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Review of *Grasslands and Climate Change* by David J. Gibson and Jonathan A. Newman

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GRASSLANDS AND CLIMATE CHANGE.
Edited by David J. Gibson and Jonathan A. Newman. 2019. Cambridge University Press, Cambridge, United Kingdom. 348 pages. $89.99 (hardcover), $44.99 (paper), $36.00 (digital). ISBN: 978-1107195264 (hardcover), 978-1316646779 (paper).

The last decade has seen an explosion of information about climate change, some of which is contradictory, much of which is confusing, and the entirety of which is too much for the typical biologist or scientist to assemble and comprehend. This is why reviews such as *Grasslands and Climate Change*, edited by David Gibson and Jonathan Newman, are so valuable.

To produce this review of climate change issues and influences relative to grasslands, Gibson and Newman recruited 30 scientists—predominantly from Europe and North America—who wrote 19 chapters dealing with various aspects of grasslands and climate change. The chapters are grouped into a general introduction and three subsequent sections, each of which is prefaced with a short introduction.

The first chapter of the general introduction provides an overview of grasslands, their variety and importance, and the increasing pressures they are experiencing from ever-growing human populations. This is followed by a methodology chapter, which evaluated the focus, timing, treatments, methodology, response(s), ecological complexity, and experimental design of 841 studies of grasslands and climate change. The final chapter of the general introduction covers remote sensing of change in grasslands, with an excellent review of the mechanisms and methods of evaluating landscapes using satellite imagery and other remotely sensed data. These three introductory chapters set the tone for the book by being well organized and easy to understand, with strong emphasis on how study design, spatial scale, temporal scale, replication (or lack thereof), methodology, and analytical techniques affect inferences that can be made from research. Throughout the book there is repeated recognition of information gaps and the need to conduct research that is well designed and answers specific, targeted questions.

The remaining sections (Part I, *Grassland dynamics and climate change*; Part II, *Species traits, functional groups, and evolutionary change*; and Part III, *Dealing with climate change effects*) each contain five or six chapters on topics pertinent to the section, ranging from projected climate change and global distribution of grasslands to climate change effects on grassland ecosystem services to restoring grassland in the context of climate change. One of the chapters (*Projected climate change and the global distribution of grasslands*) contains a brief overview of various climate projection and vegetation distribution modeling techniques, which provides useful context for the book and for understanding climate change projections and research in general. With minor exceptions, the chapters were well organized, thorough, and easily readable. Credit must be given to the editors and the authors for working to ensure a review that is consistent, concise, and readable but also informative.

Grasslands and Climate Change is written for a global audience, with examples and case studies from around the world. The chapters are generally very process oriented, with emphasis on plant physiology, communities, and management, as well as the economic and social values of grasslands. As a wildlife biologist who works in a system where grassland conservation is often dependent on the wildlife value that grasslands provide, I would have appreciated a chapter on grassland wildlife species, which are declining precipitously as grasslands are being lost and degraded.

Grasslands and Climate Change makes good use of figures, particularly flowcharts and diagrams that illustrate concepts from the chapters. My single biggest complaint about the book is that the publisher used gray-scale versions of color figures in the chapters, including figures where discriminating among colors is necessary for comprehension, but impossible in gray-scale. This necessitates flipping to the central section of the book where color figures are provided, but, inexplicably, several of the figures are printed out of sequence, which makes finding the appropriate figure cumbersome.

The book ends with a chapter entitled *Grasslands in the Anthropocene: research and conservation needs*, written by the editors. Research gaps are not only identified, but categorized as general experimental gaps, specific experimental gaps, modelling research gaps, or management research gaps, with numerous, specific topics identified in each category. Similarly, uncertainties related to climate change projections and ecological responses are identified, along with specific sources of uncertainty and suggestions for addressing them.

Grasslands and Climate Change has a strong academic and research focus with relatively little specific information that can directly be applied by conservationists and managers. Nevertheless, the book provides useful background information along with context for conservation and policy making and will be an excellent reference for people interested in how climate change might affect grasslands and grassland management, whether in the Great Plains or across the globe.—*Neal D. Niemuth, Conservation Scientist, U.S. Fish and Wildlife Service, Habitat and Population Evaluation Team, 3425 Miriam Avenue, Bismarck, North Dakota 58501, USA. The findings and conclusions in this article are those of the author and do not necessarily represent the views of the U.S. Fish and Wildlife Service.*