RESILIENCE BASED MANAGEMENT AS A FRAMEWORK FOR DROUGHT RESPONSE

GARDEN CITY KS

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Jornada Experimental Range

OUR VIEWS OF SYSTEMS HAVE CHANGED

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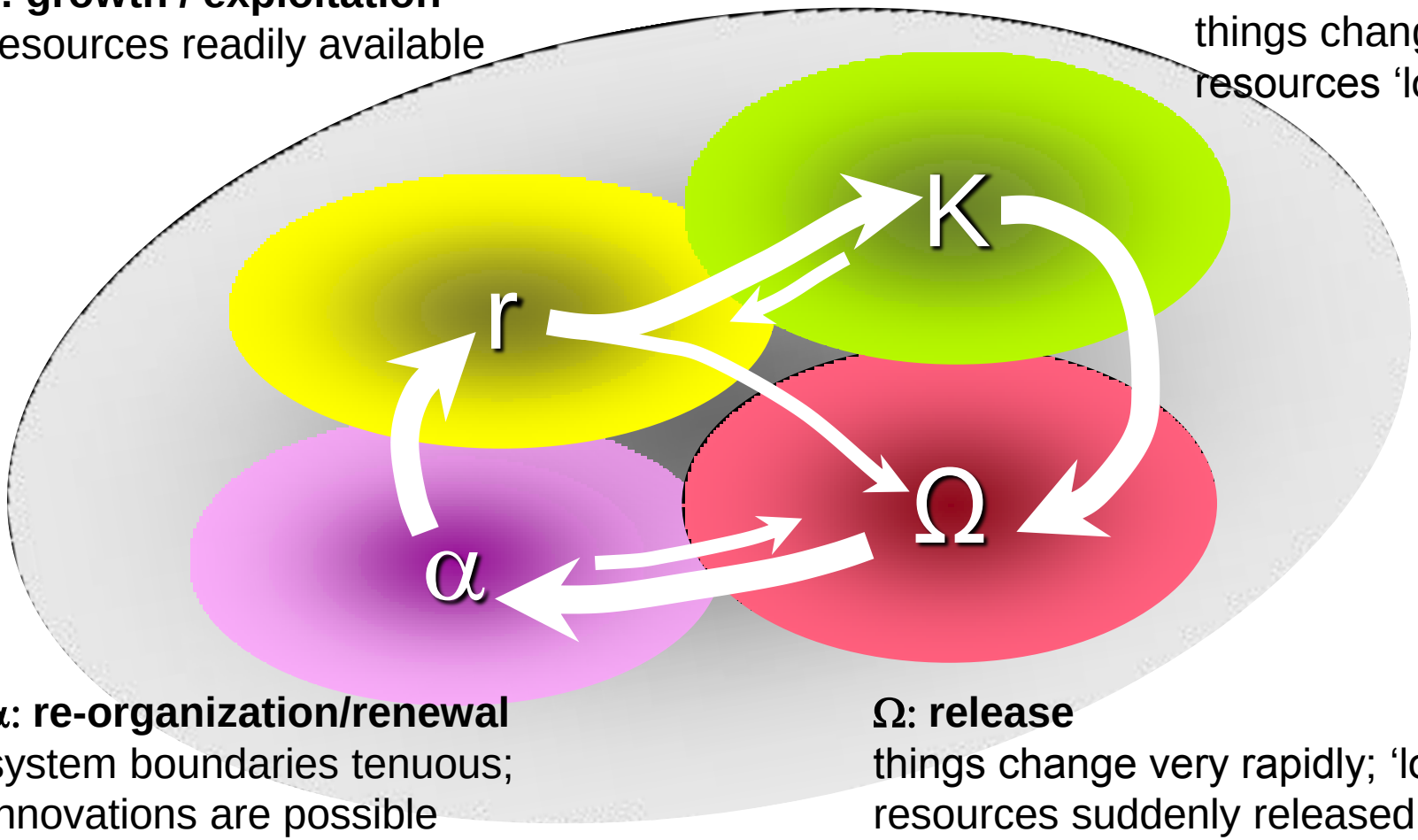
DYNAMICS OF SOCIAL ECOLOGICAL SYSTEMS

r: growth / exploitation
resources readily available

K: conservation
things change slowly;
resources 'locked up'



