Why resilience?

What is resilience?

Operationalizing resilience

Resilience & Sustainability
Anthropocene
humanity no longer impact or disturbance but an integral part of ecosystem function

how do these social-ecological systems work?
Ecological Change in 20th Century produced surprises

- Pests and pathogens rapidly evolved resistance to biocides
- Toxins biomagnified in food chains
- Emergence of disease facilitated by modifying ecosystems (e.g. irrigation)
- Removing top predators decreased resilience & reliability of many ecosystem services

(Bennett et al 2003 Frontiers; Raudsepp-Hearne et al 2010)
Approaches to sustainability based largely on assumptions of linear, isolated world

Why resilience?

What is resilience?

Operationalizing resilience

Resilience & Sustainability
“Ecological Resilience”

Ecologist C.S. Holling analysis of insect outbreaks in 1970s

Systems approach

Extended to many ecological management situations & later to management more generally
Resilience: Two Faces

Amount of shock system can absorb without reorganizing

Regime A | Regime B
---|---

Persistence Resilience

Capacity for self-organization, learning, adaptation

Collapse

Reorganization

Reorganizational Resilience
Development of Resilience

1970s model

1980s critique

1990s empiricism, diversification

2000s acceptance diversification

Pathological dynamics of systems

regime shifts

ecological resilience

transformation
Regime shifts are substantial, persistent, reorganizations in structure and processes.

E.g. Coral Reefs

<table>
<thead>
<tr>
<th>Regime</th>
<th>Diverse coral dominated reef</th>
<th>Algae dominated reef</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecosystem Services</td>
<td>Food, Tourism, Storm surge protection Reduced &amp; less valuable food</td>
<td></td>
</tr>
</tbody>
</table>

Source: CoralReefInfo
What causes regime shifts?

Biggs et al. 2012

"Fast"
Dominant feedbacks are overwhelmed

"Slow"
Dominant feedbacks are slowly eroded
Dynamics of resilience & social-ecological transformation
Holling’s pathology of natural resource management - resilience dynamics

1) to increase supply of desired ecosystem services people simplify ecosystem

2) this decreases ability of ecosystem to self-regulate

3) people become increasingly dependent on continued supply of ecosystem services

5) People invest in artificial regulation

6) Artificial regulation further decreases resilience leading to either

   a) a rigidity trap or

   b) crisis & reorganization of SES

(Holling 1986, Holling, Gunderson, & Peterson 2002)
Holling’s Adaptive Cycle

- Reorganization
  - Active: Growth
  - Passive: Release
- Conservation
  - Active: Conservation
  - Passive: Reorganization

- Capital
  - Active: strong
  - Passive: weak

- Connectedness
  - weak
  - strong
Adaptive Cycle & Key Actors

New type of system?

Key actors

α 
Reorganization Alternatives

Decision Makers

Bureaucratic

Catalyst

Activist

K 
Implementation Expectation

r
Growth Goals & Plan

Ω 
Crisis
Undeniable differences between expectations & observations

(Gunderson and Holling 2002)
## Organization roles identified using Adaptive cycle
From large scale environmental governance

