

## Societal collapse or transformation, and resilience

The recent article by Butzer (1) illustrated, through historical analysis, that resilience is not enough: many societies have collapsed irrespective of their resilience capacity. We argue that it might be because of their preoccupation with resilience. What they needed, and what Butzer also writes, is transformability: "...after overcoming initial, ideological dissonance, people can indeed come together to support change" (1). This is truly a message for our times as governments struggle with transforming to low-carbon societies.

So, how might we frame future studies that Butzer advocates? Butzer avoids the resilience-vs.-transformation issue by recommending research into information diffusion and socioeconomic integration across class and spatial scales. Although we agree that these specific domains, and panarchy, are important, we suggest that thought needs to continue to be given to a conceptual frame, and in particular to the relationship between "resilience" and "transformability." It is no longer helpful to think of transformability as simply an overshoot of resilience that causes the rolling ball to fall outside the bounds of an existing socio-ecological system (2).

The same-trajectory perspective that characterized the foundational theory of resilience continues today: in Walker's keynote paper to the Resilience 2011 Conference "Resilience, Innovation, and Sustainability: Navigating the Complexities of Global Change," he spoke of "resilience towards transformability" and that resilience and transformability "are not opposites" (3).

We suggest that, consistent with Butzer's article, characteristics underpinning, and impetus for, resilience and transformation may sometimes be common but they may also be different: resilience is, by definition, inward-directed, centripetal, pursuing the maintenance of an existing system's identity, feedbacks, structure, and functions. Our current societies, although unsustainable, are brilliantly resilient and self-reinforcing. Transformation, by contrast, requires accidental or deliberate outwardness, centrifugal thinking, trajectories toward "outside

the box," e.g., where researchers and governments propose a shift to a low-carbon economy (4).

Fig. 1 frames these differences. Resilience aims inward, transformability outward. The four axes are drawn from Walker's (5) "Determinates of Transformation." They are overarching labels to aggregate system attributes such as socioeconomic integration, as flagged by Butzer. Some of these attributes might (initially) strengthen resilience (Fig. 1A), but, we suggest, when leadership or societal activism changes the frame to transformability, they can create centrifugal momentum. Other attributes such as visionary leadership (identified by Butzer), latent capitals, societal dissatisfaction with the status quo, and open societal networks will likely only contribute to transformation. As momentum leads to societal transformation, it may lead to collapse, or to a better, changed system. Usually, we think of transformation to collapse as inadvertent, although Western colonization that caused collapse of indigenous cultures and Pol Pot's transformation of Cambodia were deliberate. Positive societal change to new states, such as the global need to transform to sustainable, equitable, low-carbon society, requires deliberate transformation. We call on all colleagues investigating societal change to clarify the attributes and characteristics necessary for societal transformation and resilience for a sustainable future.

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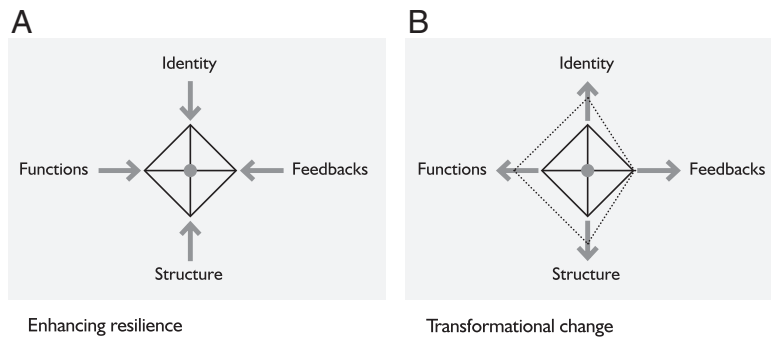
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**Fig. 1.** Conceptual representation of resilience and transformation of a social ecological system. (A) Representation of a system increasing resilience capacity, in which the difference between the two states being assessed is minimal and the system is reinforcing current characteristics: identity, feedbacks, structure, and functions (arrows are pointing in toward the center). (B) Representation of a system undergoing transformational change, with the two states, the gray shaded box and the dotted line, showing differing system characteristics (arrows are pointing outwards).