α: re-organization/renewal
system boundaries tenuous;
innovations are possible

Ω: release
things change very rapidly; 'locked up'
resources suddenly released

From: Gunderson and Holling

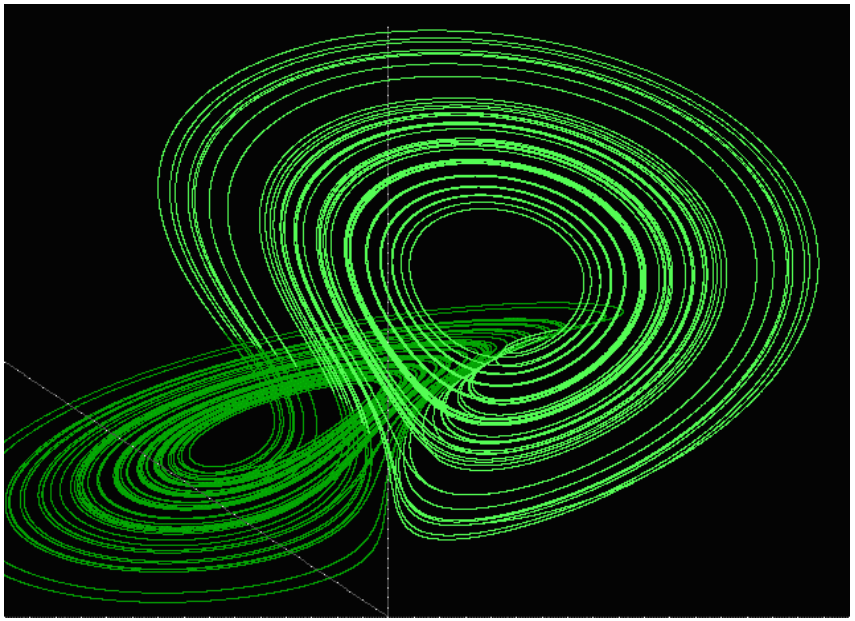
Four misconceptions that affect management, programs and policies

- a focus on central tendencies rather than probability distributions and extreme events.
- belief that problems from different sectors do not interact.
- expectation that change will be incremental and linear.
- the system as an optimal state.

From Dr. Brian Walker, CSIRO Chief Emeritus and Resilience Alliance

Managing in a Changing Environment

- Averages do not mean much-you have to survive bad years, make progress during good years
- Problems and opportunities are not isolated
- Unexpected things happen, both good and bad
- Systems are dynamic



An Alternative Paradigm
"Resilience Management"

Coupled systems of people and nature are dynamic, social-ecological systems that behave as *Complex Adaptive Systems*

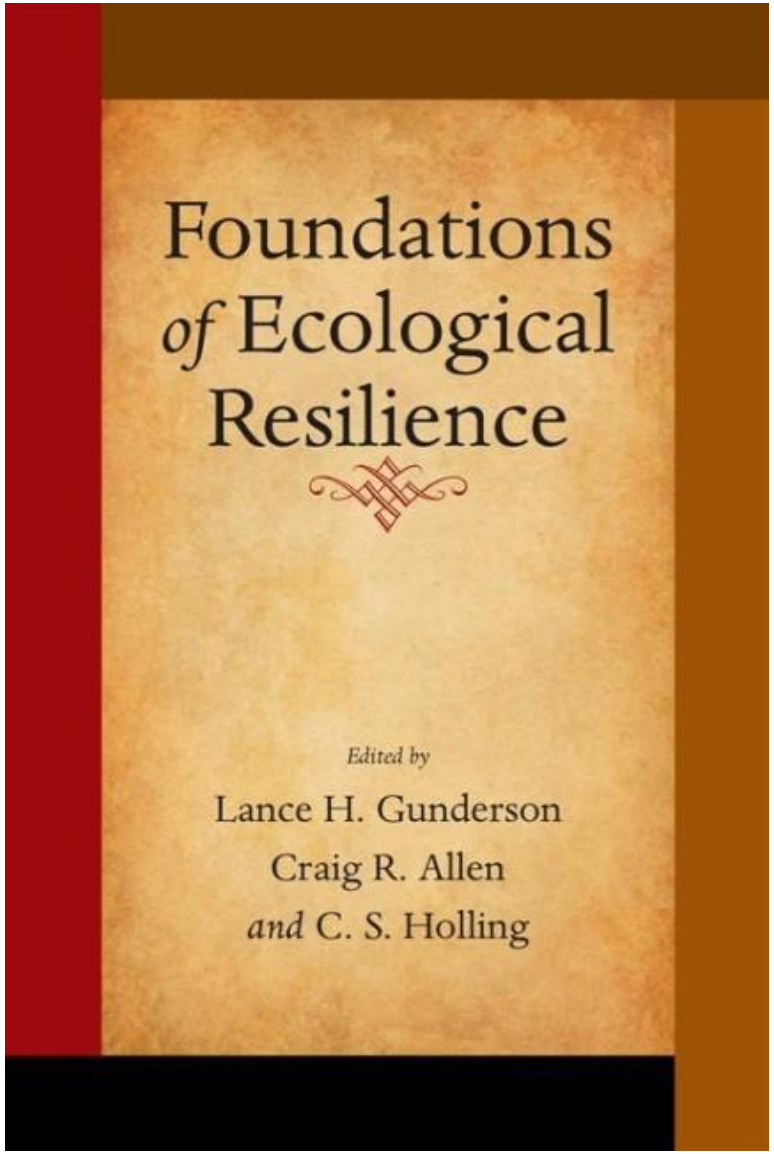
- self-organizing (*shrubs replacing grasses*)
- non-linear with multiple attractors (*what happened*?)
- emergent behaviour (*forage production vs livestock distribution*)
- cross-scale interactions (*livestock behave differently at different scales*)

Success rests on three attributes

Resilience
Adaptability
Transformability

Resilience

"The capacity of a system to absorb disturbance and re-organize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks"

