

The state of the art for application of resilience thinking in social-ecological systems

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BOOK REVIEW - DOSSIER

Reinette Biggs, Maja Schlüter, Michael L. Schoon (editors). *Principles for Building Resistance: Sustaining Ecosystem Services in Social-Ecological Systems*. Cambridge University Press, 2015. 290 p. ISBN: 978-1-107-08265-6.

This integrated multi-author book is a product of the Resilience Alliance Young Scholars network, an international network of resilience scientists, in collaboration with senior Resilience Alliance researchers. It builds on a 2012 article by many of the same authors (BIGGS *et al.*, 2012). The book is a product of an extensive set of online discussions, several workshops, and a Delphi-like survey process dating back to 2008, and can therefore be seen as a distillation of the thinking within the Resilience Alliance network. As Lance Gunderson notes in the interview section of this Special Issue, the historical roots of this intellectual and epistemological network are in the US, Sweden, Australia and South Africa, and in fact 29 of the 31 authors are from these four countries plus Canada (with one from Spain and one from the UK).

Gunderson also notes that the resilience network has ecological roots but has ambitiously sought to extend resilience concepts to linked social-ecological systems (SES) since the 1990s. The purpose of this book is to synthesize and review the evidence for various propositions that have been promoted as key to enhancing the resilience of social-ecological systems. In particular, the focus is on maintaining the potential of social-ecological systems to provide ecosystem services in the face of disturbance and change. This means resilience of ecosystem services rather than maximizing those services, while neglecting other values of social-ecological systems such as equity, wealth or human development.

The authors of this volume are quite cognizant of the equity concerns and potential for conflict and elite capture that are inherent in trade-offs between provision and resilience of various ecosystem services, including inter-generational tradeoffs, tradeoffs across scales (local vs. global ecosystem services), and tradeoffs between different users within a given scale. They provide a welcome early chapter on "Politics and the resilience of ecosystem services" which highlights political and social implications of governance or management decision-making and action. This can be a contentious process among different interest groups, with the outcome determined by power relations, and inevitably privileges certain ecosystem services and benefits different groups of people to greater or lesser extents. The chapter also recognizes the normative nature of decision-making and warns against "scientization" of such processes that gives power to scientists and enables them to defend their own interests without

making these explicit (or even being aware of them). The role of power is also acknowledged in other chapters. For example, learning can be skewed towards certain more valued knowledge systems, as when local fishermen's perception of an oncoming collapse of the north Atlantic cod fishery was ignored in favor of scientists' mistaken view. This represents a significant advance over the apolitical nature of the Resilience Assessment methodology dating back to 2007 (RESILIENCE ALLIANCE, 2007, 2010) that is evaluated and critiqued by the authors of this Special Issue (BARTELS *et al.*, 2016).

The core of the book consists of a chapter for each of seven key principles for maintaining resilience of ecosystem services, three of which relate to socio-ecological features: (P1) maintain diversity and redundancy, (P2) manage connectivity, and (P3) manage slow variables and feedbacks; while four relate to governance features: (P4) foster Complex Adaptive Systems thinking, (P5) encourage learning, (P6) broaden participation and (P7) promote polycentric governance systems.

Unlike many edited volumes, the chapters are quite consistent in their treatment. Each chapter follows a common structure, with a useful summary, an introduction, an explanation of the principle, the rationale of how it can contribute to resilience of ecosystem services but also a major section on how the principle can diminish the resilience of ecosystem services. The chapters conclude with a synthesis of how the principle can best be applied and consideration of key research and application gaps.

One strength of the book is its comprehensive coverage. The five or so co-authors per chapter provide a wide range of literature and illustrative cases, although certain examples representing the geographical biases of the authors recur across chapters: Kruger National Park in South Africa and Goulburn-Broken catchment and Great Barrier Reef in Australia. Unfortunately, there is a limited number of relevant studies from Brazil specifically and Latin America in general, but also from Africa and Asia beyond the relatively developed portions of South Africa and Australia. Authors do consistently seek to balance social and biophysical examples, for example connectivity can refer to social networks or ecological corridors, and diversity can refer to species or ethnicity. In addition, the first chapter provides a useful justification and overview of resilience thinking and ecosystem services, while the final chapter considers the interactions among the seven principles and provides a synthesis of applying the principles to governance, including the limitations of our knowledge and ability to manage complex social-ecological systems.

The other key merit of the book is its nuanced and critical analysis of the seven principles. In the first place, there is a critical evaluation of the empirical evidence that the principles do contribute to resilience. In fact, the assertions are surprisingly difficult to prove, in part because of a lack of studies but also because a mix of causal factors operating over long time periods in complex systems makes demonstrating causality for a single principle challenging. For example, authors explicitly acknowledge that evidence is limited that Complex Adaptive Systems (CAS) thinking -- focusing on interconnectedness, non-linear change, uncertainty and multiple perspectives -- actually improves resilience. Interesting examples are presented, both from Traditional Ecological Knowledge and modern governance processes such as a management program built around "Thresholds of Potential Concern" in Kruger National Park. But it is hard to even define and document CAS thinking, and harder yet to link it to outcomes because such thinking is only one component of decision-making in a multiple-scale SES.

The second aspect of nuanced analysis is to recognize that several of the principles are explicitly ambiguous. For example, "manage" rather than "maximize" connectivity because both too much and too little connectivity can be problematic. For example, disease can spread through wildlife corridors or global travel. Similarly, learning can deepen belief in misinformation, for example the global campaign to trump up scientific uncertainty about climate change or the health effects of tobacco use (ORESQUES; CONWAY, 2010).

More broadly, the value of each principle for increasing resilience depends on HOW it is implemented, and it is therefore valuable that each chapter contains a section on how the principle could lead to negative outcomes. For example, the chapter on participation addresses pitfalls such as failing to engage the appropriate actors, consultation fatigue, the need for supportive social and institutional environments, and the potential to strengthen some groups at the expense of others, for example by corruption or rent-seeking by powerful actors.

There are no panaceas for the complex challenge of management and governance of social-ecological systems. This book will be a useful entry to the current resilience literature for scholars and managers from a variety of disciplines who are grappling with that challenge.

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