Book review

Managing Forest as Complex Adaptive Systems; Building Resilience to the Challenge of Global Change

Christian Messier, Klaus J Puettmann, and K David Coates (eds) (2013). New Delhi: Routledge

Reviewed by Dr Joachim Schmerbeck

In times where global environmental changes occur most severely in large parts of the human society fears diminishing of wellbeing found in a healthy environment, along with alteration and even extinction of entire ecosystems. . There is lack of understanding of earth as a live supporting system that can cope with present and future challenges posed by environmental changes. The ecosystems as we see them today are "trained" in adapting to environmental changes of different magnitudes. This may lessen the fear of global changes and enable society to realize that we deal with complex adaptive systems that provide us with efficient tools to maintain our wellbeing, only if we are wise enough to understand and use them.

With this spirit, the book is edited by Christian Messier, Klaus Puettmann and David Coats. "Managing Forests as Complex Adaptive Systems" provides a profound and holistic overview of the major global forest biomes as complex systems that have a good potential to adapt to the future global changes. The book is not just a collection of articles, but is a result of a process of joint learning undertaken by the authors in a three-day workshop held in the initial phase of the book. In this workshop, the contributing authors have interacted with experts of complexity science and exchanged their concepts and ideas for the book. As a result, the outcome is an organized, informative and well-written piece of work.

The book primarily asks two questions:

i) Can complexity science provide a useful framework to understand the functioning of various and seemingly very different forest biomes?

and

ii) Can complexity science be useful in reconciling the variety of recently developing forest management and restoration approaches that are emerging in numerous regions?

To address this question the book is structured in three parts. The first part, "Setting the stage" contains two chapters. In the first chapter, the editors have set the foundation by showing how forests are adaptive systems, clarifying terminologies used for complex adaptive systems. The chapter also pointed out differences in the views on forests as complex adaptive systems and traditional forest management. The second chapter, written by Lael Parrot and Holger Lange, informs the reader about the characteristics of complex systems and key definitions used in complexity science. This makes the reader well-prepared to absorb the messages of the second part which apply the concepts of complexity science to three major forest biomes. In the third chapter, Robin Chazdon and Juan Pablo Arroyo start off with an excellent introduction into tropical forest as complex adaptive systems. The writers have clarified some points that are expected to reach out to a broad audience. The central finding in the chapter is that tropical forests are not fragile systems but "resilient to a range of natural and human large-scale disturbances", a statement which is based on an in-depth review and interpretation of the tropical forest science literature. In the fourth chapter, Sybille Haeussler, Charles Canham, and David Coats merge forest dynamics of temperate forests and principles of complexity science together by comparing forest of the West and East coast in North America. They conclude that "complexity science has become, de facto, our modern theory of succession" and this succession is lifted from a sequence of different plant communities to the core element of the new approach to forests as complex adaptive systems. In chapter 5, Philip Burton shows the reader that the principle of complexity systems not only applies to forests with a high diversity in species and structure like tropical forests, but also to forest ecosystems that are relatively poor in tree species. He points at the high diversity of boreal forest taxa that exists beside trees, mainly among soil biota, including an enormous variety in species and

genomes of mycorrhizal fungi. It gets evident that these interactions drive a diversity that, to a large extent, lies in compositions of species that assemble in many different pathways of succession, acting as a set of tools of boreal forest systems to respond to disturbances.

Informed about the ecological basics of forests as complex adaptive systems through these illustrated examples, the reader gets into the third part of the book and gets introduced to the management of forest against the backdrop of complexity science. Chapter 6 and 8 elucidate with examples the challenges in the practical application of the complexity science in the southern boreal transition zone at the Great Lakes region and tropical forest. Meredith Cornett and Mark White, in the first example, show that as preconditions for applying complexity science principles, managers need to be well-informed about the complexity of ecological factors and processes. In chapter 8, after introducing ecological features important for silviculturists as well as the problems they face in Bornean Forests, Francis Puts points out that the knowledge and concepts for tropical forests remain mainly in the academic community and hardly reach on-the-ground managers. Suzanne Simard, Kathy Martin, Alan Vyse and Bruce Larson, in chapter 7, illustrate the complexity of interaction between different elements of temperate Douglas fire forest in meta-networks connecting fungi, fauna and flora in a comprehensive manner and how the knowledge about these mutual interaction can aid in conceptualizing forest management.

In chapter 9, Jürgen Bauhus, Klaus Puettmann and Christian Kühne ask if the close-to-nature forest management (CTNFM) in Europe leads to an enhanced complexity and adaptability of these forests. They find that CTNFM overlaps with principles of complexity science to some extent but fall short of some important aspects like permitting large scale disturbance that triggers diversity and capacity to adapt. In chapter 10, written by Susanna Nocentini and Lluis Coll, the reader gains new insights in the complex topic of the severe alteration in the Mediterranean forests due to a long history of human land use. As a consequence, the forests act as complex adaptive systems and instead of avoiding them, a call to include changes in forest management framework has been made. Timo Kuuluvainen and Juha Siitonen, in chapter 11, show the complexity in species interaction in the boreal forests of Finland and the role the forest fire plays in building structure and resilience. They point out that it is time to utilize the capacity of as complex adaptive systems in order to enhance this capacity and not lose it. Sue Baker, in chapter 12, elaborates in length and maybe a bit too long, about fire as a natural agent of complexity of Tasmanian forests and expresses the need to further build this knowledge and apply it in forest management as a preparation measure for the unpredicted changes that can be expected in future. Finding of the Alain Paquette and Christian Messier in their application of complexity science to forest plantations in chapter 13 are important that shows that forest plantations do not need to be green deserts and they contribute to enhance ecosystem functions as "simplified complex adaptive forest ecosystems".

The final chapter on the history of this book is a pleasure to read. It summarizes the main findings and provides space to the main authors of the chapters to express their learnings that emerged while writing their contributions. Messier et al. also answers the questions that they asked at the beginning. The answer to the first question is a clear yes and the answer to the second question leads to a statement that a new approach in forest management is needed that sees forests as a "network of interaction and strongly linked elements that compete and help one another at the same time". At the end of the different chapters of part III, they show that this new approach has already started to realize in several parts of the world.

The book provides new insights of ecology and forest science with practical relevance. Another example, that would have added value to the book, are of mangrove forests, that are also often perceived as fragile but are a very good example for complex adaptive forest ecosystem at the forefront of climate change. Some chapters could have been made more focussed in their approach to inform managers. For instance, chapter 12 gives the impression of promoting the utilization of fire as a tool for forest management against the view of environmentalists. More space could have been given to the ecological role of fire in Tasmanian forest in the backdrop of a long history of fire as a management tool in this region. Many chapters that are of high scientific value and are in a danger to remain within the scientific community, just as Putz pointed out in chapter 8 for scientifically based concepts for tropical forest management. The best match may have been provided by chapter 9 as it informs a well-establish forest administration in Europe which is likely to absorb some of the findings. However, the book is not thought to be a guideline in management, but is an excellent tool that could be used in higher education and research and as a base to develop means of communication to reach out to practitioners. It can only be hoped that this trend continues to benefit the society and the knowledge about forest as complex adaptive systems finds its way, not only to forest managers but also to environmentalist and conservationists and even further to larger parts of society.