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Commemorative Lectures

ブライアン・ウォーカー教授
講演スライド集

レジリエンス思考の科学と実践

Prof. Brian Walker

Slides for the Lecture

The Science and Practice of Resilience Thinking

The Science and Practice of Resilience Thinking

Brian Walker

"Resilience" is now a common word, used in different ways, often casually with no real meaning -- and therefore it can lose its value.

This would be a serious loss, because the rapid, significant changes happening in the world require a well-structured resilience approach to cope with them.

The key feature of resilience is that there are limits to how much a system (ecosystem, society, business, city, - - -) can change before it can no longer recover.

The simplest definition of resilience is: “The ability to cope with shocks and to keep functioning in much the same kind of way”.

A more detailed definition, that captures how resilience works is:
“The capacity to absorb disturbance and *re-organize* so as to retain essentially the same *function*, *structure* and *feedbacks* – to have the same *identity”*.

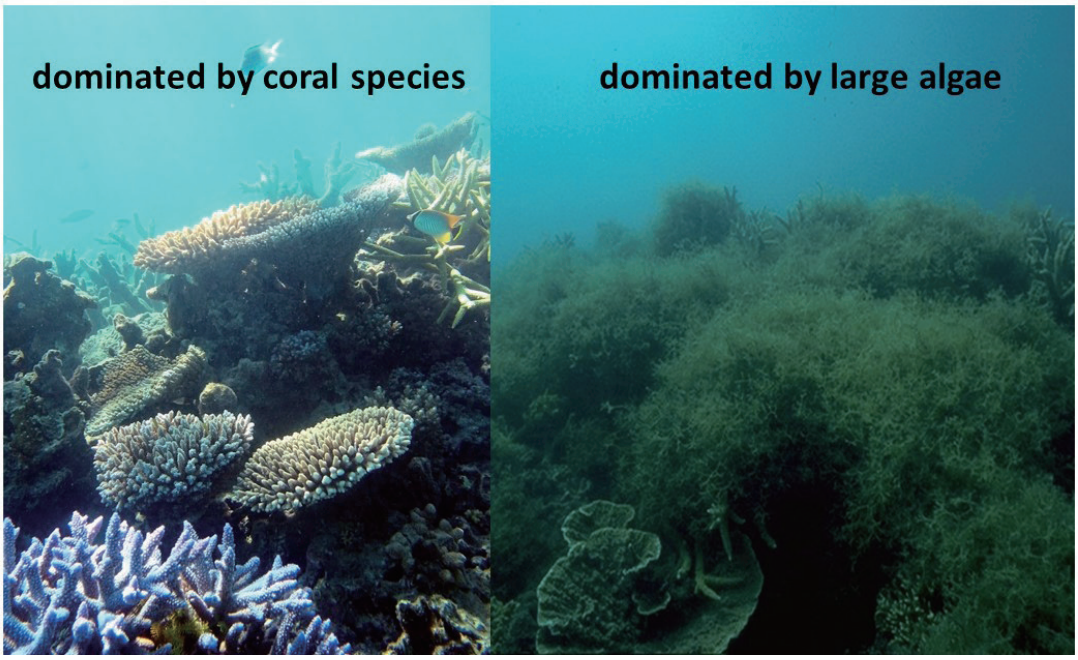
Resilience does *not* mean just staying the same. It involves changing, re-organizing in response to a disturbance in such a way that the system can keep functioning in the same kind of way.

There are limits to how much a system can change, or be disturbed, and still recover

These limits are thresholds between alternate states the system can be in. Once a threshold is crossed it is very difficult, sometimes not possible, to cross back again into the original state.

Such threshold effects are common in all kinds of systems

Alternate states of a coral reef (T.Hughes)



Alternate states of lakes in Wisconsin (Stephen Carpenter)

low in nutrients
- clear water

above a threshold of nutrients
- dense algal blooms (phytoplankton)

Alternate states of a rangeland in Australia

Shrubs out-compete grass for soil water

Fire kills shrubs but not grass

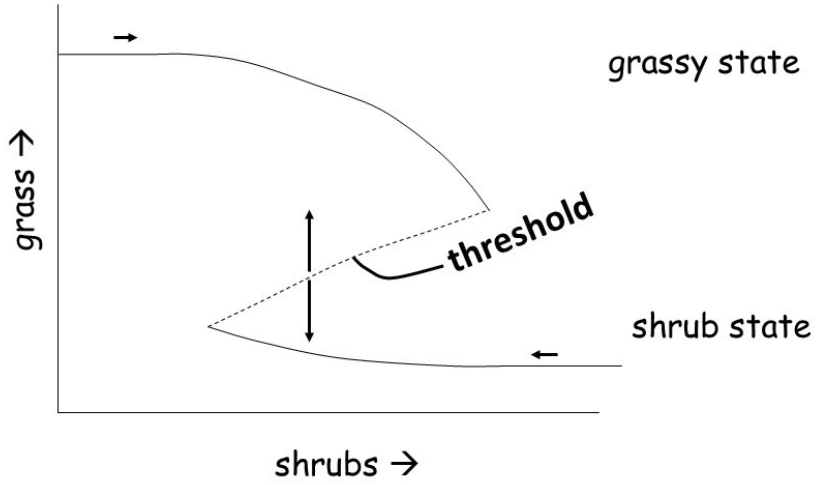
Every few years there is enough grass for a fire, so the rangeland stays in the grassy state