<table>
<thead>
<tr>
<th>Phases</th>
<th>r-&gt;K</th>
<th>K-&gt;Ω</th>
<th>Ω-&gt;α</th>
<th>-&gt; novel</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key internal actors</strong></td>
<td><strong>Bureaucracy</strong></td>
<td><strong>Loyal heretics</strong></td>
<td><strong>Reformers</strong></td>
<td><strong>Higher level decision body</strong></td>
</tr>
<tr>
<td><strong>Problem Network</strong></td>
<td><strong>NGOs</strong></td>
<td><strong>Activists</strong></td>
<td><strong>Epistemic leadership</strong></td>
<td><strong>Visionary leadership</strong></td>
</tr>
<tr>
<td><strong>Policy activity</strong></td>
<td><strong>Implementing</strong></td>
<td><strong>Destroying</strong></td>
<td><strong>Framing new options</strong></td>
<td><strong>Resolution &amp; transformation</strong></td>
</tr>
<tr>
<td><strong>Strategy</strong></td>
<td><strong>“do more”</strong></td>
<td><strong>“create crisis”</strong></td>
<td><strong>“unlearning yesterday”</strong></td>
<td><strong>“invent tomorrow”</strong></td>
</tr>
<tr>
<td><strong>Response to change</strong></td>
<td><strong>Ignore &amp; deny change</strong></td>
<td><strong>Forcing change</strong></td>
<td><strong>Articulate new futures</strong></td>
<td><strong>Compromising &amp; reconciling</strong></td>
</tr>
<tr>
<td><strong>Guiding vision</strong></td>
<td><strong>Stability</strong></td>
<td><strong>Survival</strong></td>
<td><strong>Reconstruction</strong></td>
<td><strong>Creating new visions</strong></td>
</tr>
<tr>
<td><strong>Role of science</strong></td>
<td><strong>Science supports policy</strong></td>
<td><strong>Science invalidates policy</strong></td>
<td><strong>Science integrates &amp; assesses</strong></td>
<td><strong>Politically expedient science selected</strong></td>
</tr>
</tbody>
</table>

(Gunderson 1995; Holling, Gunderson, Peterson 2002)
Panarchy

Importance of cross-scale feedbacks

Memory - larger scales shape the reorganization of smaller scales after crisis

Transformation - Smaller scales can trigger reorganization or crisis at larger scales, if larger systems are open to change

(Gunderson & Holling 2002)
Diversification of Resilience Concepts

- Adaptive Management
- Adaptive Co-Management
- Adaptive Governance
- Social-ecological innovation
- Social-ecological networks
- Transformation

Resilience '73
Regime Shifts

Adaptive Cycle

Ecological
Social-ecological
Questions?
Why resilience?

What is resilience?

Operationalizing resilience

Resilience & Sustainability
Why Use Resilience?
Rob Hopkins of Transition Town Movement:

“the concept or resilience is a much more useful idea than that of sustainability. Sustainability implies that we are trying to design a steady-state system with less inputs and less outputs than we have at the moment, which can carry on indefinitely. Whereas actually what we need to be designing for is the ability to withstand shock ... [and] it's about seeing that shock as an opportunity to change.”

“making a community more resilient, if viewed as the opportunity for an economic and social renaissance, for a new culture of enterprise and reskilling, should lead to a healthier and happier community while reducing its vulnerability to risk and uncertainty .... resilience is reframed as a historic opportunity for a far-reaching rethink”.

“Transition has been framed in terms of building (or rebuilding) resilience in local communities. So far, the movement seems to have successfully used resilience as a motivating framing concept. The lack of specificity used in the framing of resilience has probably contributed to resilience being perceived as an appealing goal by the wide range of citizens who have become involved with the movement”
Two examples of Resilience Application

• Vacation area in Northern Wisconsin, USA
• Town of Eskiltuna, Sweden
Paradox of Development in Northern Wisconsin

Desire for North Woods Life
Quiet, Independence, Jobs,
Quality Water & Fish

Destroys North Woods Life
Framework for Assessing Resilience

1. **Scoping**
2. **Imagining the System**
3. **Synthesis & resilience analysis**

New understanding
New policies & actions
Shared understanding

(Walker et al 2002)
NHLD Participatory Scenarios

Anaheim North

- **Unintended consequences** of development + myopic lake associations -> regional Balkanization

Northwoods Quilt

- **Path to Ecological Development** - Lake association power -> Diverse lake management -> Lake Heterogeneity

Walleye Commons

- **Tourist Decline** - Ecological Degradation + Social Conflict --> Population decline --> Tribal dominance

Refugee Revolution

- **Settlement Boom** - 2nd homeowners start to stay most of year long --> region becomes work rather than tourism focused
Resilience Assessment & Strategies