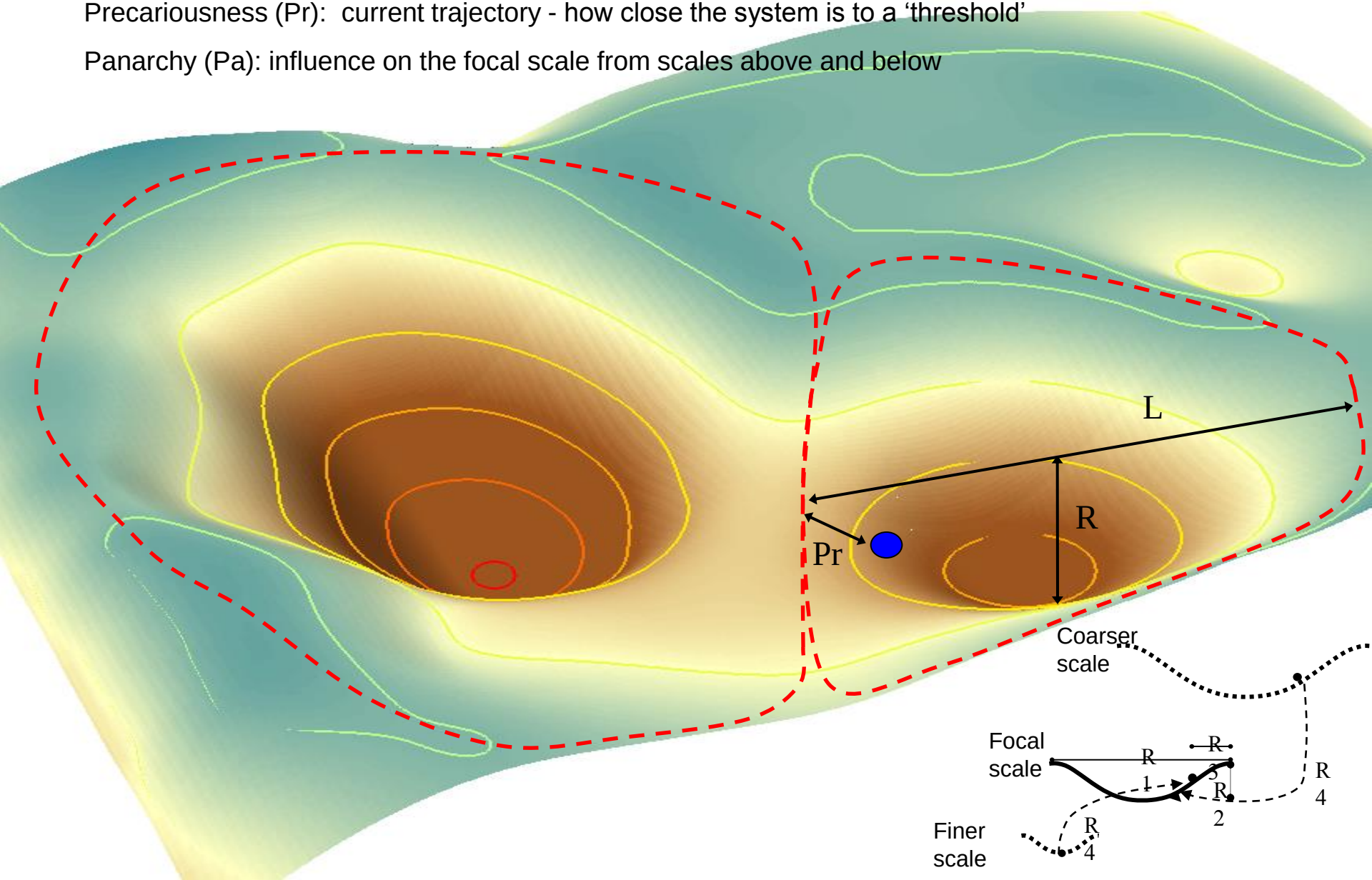


Latitude (L): the maximum amount a system can be changed before losing its ability to recover (before crossing a threshold which, if breached, makes recovery difficult or impossible)

Resistance (R): ease or difficulty of changing the system

Precariousness (Pr): current trajectory - how close the system is to a ‘threshold’

