SOME COMPARISONS BETWEEN ECOLOGICAL AND HUMAN COMMUNITY RESILIENCE

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At least five themes emerged from a comparison between ecological and community resilience (Gunderson, 2009; Table 1). One is that both systems demonstrate the multiple meanings of resilience—both in terms of recovery time from and capacity to absorb disturbances. The second theme is that both systems recognize the role of diversity in contributing to resilience. The third theme is the role of different forms of capital. The fourth is the importance of cross scale interactions. The fifth theme involves the need for experimentation and learning to build adaptive capacity. Each of these is discussed in the following paragraphs.

Scholars of both ecological and community resilience recognize that at least two different types of resilience exist. Vale and Campanella (2006) define urban resilience as "the capacity of a city to rebound from destruction," which is very similar to the Holling (1996) definition of engineering resilience. Yet, other authors apply ecological resilience concepts to community resilience. This involves a regime change, in which the structures and processes and identity of community either evolve into a more desired configuration or devolve into a lesser desirable state. Examples of the former include the transformation of San Francisco into a "modern" city following the earthquake of 1906 (Vale and Campanella 2005) or the decline of New Orleans as a regional center of culture, economic, and political power following the 1927 flood of the Mississippi River (Barry 1997).

Diversity is important to providing ecological resilience. Numeric diversity (different types of entities) is probably less important functional diversity (Walker and Salt 2006). Also, the ways in which functional units are connected is a critical factor contributing to system resilience (Vale and Campanella 2006).

Various forms of capital are critical to ecological and community resilience. Capital is developed during phases of system growth and development. That capital, as well as the influx of capital from broader areas, is critical to system recovery and in determining system trajectories (MEA 2005). Especially important to natural disasters is the role of maintaining or restoring natural capital, in the form of ecosystem goods and services (Olshansky and Kartez 1998). Wetland ecosystems, whether forested or not, are critical buffers to mitigating hurricane impacts of coastal areas (Day et al. 2007). Floodplain ecosystems provide similar functions during extreme floods.

Panarchy is a theoretical model that suggests how complex systems interact across scales of space and time. Panarchy suggests that certain properties, such as connectivity, can lead to system vulnerability in the form of perpetuating or cascading disturbances that can expand across wider spatial and temporal scales.

Panarchy theory also suggests the critical importance for cross scale interactions—when the broader and slower variables are critical to post-disturbance recovery and resilience.

Coupled systems of humans and nature are complex, in terms of how they anticipate and respond to natural disasters. These complexities present great uncertainties for many facets of society. The capacity to deal with the types of uncertainty and surprises will requires novel approaches, creative combinations of strategies, and the ability to adapt in a changing environment. Accelerating learning and supporting novel approaches that limit vulnerability and expand our understanding of the occurrence and impacts of natural disasters seem to be critical components of building community resilience.

Table 1. Similarities and differences between ecosystems and human communities with respect resilience and adaptive capacity in the face of natural disasters

Theme	Ecological systems	Human community
Definition of resilience	Two meanings; one is defined as return time following a perturbation, the other as the amount of disturbance to shift regimes.	Multiple meanings, but primarily refers to return or recovery time. Limited application to regime shifts.
Anticipation of disasters	No ability to anticipate, ecological systems can only adapt through selective pressures.	Human communities can anticipate disasters through foresight and experience.
Responses to disasters	Functional forms of biodiversity across scales provide resilience. Networks and connectivity can provide resilience.	Functional components provide resilience. Disaster effects can be intentionally buffered by technology. Networks, linkages can provide resilience through increased communications.
Recovery after disasters	Can return to prior configuration, transform to degraded regime.	Can return to prior configuration, devolve into degraded regime, or evolve into desired regime.
Renewal and novelty	Dependent on cross scale inputs (seeds, carbon, energy) and remnant forms of capital.	Also dependent on cross scale inputs. More novelty, creativity in creating new configurations. Different forms of capital can be substituted.

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