A RESILIENCE APPROACH TO THE FUTURE

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Resilience

The capacity to absorb disturbance and *re-organize* so as to retain essentially the same _function_, _structure_ and _feedbacks_ – to have the same _identity_

(The ability to cope with shocks and to keep functioning in much the same kind of way)

Resilience involves three, intertwined concepts
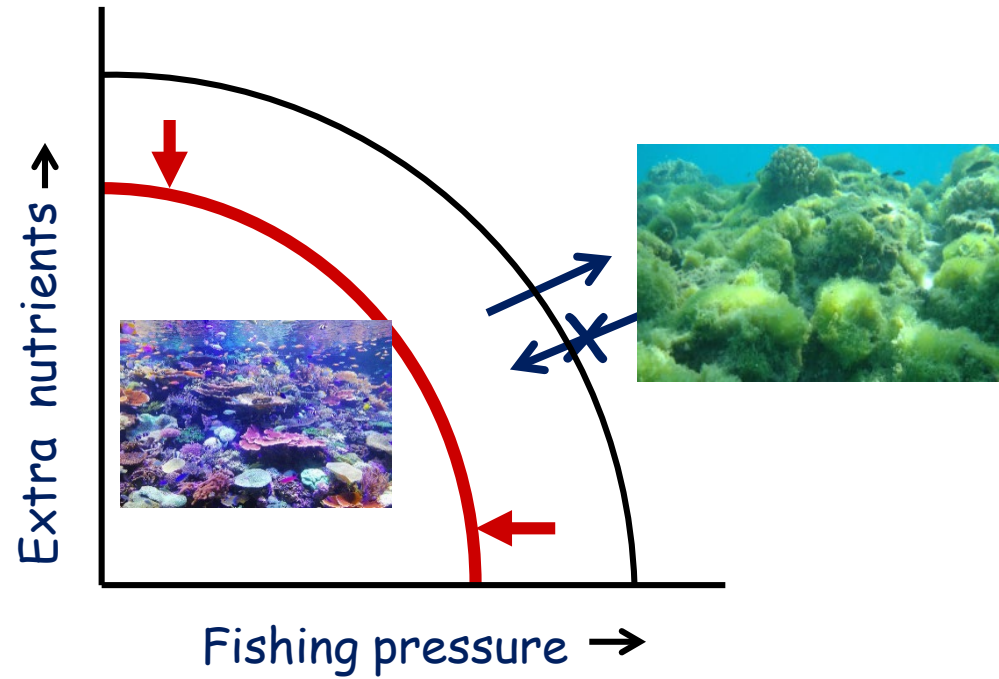
(1) The existence of thresholds

(2) Adaptation

(3) Transformation

(1) *threshold levels* (*tipping points*) in the dynamics of complex systems

Alternate states of coral reefs

Coral reef thresholds and alternate states

Extra nutrients →

Fishing pressure →

Effect of climate change and ocean pH on threshold positions

After Bellwood et al, Nature 2004

Social / technical system thresholds (tipping points)

- economic systems
    (labour supply; debt:income ratio)
- infrastructure systems
    (transport; communication networks, - -)
- crowd behaviour
    (riots)

making a system resilient in one way can cause it to lose resilience in other ways, and at other scales.

there is a danger in focusing on a particular, known threshold

how to build resilience in general, in all parts of the system, to all kinds of shocks?

What kinds of attributes confer resilience ?

- **diversity**
- being **modular** (not over-connected or under-connected)
- **able to respond quickly**
- **reserves** (financial, biophysical, social (memory))
- **learning, innovation, novelty** (vs. subsidies to continue doing the same thing)
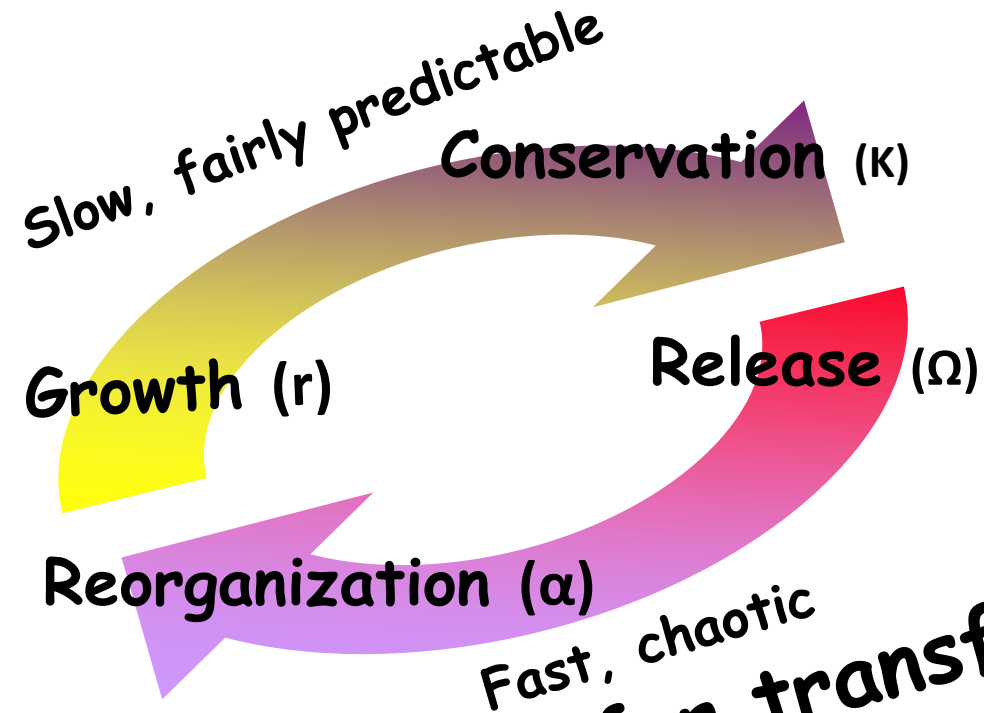- **social capital** (trust, leadership, social networks)

(2) Adaptation

using both **specified resilience** (capacity to avoid or move thresholds) and **general resilience** (capacity to cope with all kinds of shocks in all parts of a system) to maintain identity

(3) Transformation

If a shift into a "bad" state has happened or is inevitable and irrecoverable, adaptation is no longer possible.

The only option is **transformation**

using the 'adaptive cycle'

Slow, fairly predictable

Conservation (κ)

Growth (r)

Release (Ω)

Reorganization (α)

Fast, chaotic

_ opportunity for transformation
"Never waste a crisis"

Resilience is not 'good' or 'bad'

undesirable states of systems can be very resilient

a 'desired' state can become 'undesirable' due to changes in external conditions

resilience is NOT the ability to "bounce back" to what it was before

it is the ability to adapt and change, to re-organise, while coping with disturbance - learning **how** to change in order not to **be** changed

most losses in resilience are the consequences of narrowly focused optimization

e.g. efficiency drives to get rid of redundancies
  - **BUT**, so-called "redundancy" is often "response diversity"

don't try to determine a single "best" future state of a system

predicting the future is impossible

determine the set of possible future states that are acceptable, that constitute an **adaptive pathway** into the future

identify the boundaries of this **adaptive pathway** - and learn how to avoid crossing them into undesirable states from which recovery is not possible