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Letter Resisting Resilience Theory: AResponse to Connelland Ghedini

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Letter

Resisting Resilience Theory: A Response to Connell and Ghedini

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Connell and Ghedini [1] argue that ecologists are primarily concerned with community change and tend to ignore processes like trophic compensation that contribute to community or system-level stability. Resilience, they claim, is the study of change, and researchers should spend more time studying stabilizing processes to better predict the types of changes documented by ecologists who study resilience [2,3]. The bulk of their paper addresses resilience and related concepts to contextualize resistance to change, but their arguments are diminished because the authors fail to explicitly place their work within the range of resilience concepts that have proliferated across academic disciplines. More importantly, the paper furthers confusion regarding core ecological resilience concepts. Within the discipline of ecology, resilience concepts have been developed in a fundamentally cohesive way [4]. Understanding the resilience of complex systems of humans and nature during this time of rapid global change is important and the misuse or casual use of concepts with specific meaning is more than simply a trivial point of contention; it potentially obscures processes and properties that have direct relevance to humanity's interaction with the environment.

Ecological resilience has a rich definitional history, necessary to distinguish it from engineering resilience, which is predicated on different assumptions of system behavior [5]. To wit, ecological resilience was originally defined as ‘a measure of the persistence of systems and their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables’, whereas engineering resilience is ‘the ability of a system to return to an equilibrium state after a temporary disturbance’ [6]. The two definitions are critically different in terms of assumptions of system dynamics and behavior (nonlinear, out-of-equilibrium, and multiple alternative regimes versus a single linear equilibrium). Within ecological resilience, researchers have focused on different elements of a broad but coherent theoretical base (e.g., [7,8]). Connell and Ghedini [1] do not state which form of resilience they are referencing, but their usage of the term flips between engineering and ecological resilience. Although the reader is inclined to think they mean ecological resilience due to the nature of their discussion and references, their usages of the term are confusing (Box 1) and suggestive of engineering resilience, as when they focus on a process that promotes stabilization but neglect to discuss the role of stabilization in maintaining engineering but reducing ecological resilience. The first paper they cite is from the ecological resilience literature [2], whereas the case study they later reference is an example of engineering resilience [9], and their definitions cannot be assigned readily to either meaning (Box 1).

Another critical point of confusion with direct bearing on the premise of their paper is exemplified in the first paragraph of the manuscript, which is subtitled ‘Ecosystem Collapse Need Not Be Surprising’, yet said paragraph actually discusses community change. Ecosystems are more than a community and community change ought not to be conflated with regime shifts, which are generally understood to occur at the level of ecosystems or higher levels of organization. Changes in community dynamics can drive an ecosystem-level regime shift, but they are not the same thing. For example, in Caribbean reefs the functional extirpation of an entire community (herbivorous fishes) did not immediately induce a regime shift because urchins were able to compensate until disease wiped them out [10]. Defining resilience as the study of change (Box 1) is both vague and inaccurate. Much resilience research has been precisely concerned with identifying system attributes that allow ecological and social–ecological

Box 1. Multiple Conflicting Usages of ‘Resilience’ Found in Connell and Ghedini [1]

Their Glossary Definition

The capacity of a system to reorganize and return to a prior state after a disturbance.

Their Parenthetical Definitions

(i) The processes that shift a system from one state to another and back
(ii) The regenerative capacity for recovery
(iii) Change in response to disturbance
(iv) Mechanisms that adjust to change

Issues

Return to a prior state (glossary definition) suggests engineering resilience, which is concerned with the rate of return to equilibrium. Their definition, however, does not specify an equilibrium state and seems to allow alternative states; nor does it fit ecological resilience, which is concerned with system capacity to buffer disturbances and *prevent* a regime shift, not shift and then shift back as their definition implies.

Nor can ecological resilience be conflated with (i) the processes around which a regime is organized, as system resilience is not defined by those processes – the regime is. Although adaptive capacity is related to degree of resilience, recovery post-disturbance (ii) is engineering resilience. Finally, the words ‘change’ and ‘disturbance’ in (iii) and (iv) are not defined. Is change a regime shift or some lesser degree of reorganization? Either way, the definitions are too vague to be understood as belonging to any particular theory of system resilience.

systems to buffer disturbance without undergoing a regime shift [3,8,11]. Indeed, the literature is so large we cannot begin to do it justice.

Ironically, resistance and its accompanying mechanism, trophic compensation, fit quite neatly within the theoretical framework of (ecological) resilience theory. Classifying the mechanism under resistance is unnecessary, as the mechanism of trophic compensation likely belongs alongside the panoply of other mechanisms such as functional compensation, functional reinforcement, and response diversity that contribute to ecological resilience. We say likely, because the premise of Connell and Ghedini appears to rest on one mesocosm experiment confined to two species [12]. Although mesocosm experiments can provide powerful insights into community dynamics that may well scale up to more realistic and complex communities and ecosystems, at the present time the role of trophic compensation as a buffering mechanism against disturbance remains largely hypothetical. In failing to differentiate between engineering and ecological resilience and then also ascribing conflicting, flattened, and even inaccurate definitions to resilience, they inadvertently diminish the strength of what they were intent on communicating, which is that 'quiet' mechanisms such as trophic compensation may play a role in buffering disturbance and understanding the limits of such mechanisms may allow us to better characterize the degree of resilience in any given system, or its vulnerability to a regime shift. Unfortunately, the merits of the mechanism in the context of ecological resilience are unlikely to receive due attention given their misuse of resilience in framing their argument.

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