Panarchy (Pa): influence on the focal scale from scales above and below

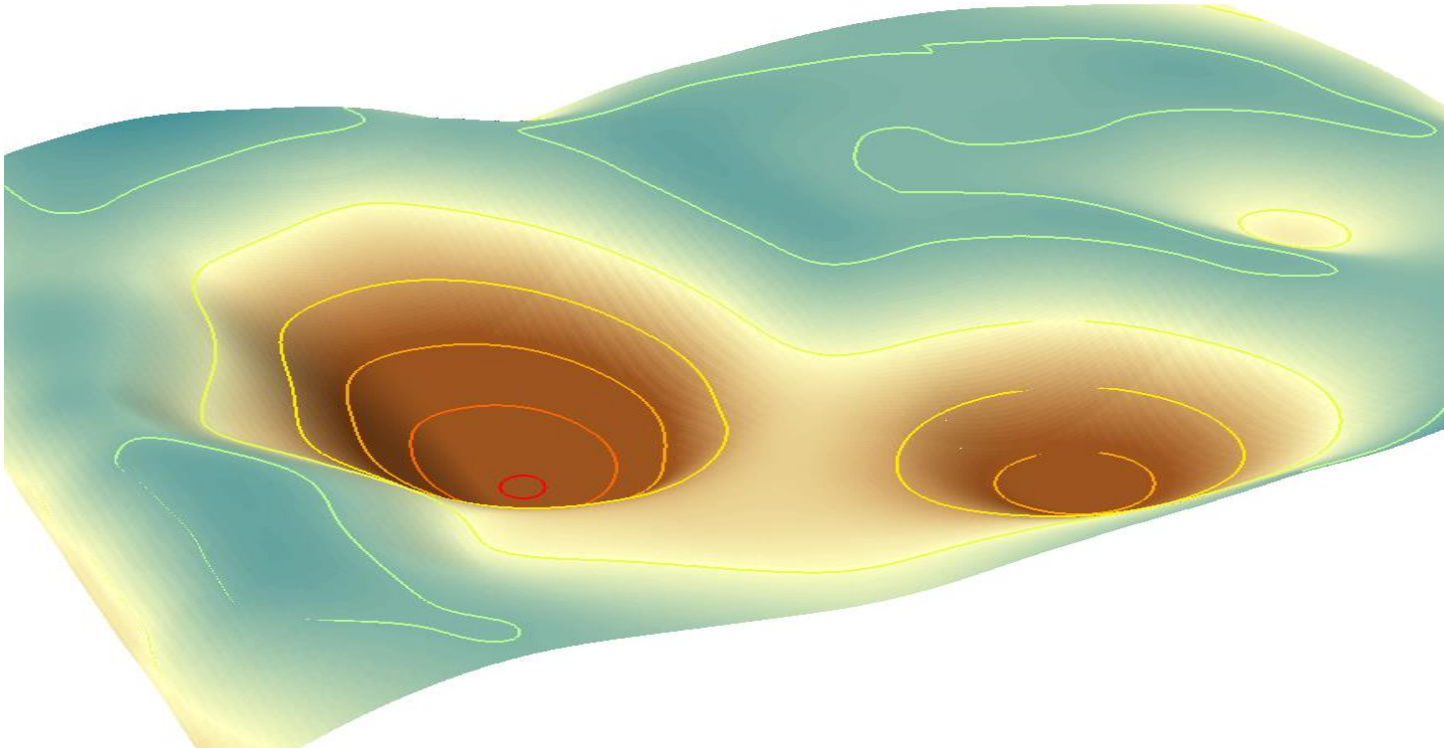


Adaptability

The capacity of people in the system to manage resilience :

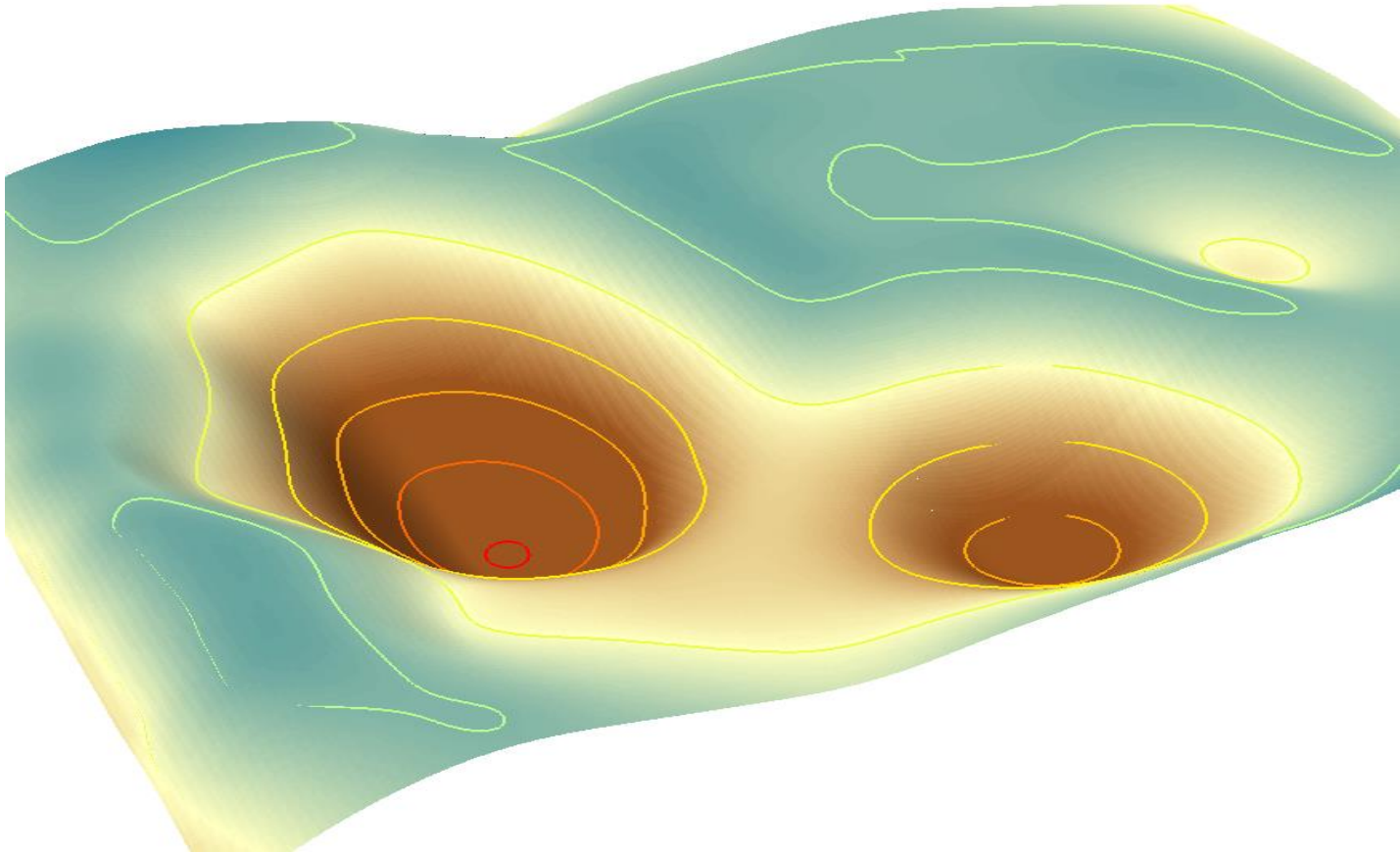
(i) change the stability landscape - move thresholds or make it easier/harder to change the system, and