If shrubs increase, grass decreases

There is a threshold level of shrubs where not enough grass can accumulate for a fire that will kill shrubs

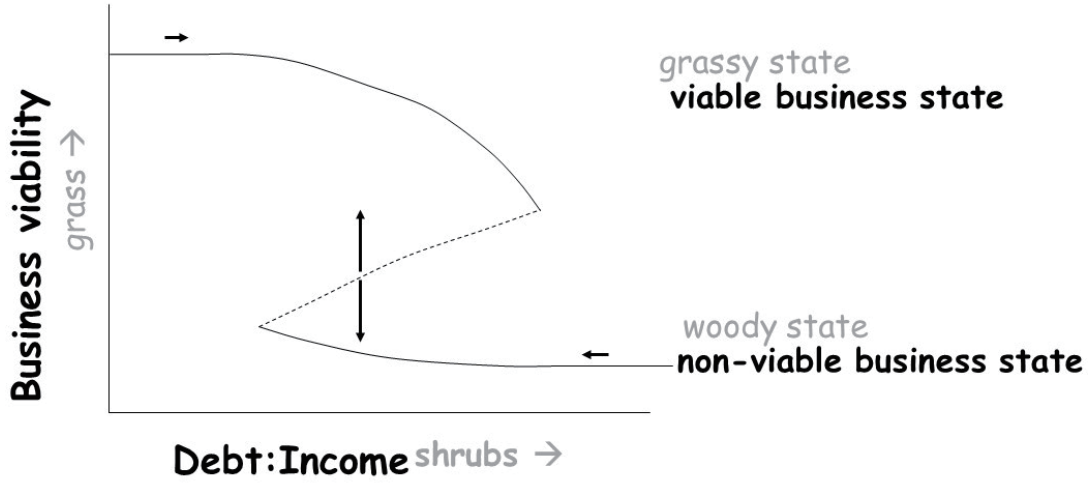
Once the rangeland has crossed the threshold level from the grassy to the shrub state, the amount of shrubs has to be reduced to much below that level before the rangeland crosses a different threshold back into the grassy state

Threshold between grassy and shrub states in a rangeland



In a business, the same kind of threshold effect occurs between increasing debt:income ratio and the business viability

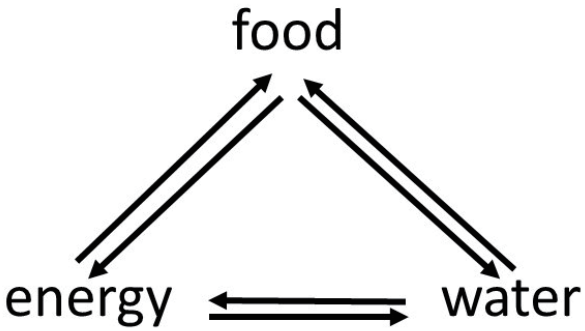
Viability of a business
Shrub invasion in rangelands



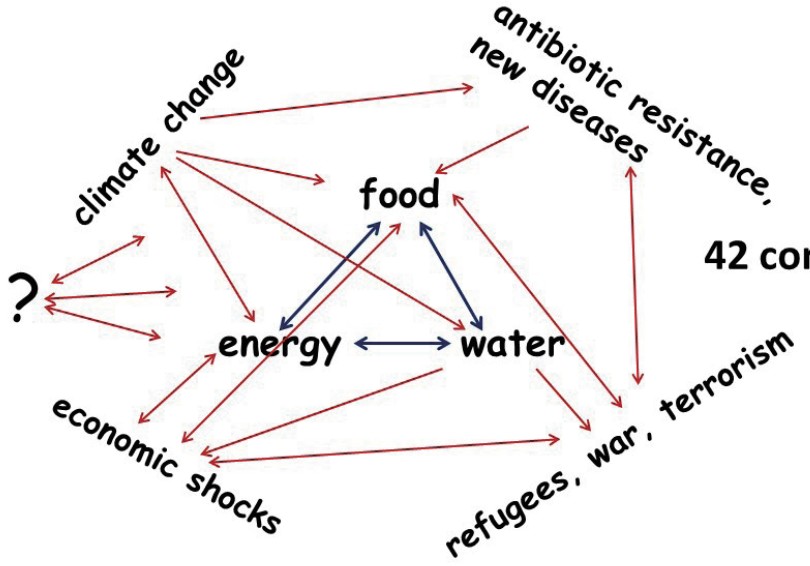
Virtually all systems have at least one, usually several, thresholds; environmental, social, economic, transport, power supply, many others.

