walker  
and David Salt*

HOW CAN LANDSCAPES AND COMMUNITIES  
ADAPT AND TRANSFORM IN A CHANGING WORLD?

Island Press

<http://islandpress.org/ip/books/book/islandpress/R/bo8070201.html>