(ii) control the trajectory of the system – avoid crossing a threshold, or engineer such a crossing

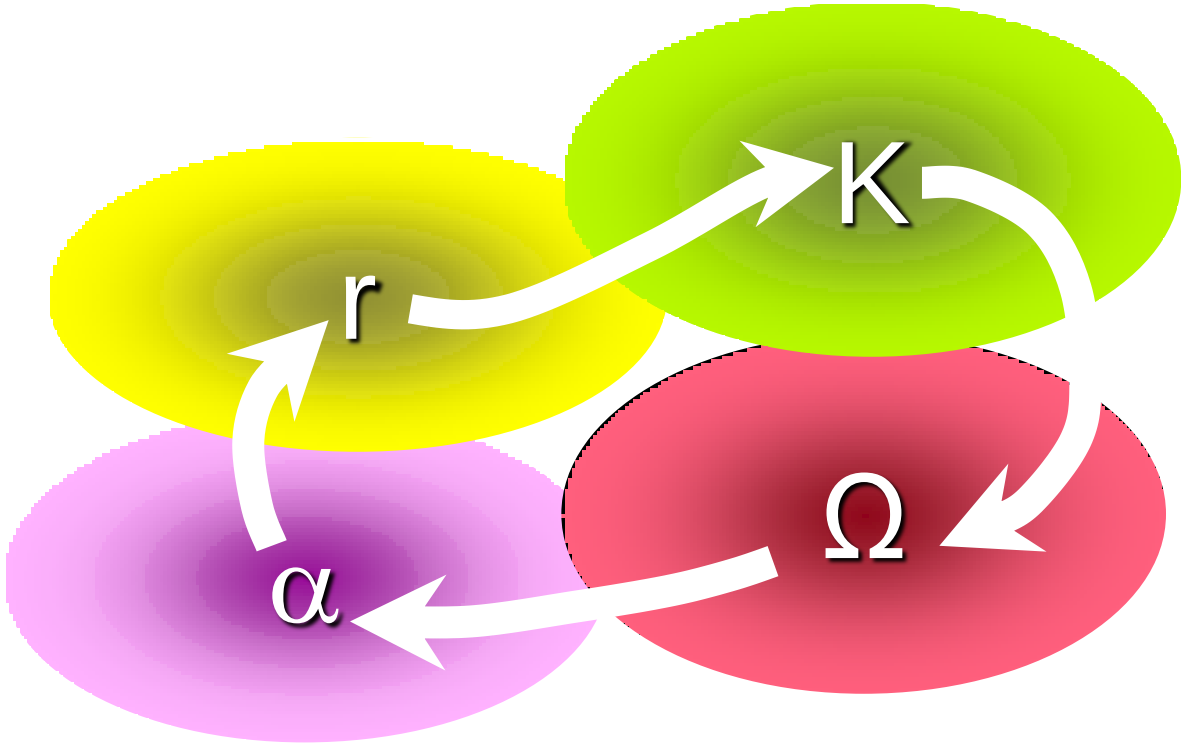


Transformability

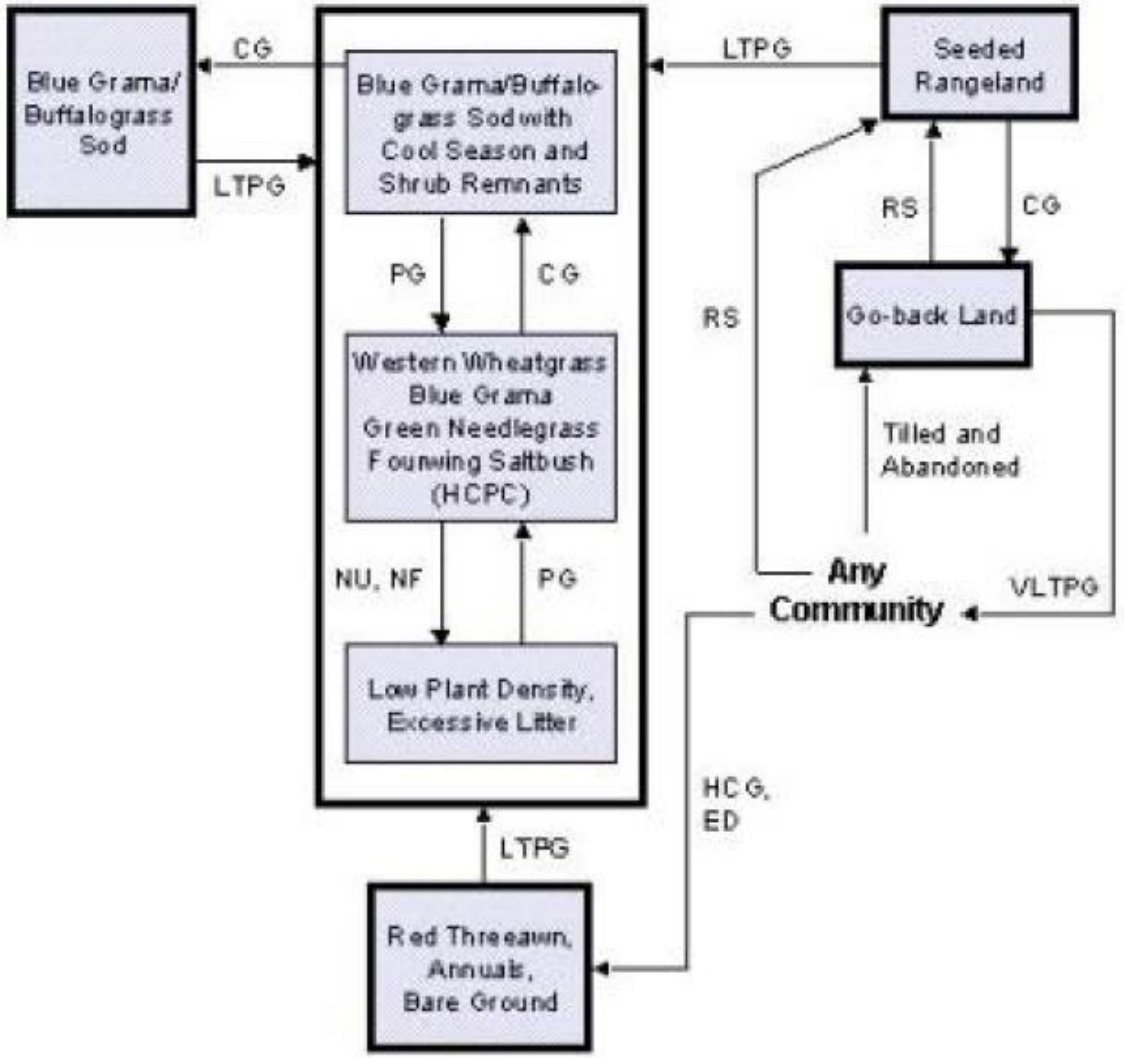
The capacity to become (or create) a fundamentally different system when ecological, social and/or economic conditions make the existing system untenable.



The effectiveness of management or governance interventions depends on recognizing where a system is in the adaptive cycle, what drivers are active and the context for the subsystem within a larger system