it cannot be assumed that all the important thresholds are known

The looming food-water-energy "nexus"



Links and feedbacks in the food-water-energy nexus



42 connections

Cannot predict the consequences of any particular change in any one of the system components.

The only way to deal with the food-water-energy nexus is to build the capacity of the whole system to withstand any and all kinds of impacts -- build **general resilience**.

Attributes of a system that confer resilience, in general

- Diversity - functional diversity
  - response diversity
- Variability – "probe the boundaries"
- Reserves
- Modularity – some connectivity, but not fully interconnected
- Tight feedbacks (e.g. response time)
- Social capital – trust, social networks, leadership
- Innovation and learning (versus subsidies to continue doing the same thing that's not working)
- Adaptive and distributed (overlapping) governance.
- *Fairness / equity.*
- *Humility*

Important points that emphasize what resilience is, and is not:

1. Resilience, *per se*, is not 'good' or 'bad'

2. It is NOT the ability to "bounce back" to what it was before. It's the ability to adapt and change while coping with disturbance, within limits, so as to retain the same identity

3. It is NOT about NOT changing, preventing disturbance. Keeping a system constant reduces its resilience

4. You cannot understand or manage the resilience of a system at one scale.

All complex systems function at multiple scales, and the interactions across scales are critical to resilience

5. Most losses in resilience are consequences of narrowly focused optimization (efficiency drives). This relates to the next point:

6. Maintaining and building resilience comes at a cost; accepting some inefficiencies, several ways of doing the same thing - all too often called “redundancies”, but which are in fact “response diversity”.

7. In applying resilience, the task is not about choosing where *to* go, some particular future, it’s about choosing where *not* to go
- avoiding thresholds into unwanted states (“guided self-organization”)

In much of the world today existing systems are failing, and the need is not to make them more resilient; the need is for transformation to a different kind of system

What determines transformability?

Three things seem to be very important:

i) Getting past the state of denial; accepting reality, that the *status quo* is no longer tenable

ii) Identifying options; some existing and some to be created

iii) Support, generally from higher levels – help TO change, rather than help NOT to change, to keep doing the same things that are failing.

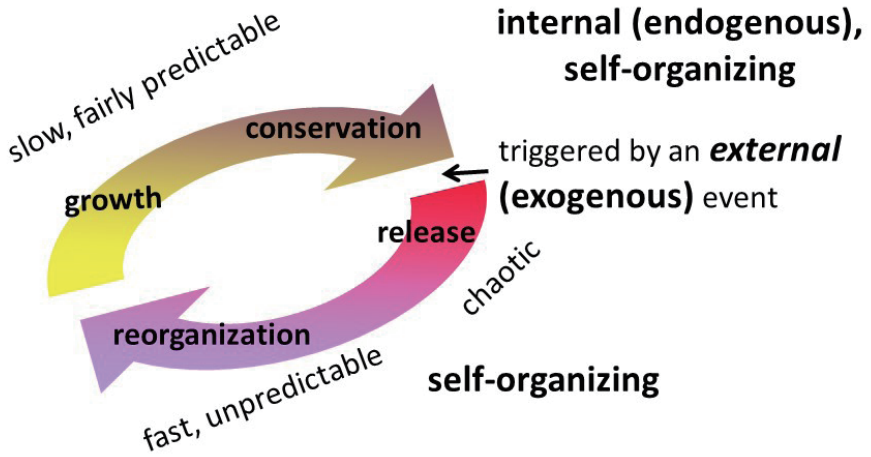
The big question, therefore, confronting much of the world today is:

"Where is there a need to build resilience, and where is there a need for transformational change?"

Where and when to intervene in a system to manage resilience?

A useful guide is the metaphor of the adaptive cycle

Phases of an adaptive cycle



The “collapse” that triggers the shift from the rigid conservation phase to release and re-organization is often a crisis *opportunity* for making a difficult change.

Being prepared and ready to make use of crises is an important part of transformability.

I leave you with four resilience messages

- embrace change and uncertainty
- build systems that will be safe when they fail, rather than trying to build fail-safe systems
- learn how to ride the system, finding adaptive pathways into the future
- be ready for the opportunities that crises provide