Preface

A central question for Ecology, now and in the future, is how do we render or assure that the ecosystems that humans rely upon are resilient to environmental change? Ongoing global change, wrought by modifications, for example, to climate and land use, has placed considerable stress on the planet's ecosystems and underscored the need to measure ecosystem resilience, to understand mechanisms behind resilience and to provide appropriate management to assure that our ecosystems continue to deliver the services we require. This volume was conceived with certain constraints. Resilience was not to be limited to the ecology of ecosystems. Rather, resilience should also consider aspects of social resilience, including those of the differing sentiment and need between groups of stakeholders and the economics of resilience. There was no attempt, however, to limit the volume to a single definition of resilience such as ecological or engineering resilience (Holling, 1973, 1996), but to examine something of the range of work that is ongoing in this domain. The work covered here includes theoretical work outlining how resilience and correlates of stability might be measured theoretically, to pragmatic approaches working with various stakeholders, and improvements to measures of systems performance from those that currently exist.

In this volume entitled 'Resilience in Complex Socio-ecological Systems', we present five articles that illustrate something of the diversity of work currently being undertaken from first-principles theoretical work on the definition and measurement of socioecological resilience, via experimental systems to practical case studies in real-world systems. In Chapter 1, David Angeler and colleagues argue for measuring 'adaptive capacity' as an approach to resilience. In their chapter, the authors detail past definitions of adaptive capacity, which have often been confusing, to define the concept as 'the latent potential of an ecosystem to alter resilience in response to change'. Their now operational concept is then used to propose hypotheses that through modelling and appropriate sampling could be tested and evaluated. Angeler et al. believe that this would, over time, incrementally reduce key uncertainties about system resilience and improve our understanding of the adaptive capacity of ecosystems.

Julia Siebert and her coauthors then examine the resilience of soil-derived ecosystem functions in grasslands, including nutrient cycling and decomposition, from an experimental system designed to examine the potential effects of climate change. Siebert et al. (Chapter 2) explicitly examine both the ecological insurance hypothesis, that a higher diversity of soil communities would assure more stable provisioning of ecosystem functions under climate change, and past support for this idea in grasslands. Their 2-year study shows that the manipulation of temperature and humidity conditions, which mimic future climate, consistently reduced soil biological activity. Manipulations that increased land-use intensity also had reduced soil biological activity, but in contrast to past results, extensification of land use did not alleviate the detrimental effects of simulated climate change. Rather, the extensively used grasslands showed the greatest relative reduction in soil biological activity, highlighting vulnerability and the need to identify complementary managements to assure their future functioning.

In Chapter 3 Martin et al. explore whether it is possible to operationalize resilience to biodiversity-derived functions in agroecosystems under environmental change. This question is of great importance for the long-term security and environmental safety of these systems, but because of the marked conceptual differences that exist between different measures, resilience operationalization is difficult. These authors use a four-step approach of summarizing potential dimensions of resilience and disturbance under environmental change, reviewing indicators of the resilience of biodiversity-driven functions in agroecosystems, using these indicators to explore the resilience of the ecosystem services of biological pest control, biological disease control in soil and pollination, and finally reviewing those tools and approaches that could catalyse further the assessment of resilience of biodiversity-driven agroecosystem functions.

Mette Termansen then explores how understanding the coupling of social and ecological systems is a requisite to attain sustainable and resilient land management in the long term. Termansen et al. (Chapter 4) contrast a standard approach to understanding land-use change, which is based upon those land-manager behaviours applied when managed areas are influenced by direct and indirect drivers of environmental change, the subsequent resulting changes in land use, and the environmental consequences of that change, with an alternative approach. This proposes the combined use of land-use dynamics modelling, integrating land management behavioural models derived from choice experiments, and spatially explicit systems dynamics modelling. The advantages of this alternative are that it explicitly models potential environmental and management feedbacks, that behavioural rules can be tested from actual and hypothetical choice data, and that the behavioural choice models generate probabilities of alternative behaviours for realistic scenarios of the future.

In Chapter 5 by Avriel-Avni and Dick, the authors present a case study of how scientists and land-managers can have differing views of same system. This question is important because acceptable, codeveloped management of any given ecosystem within the complexities of ecosystems will require these different actors to forge a shared agenda and worldview. The focus of their study was the Long-Term Social-Ecological Research Platform (LTSER) in the Cairngorms National Park (CNP; Scotland). Using semi-structured interviews of land-managers and scientists, a conceptual mapping of the CNP social–ecological system was created. It found that there were marked differences in interests between the two groups. Land-managers were found to be predominantly concerned by local-scale economic problems, while scientists were more concerned by environmental and global questions. However, both groups shared a common sense of uncertainty about the future which promoted a willingness for both groups to work together.

This volume present a snapshot of some of the work currently being done on the resilience of complex socioecological systems. As Martin et al. (Chapter 3) note, socioecological resilience research is still embryonic, but there is clearly plenty of exciting and challenging work remaining to be done. This thematic issue illustrates some of the most important steps being taken towards developing the approaches necessary to achieve a more sustainable future.

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