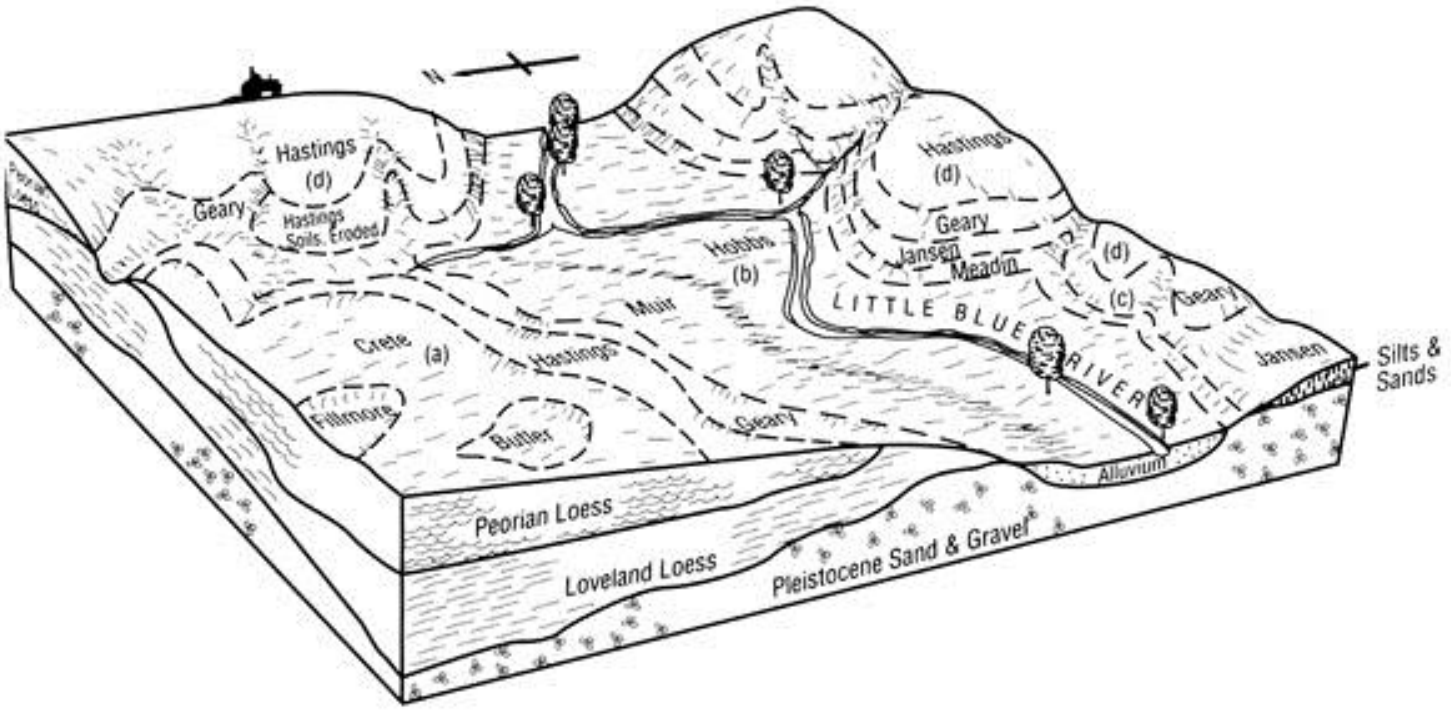


What are the current conditions and what are the drivers?

