Wales’ Natural Resources: Resilience of Ecosystems and Biodiversity

Prof Jack Cosby
NERC’s Centre for Ecology & Hydrology
Bangor
A substantial challenge!!

Overview

• Improving resilience of ecosystems and biodiversity is a substantial challenge.

• Explore collective efforts to shape and effect change to improve biodiversity and ecosystems in Wales,

• Examine the implications and opportunities contained in the Environment Bill and the Well-being of Future Generations Act.
Big part of the challenge: Resilience

Prelude:
Why Resilience in Wales?
Definitions of Resilience.
A brief history of Resilience.
Set some Resilience challenges for the conference?
Biodiversity and Resilience of Ecosystems Duty

Background

Biodiversity underpins our ecosystems. The more biodiversity we have, the more resilient our ecosystems will become,.....

As part of the Welsh Government’s commitment to reversing the decline in biodiversity in Wales and increasing the resilience of our ecosystems, the Environment (Wales) Bill will introduce a new biodiversity duty, which will also highlight biodiversity as an essential component of ecosystem resilience.
Why Resilience: Well-being of Future Generations (Wales) Bill

A Resilient Wales

Description of Goal:

A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).
What is Resilience?

- The ability to recover quickly from depression or discouragement
- The ability to recover quickly from illness, change, or misfortune
- Strength of character
- An act of springing back
- The property of a material that enables it to resume its original shape or position after being bent, stretched, or compressed
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What is Ecosystem Resilience?

Ecosystems

- Complex systems including adaptive agents, self-organized, self-similar over time.
- Resilience is one of myriads of stability concepts in ecology.

What exactly “is“ resilience? **Wrong question!**
What, exactly, do we “mean” by resilience?

- Resilience of what?
- In response to what?
- Perceived by whom?

**But first, A Brief History of Resilience**
A Brief History of Resilience

Robert May

- Cited more than 1600 times
- Lotka-Volterra plus linear stability analysis (plus brilliant mind)
- Until about 2000, the most frequently used stability concept in Theoretical Ecology
- Why so successful?
Proxy science (model ecosystems)

• Intellectually appealing and thought-provoking

• “Success” in terms of capturing key features of real systems depends on quality of those proxies

• “Engineering Resilience”
Not all ecologists were happy with the "engineers" notion of resilience.

Holling’s review from 1973 introduced a different notion of resilience, that intrigued generations of ecologists,

But never took ground in Theoretical Ecology.
A Brief History of Resilience

C.S. (Buzz) Holling

"Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist. In this definition resilience is the property of the system and persistence or probability of extinction is the result."

“Ecological Resilience”
In 1999, Holling and a small group of other scientists founded the “Resilience Alliance“ (www.resalliance.org):

The Resilience Alliance is a research organization comprised of scientists and practitioners from many disciplines who collaborate to explore the dynamics of social-ecological systems. The body of knowledge developed by the RA, encompasses key concepts of resilience, adaptability and transformability and provides a foundation for sustainable development policy and practice.
Babel, or the ecological stability discussions: an inventory and analysis of terminology and a guide for avoiding confusion

Received: 4 June 1996 / Accepted: 5 November 1996

Abstract We present an inventory and analysis of discussions of ecological stability, considering 163 definitions of 70 different stability concepts. Our aim is to derive a strategy that can help to dispel the existing “confusion of tongues” on the subject of “stability” and prevent its future recurrence. The strategy consists of three questions that should be kept in mind when communicating about stability properties. These three questions should overcome the three main sources of confusion in terminology.

Introduction

Human concepts are signposts through the confusing complexity of nature. We need them to narrow down the never-ending tally of possible questions that we empirically or theoretically ask of nature. Without concepts it is impossible to work scientifically. The price for this, however, is that the concepts determine the ways and methods in which we perceive nature. Critical examina-
Volker Grimm’s 1996 review

Table 1  A list of stability terms to be found in the literature. Adjectives (e.g. stable, persistent) are changed into substantives. The numbers in parentheses denote the number of definitions to be found for each expression. Terms marked with an asterisk (*) are defined in the original German. The terms are classified as: (1) Conventional terms (first column); (2) newly invented terms (second column); (3) “Stability”, plus an adjective (third column).
A Brief History of Resilience

Volker Grimm’s 1996 review

Essentially, there are only six (three) different stability properties

1. Constancy: Staying essentially unchanged
2. **Persistence**: Persistence through time of an ecological system
3. **Resistance**: Staying essentially unchanged despite the presence of **disturbances**
4. **Resilience**: Returning to the reference state (or dynamics) after a temporary **disturbance**
5. Elasticity: Speed of return to the reference state (or dynamics) after a temporary **disturbance**
6. Domain of attraction: The whole of states from which the reference state (or dynamics) can be reached again after a temporary **disturbance**
A Brief History of Resilience

So how do we view resilience now, 40 years after May and Holling?
What are the pressures?

Four of nine planetary boundaries have now been crossed as a result of human activity, says an international team of 18 researchers in the journal Science:

- climate change,
- loss of biosphere integrity,
- land-system change,
- altered biogeochemical cycles (N&P).

(Steffen et. al, 16 January 2015, Science)
How do pressures act?

Pulse (episodic) vs Press (chronic) Pressures
What do we want Wales’ natural resources to do?

“Bend not break”

Be able to recover their function (so we receive the benefits) when exposed to:

Chronic pressures
• Warming
• Air pollution
• Land Management

Episodic pressures
• Pests and disease
• Droughts and Storms

i.e. be resilient
(& sustainable)
Conference Challenge?

What are the methods and metrics for quantifying Resilience?

“Make everything as simple as possible, but not simpler”

If we knew what we were doing, it wouldn’t be called research.
Ecosystem Services can be delivered at high rates but with the underlying Natural Capital being eroded i.e. we are not using them sustainably

Living off your savings to pay your bills - Similar analogy to the ‘illusion’ of GDP
People and natural resources are highly inter-connected
How can we monitor Wales to reflect this complexity and inter-dependence?

The Glastir Monitoring and Evaluation Programme

- GHG’s
- Soil
- Biodiversity
- Freshwater
- Socio-economic benefits
- Woodland
GMEP data and modelling work have the potential to deliver resilience metrics around 4 key issues.
GMEP: An example of collaborative working involving 17 organisations and > 100 scientists
Current (and Future) Challenges

- Little consensus in scientific world on resilience metrics
  - Connectivity can be undesirable during disease outbreaks
  - Extent and diversity can be mutually exclusive
- Targets will be challenging and potentially impossible
- In the meantime:
  - Actions to improve condition of our Natural Resources
  - Monitor Natural Resources to see if successful as we go along as evidence base is incomplete

Combine with new sensor technologies to develop early warnings (e.g. the Environmental Internet of Things)
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Thank you & questions

jaccos@ceh.ac.uk

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