What on Earth is Resilience?
Law for Social-Ecological Resilience

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Capturing Essential Feedbacks

• In social-ecological systems
• In relation to tipping points, thresholds
• Across levels and scales
• In multilevel and adaptive governance
• For transformations towards sustainability
A biosphere shaped by humanity
Perspective

- Integrated economies and societies
- The living resource base as the foundation for the integration
- Strengthening the ability of people to enhance Earth’s life support capacity for societal development and human wellbeing
Common Pool Resource Stewardship and Climate Change

Seafood management in Maine, USA
a success story
Lobster aquaculture and juicy dinners........ a gilded trap?

Rhode Island – 72% loss from shell disease

Steneck et al. in review
Tipping points –
critical transitions
Marine shifts

Losses of ecosystem services

Hughes et al. 2005. TREE
Critical transitions and regime shifts

Critical Transitions in Nature and Society

Marten Scheffer
Princeton University Press

Scheffer et al. 2001. Nature
<table>
<thead>
<tr>
<th>Type of Misfit</th>
<th>Definition of Mechanism</th>
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<tbody>
<tr>
<td>Spatial</td>
<td>Governance does not match the spatial scales of social-ecological processes</td>
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<tr>
<td>Temporal</td>
<td>Governance does not match the temporal scales of social-ecological processes</td>
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<tr>
<td>Threshold behavior</td>
<td>Governance does not recognize, or is unable to avoid, abrupt shifts in social-ecological systems</td>
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<tr>
<td>Cascading effects</td>
<td>Governance is unable to buffer, or amplifies cascading effects between domains</td>
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Cascading effects
El Niño, Borneo and global markets
Turning El Niño from creator to destroyer

1997 fires - 13–40% of the mean annual global carbon emissions from fossil fuels

e.g. Curran et al. 2000. Science
Global drivers (exogenous and endogenous)

Changed C/N cycles and rising atmospheric GHG concentration
Increasing antibiotic resistance
Increasing connectivity
Rising human numbers and urbanization
Increasing per capita resource use
Nuclear proliferation
International terrorism
Decreasing transparency (in financial systems, production chains, governance, trade)

Unwanted outcomes

Climate
- global warming
- sea level rise
- floods, droughts
- climate refugees

Ecosystem
- declining agriculture and fisheries
- ocean acidification
- reduced access to fresh water

Human health
- emerging pandemics
- resurgent existing diseases
- famines
- other mortality events

Economic
- energy shocks
- financial market shocks
- trade disruption
- increased correlation of risk

Collaborative, global institutions for social-ecological resilience – is it at all possible?
Illegal, unreported and unregulated (IUU) overfishing in the Southern Ocean

- Mobilization and action through an international platform putting pressure on nations and providing enforcement measures
- The CCAMLR Convention (Commission for the Conservation of Antarctic Marine Living Resources)

Österblom et al. 2010. PLoS ONE
Three features of social-ecological resilience

1. PERSISTENCE in the face of change, buffer capacity, withstand shocks

2. ADAPTABILITY the capacity of people in a social-ecological system to manage resilience e.g. through collective action

3. TRANSFORMABILITY the capacity of people in a social-ecological system to create a new system when ecological, political, social or economic conditions make the existing system untenable

Walker et al. 2002, Folke et al. 2010 Ecology & Society
The Resilience of the Earth System
Aborigines arrive in Australia
Beginning of agriculture
Great European civilisations: Greek, Roman
First migration of fully modern humans out of Africa
Migrations of fully modern humans from South Asia to Europe

Young and Steffen. 2009. In: Chapin et al. (eds.). *Principles of Ecosystem Stewardship*. Springer
A SAFE OPERATING SPACE FOR HUMANITY to stay away from global tipping points

Global governance challenges of planetary boundaries

- the capacity of international institutions to deal with individual planetary boundaries, as well as interactions between them;
- the challenges posed by institutional interactions and inter-linkages;
- the role of international organizations in dealing with planetary boundaries interactions;
- the role of global governance in framing social-ecological innovations

Galaz et al. in review
Lack of SES resilience –
expect surprise
SES transformations and law?

• Prepared and navigated transformations of social-ecological systems for shifting towards more flexible, adaptive forms of management and governance

• Focus on transformations that increase our capacity to learn from, respond to, and manage environmental feedback in social-ecological systems

• Includes redirecting governance into restoring, sustaining, and developing the capacity of social-ecological systems to generate essential ecosystem services in the context of the planetary boundaries
Transformation of SES

Preparing the system for change

Navigating the transition

Building resilience of the new direction

Window of opportunity

Sweden’s coastal landscapes
Australia’s Great Barrier Reef
Chile’s coastal marine resources

Olsson et al. 2008. PNAS
Gelcich et al. 2010. PNAS
Critical elements in the Chile transformation

- A shift to a democracy, following 17 years of a dictatorship, provided a window of opportunity and new paths for policy innovation and ecosystem management.
- Social processes, including experimenting, co-learning and communication about ecosystem dynamics between fishers and scientists, and strong social networks provided critical elements for the governance transformation.
- Enabled fishers to reorganize and influence new national fishery legislation that introduced maritime zoning, regulated mobility of the fleets, allocated exclusive territorial users rights for fisheries and introduced a differential individual transferable quota for harvested species.

Gelcich et al 2010. PNAS
Bridging organizations

- Performing essential functions in crafting effective responses to change in social-ecological systems
- Linking groups, networks and organizations across levels, creating the right links, at the right time, around the right issues
- Accessing and combining multiple sources of knowledge and interests
- Enhancing vertical and horizontal integration and social learning

Folke et al. 2005, Hahn et al. 2006, Olsson et al. 2007
• Collective action and multilevel governance may lead to traps and vulnerable SES if ecosystem resilience is not accounted for.
• Political crises, disconnected from environmental issues, may open up opportunities for transformational change of SES.
• Open access and unsustainable extraction affecting coastal resources may be curbed through international action
The Resilience Lens provides new, often surprising insights