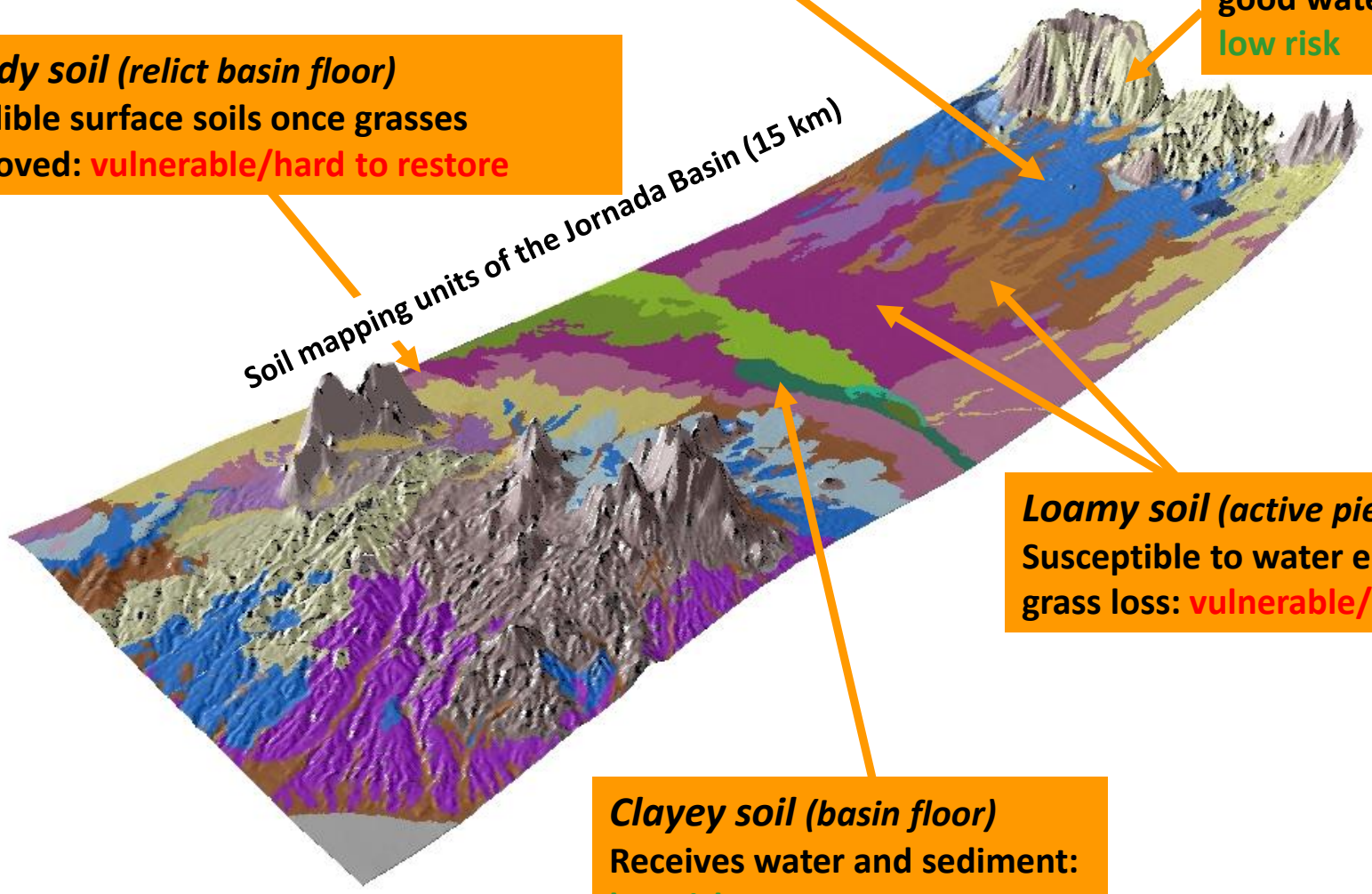


What is the context for the system?

FIGURE 2-3



Landscapes of Associations of Soil Series (Soil Survey Thayer Co., Nebraska).



***Gravelly soil** (shallow, relict piedmont)*
Surface soil water limited, high risk for grass loss and erosion: vulnerable/restorable

Limestone
Grass protected by rocks, higher rainfall, good water capture: low risk

***Sandy soil** (relict basin floor)*
Erodible surface soils once grasses removed: vulnerable/hard to restore

***Loamy soil** (active piedmont)*
Susceptible to water erosion and grass loss: vulnerable/restorable

***Clayey soil** (basin floor)*
Receives water and sediment: low risk

Monitoring the right thing at the right time

low

high

Precision/cost of information

Accuracy/ information availability

Global, continental

Climate change, atmospheric chemistry, trade agreements, disease outbreaks

Regional (10^6 km^2)

Climatic shifts, diseases, land occupation and use patterns, gov't policies

Landscape (10^3 km^2)

Climatic shifts, invasives, development patterns, gov't programs

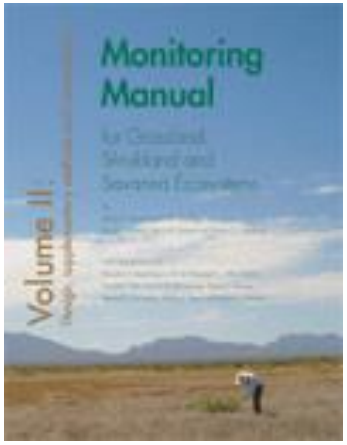
Property (km^2)

Inputs, outputs, cropping and grazing patterns

Paddock attributes

Site (ha) response

Plant/Soil Indicators



from Brown and Havstad 2005

high

low

THE ADAPTIVE MANAGEMENT PROCESS

ADAPTIVE MANAGEMENT REQUIRES AN EXPLICIT STATEMENT OF

- SYSTEM BEHAVIOR (STATE AND TRANSITION MODEL)
- MULTISCALE CONNECTIONS (LANDSCAPE PATTERNS)
- DRIVERS (CLIMATE, MANAGEMENT INTERVENTIONS)
- HYPOTHESES AND TESTS
- MENTAL MODELS ARE AT BEST USELESS AND AT WORST MISLEADING

ADAPTIVE MANAGEMENT LIMITS

- JUST BECAUSE YOU UNDERSTAND A SYSTEM DOES NOT MEAN YOU CAN MANAGE IT

- JUST BECAUSE YOU CAN MANAGE A SYSTEM DOES NOT MEAN YOU CAN PROFIT FROM IT

SUPPLEMENTARY SLIDES