Unrecognized Resilience
  – Diversity of landscape; People

Unrecognized Adaptive Capacity
  – Cooperation between state, lake associations & tribal management
  – Scientific ecological understanding

Unrecognized Surprises
  – People are providing a new cross-lake ecological connection (fishing, invasive spp., development)
  – Migration of people to region

Opportunities
  • Build of inter-group connectivity
    – need for bridging organizations & individuals
  • Lac du Flambeau tribe potential source of innovation (institutional diversity)
  • Creating shared vision of future
(Peterson et al 2003; Peterson 2008)
Urban Resilience Assessment in Eskilstuna, Sweden

Preparedness for crises

Policy and planning for sustainable development

Medium sized town

Green leader

Shifting economic possibilities
Resilience Assessment Process in Eskiltuna …

…of what FOCAL SYSTEMS:
- Food supply
- Water supply
- Transportation
- Employment

…to what SPECIFIC THREATS:
- Energy crisis
- Financial crisis
- Climate crisis
- Planetary boundaries

So what? IMPACT ON:
- Society
- Economy
- Environment

Now what? STRATEGIES FOR RESILIENCE:
Identify existing and new strategies to strengthen resilience in the face of these
Contributions of Resilience Assessment Process

**LEARNING**
- Application on their system
  - Assumptions about the systems we manage
  - Concepts
  - Method for analysis

**COMMON SYSTEM UNDERSTANDING**
- Historical perspective on changes
- Interconnectedness between parts and across scales
- System dynamics

**Process**
Application on governance?

Brings in
- Complex adaptive systems thinking
- Planning for long-term uncertain threats
  ...strengthen:
  - Operationalization
  - Holistic perspective and sector integration

...and has a potential to
- Clarify the shared vision
- Provide alternatives to “Business as Usual”
Why resilience?

What is resilience?

Operationalizing resilience

Resilience & Sustainability
Resilience for the Anthropocene

Anthropocene will produce surprise, loss, reorganization and demands transformation.

Resilience can act as an ‘operating system’ or framework for living in the Anthropocene.

Resilience focuses on both sustaining what we want to persist.

Building the capacity to adapt or transform into something better.
Learning & Resilience Need One Another

“Learning provides an alternative for crisis”
- Frances Westley 1995

Resilience is ability to persist despite surprise

To adapt to surprise you have to be able to learn

Learning requires being able to have experiments fail, & that requires resilience
Four Dimensions of Resilience Management

Bridging different knowledge systems for learning
  e.g. Build local ecological knowledge

Building Resilience
  e.g. Nurturing diversity for reorganization and renewal

Experimental Management
  e.g. management integrates monitoring, adaptation and mitigation activities

Navigating larger context
  e.g. Building external networks & collaborations – building cross-scale resilience
Resilience Building Strategies

Maintain function
- response diversity provides insurance
- functional diversity maintains functions
- cross-scale diversity provides robust function

Nurture sources of renewal
- Enhance mobile links; support areas;
- cross-scale function; experiments

Manage disturbance
- Allow failure; Produce & maintain legacies; maintain patterns

Slow release (omega)
- Avoid loss of ‘capital’, maintain legacies

Create alternatives (alpha)
- Create shared vision, wait for windows of opportunity,
  develop new feedback loops,
Criteria for a “good” anthropocene

• Fair
  – location of birth doesn’t dominate life chances

• Prosperous
  – many opportunities to live fulfilling life

• Sustainable
  – civilization strengthens rather than undermines our biospheric life support

• Resilient
  – Able to cope & benefit from surprise

• Fun?
For more information

Garry Peterson homepage
www.stockholmresilience.org/peterson

Stockholm Resilience Centre
www.stockholmresilience.org/

Twitter:
@resilienceSci

Resilience Alliance
resalliance.org

Ecology & Society
Ecologysociety.org