BOOK REVIEW

Saving a Million Species: Extinction Risk from Climate Change

Hannah, L. (Ed.), 2012.
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SAVING A Million Species is an emotive title for a book, and immediately raises a number of questions, including "Are a million species really at risk from climate change?", "Which species are they?" and "How can we save them?".

This book attempts to tackle these critical questions, and more. Organized into six key parts, and with 20 chapters authored by many of the pre-eminent researchers in climate change and biodiversity science, *Saving A Million Species* is an ambitious book that addresses the most significant conservation crisis of our time.

As a reference and a starting point for further chapters, Part I begins by introducing and dissecting the well-known paper by Thomas *et al.*, "Extinction Risk from Climate Change", published in Nature in 2004. Chris Thomas returns to arguably the most important paper of his career, and scrutinizes the methodologies and limitations of that first analysis. Chapter 3 goes on to discuss the implications and fallout from the paper, including subsequent changes in policy around the world and the incorporation of extinction risk from climate change into threatened species listings.

In the second section, Alison Cameron reviews some of the research published since Thomas *et al.*, and discusses the implications and advances of contemporary modeling methods. She concludes that more recent studies generally confirm the extinction risk from climate change proposed originally by Thomas *et al.*, while also proposing a list of recommendations to improve future extinction risk analyses based on species distribution models, including the use of ensemble global climate models. John Harte and Justin Kitzes also review the uses, and limitations, of species-area relationships in predicting extinction from climate change in Chapter 5.

Part III contains three chapters which review the evidence for current extinctions occurring on land and in the ocean. There have been few, if any, studies to directly cite climate change as a factor in species declines, let alone extinctions, so I thought it was particularly ambitious to devote an entire part to current extinctions.

The role of climate change in the extinction of the golden toad is examined in the first chapter, along with the controversial associations between climate change and the amphibian chytrid fungus. As expected, the authors do not come to any firm conclusions regarding the role of climate change in amphibian declines and extinctions. They conclude that unequivocally attributing climate change to extinctions will remain problematic for the foreseeable future due to uncertainty surrounding predictive methodologies, species interactions, and a host of other factors.

More direct evidence is available for coral reef deaths and the extinction of coral species, caused by increased water temperatures and coral bleaching, and this is reviewed in the next chapter in this part. Finally, the potentially heightened risk of some species at higher latitudes is examined in Chapter 8. High-altitude species are often adapted to a restricted set of climatic conditions, and may require seasonally predictable snow and ice cover for survival and breeding. I particularly liked the sections of this chapter which dealt with species specific extinction risk of a number of Arctic and Antarctic species, including the polar bear and walrus.

In Section IV, extinctions in history are examined, using a variety of methods including paleoecological records and ice core records, in terms of their links to past climatic changes. While relevant, I personally felt this section didn't add much new information to the topic of current extinction risk from climate change, and much of the information has been published elsewhere.

Part V seeks to predict future extinctions, including chapters focusing on insects, tropical forests, coral reefs and oceans, and freshwater fauna. In the last chapter of this part Lesley Hughes assesses the threat of cascading extinctions — how changes in species interactions could lead to extinction of one or more interacting species. This is a particularly difficult area to address, although likely one of the most important in terms of species extinctions. Hughes examines the types of changes we can expect to see (and in some cases can already see), such as changes in phenology and distribution changes, and identifies which interactions are most at risk — including plant-herbivore, pollinators and predator-prey systems. While much of the information is, by its very nature, speculative, Hughes presents some new information along with useful graphics and figures.

Part VI deals with Conservation Implications. Considering the scope of the book, and connotations of the title, I was rather disappointed that conservation implications warranted only one dedicated chapter, and it almost seemed that was tacked on as an afterthought. The chapter does cover the usual suspects, adaptive management, corridors, managed relocation, etc, but I felt it would have benefitted from a more focused look at climate change adaptation research, and also some case studies to show examples of corridor planning and managed relocation. A final short summary chapter by the editor, Lee Hannah, concludes the book.

Saving A Million Species presents plenty of new ideas from a host of respected climate change researchers, and reviews how the science has advanced since the first extinction risk estimates were published. The book is a little sparse on figures and tables in general, and the lack of focus on conservation and management was disappointing. Nonetheless, the book will still make a timely, and unique, contribution to this rapidly growing area of biodiversity research and will no doubt be widely utilized by students and academics alike.

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