Annoying Features of Complex Systems

Cascading Failures which may have catastrophic consequences on the functioning of the system

Complex systems are frequently far from equilibrium

Complex systems may have a memory and may exhibit hysteresis

Complex systems may be nested

Complex systems may exhibit behaviors that are emergent

Relationships are non-linear In practical terms, this means a small perturbation may cause a large effect a proportional effect, or even no effect at all

Relationships contain feedback loops Both negative (damping) and positive (amplifying)

The Functional Indeterminacy Theorem (F.I.T.): In complex systems, malfunction and even total non-function may not be detectable for long periods, if ever.
The Newtonian Law of Systems Inertia: A system that performs a certain way will continue to operate in that way regardless of the need or of changed conditions.

The Fundamental Failure-Mode Theorem (F.F.T.): Complex systems usually operate in failure mode. A complex system can fail in an infinite number of ways. (If anything can go wrong, it will.) The mode of failure of a complex system cannot ordinarily be predicted from its structure. The crucial variables are discovered by accident.
The larger the system, the greater the probability of unexpected failure.
"Success" or "Function" in any system may be failure in the larger or smaller systems to which the system is connected.

The Vector Theory of Systems: Systems run better when designed to run downhill. Loose systems last longer and work better. (Efficient systems are dangerous to themselves and to others.)

Management and other myths

Complex systems tend to produce complex responses (not solutions) to problems.
Great advances are not produced by systems designed to produce great advances.