

Saving a Million Species: Extinction Risk from Climate Change

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when (as will happen soon enough) we identify alleles of the genes that influence sexual orientation, intelligence, or the tendency toward violence? How will we adjust to this knowledge? How, in view of our own ever-changing understanding of morality, *should* we react to it? A book that tackles these questions is a book that needs to be written.

The philosophy of science has indeed evolved away from Aristotle. It may be presumptuous of me to suggest it, but perhaps it has evolved to the point at which it should take up a new role. Perhaps it ought to serve as an evaluator of the impact of scientific advances on our societies and on how we view ourselves and the rest of the world. There would, of course, be disagreements among the philosophers who embark on such evidence-based evaluations. But, just as the school of existentialism transformed philosophy from a dry exercise in abstract ideas into a human-oriented endeavor, science-based philosophy may be poised to make a similar leap. *The Philosophy of Human Evolution* is, I think, a hesitant step in this direction.

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SPECIES EXTINCTIONS IN THE TWENTY-FIRST CENTURY

Saving a Million Species: Extinction Risk from Climate Change. Lee Hannah, ed. Island Press, 2011. 432 pp., illus. \$35.00 (ISBN 9781597265706 paper).

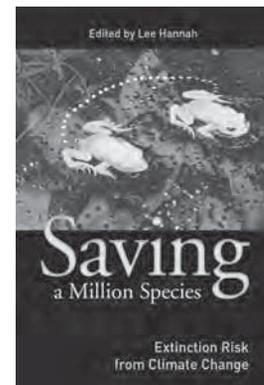
Will changes in climate cause a million species to go extinct by the end of this century? No one knows

with certainty, but there is sufficient evidence to suggest that such an outcome is entirely possible. *Saving a Million Species: Extinction Risk from Climate Change* examines the strength, limitations, and complexities of the evidence for this threat. In this way, the book provides a single compendium for the many disparate considerations needed to inform an understanding of this issue.

Saving a Million Species is edited by Lee Hannah, a leading authority on extinction risk from climate change. He is a senior fellow at Conservation International and holds an adjunct faculty position at the University of California, Santa Barbara. The book's 20 chapters are written by more than 30 scientists. These individuals are based primarily in the United States and the United Kingdom, but some are from countries such as Australia, South Africa, and Ireland. Collectively, these authors provide the world-class expertise that is needed to frame different dimensions of this threat.

The book begins by revisiting the now-seminal contribution by Thomas and his colleagues (2004) that first brought widespread attention to the magnitude of risk that climate change poses for species extinction. The retrospective by Thomas is followed by a chapter that considers the impacts of this publication on public policy. I found these pages to be some of the most enjoyable chapters in the volume, since they provide the backstory for understanding how and why the work was developed, describe some of the challenges that Thomas and his colleagues faced, and explain how the work was received by both scientists and policymakers. As someone who regularly teaches the topic of extinction risk as a result of climate change, I felt satisfied to be given access to the broader context of this seminal work. Two later chapters address how the models that estimate risk can be refined, complementing the macro-view discussion presented in Thomas's chapter with details of how to improve model accuracy, as well as suggestions on how we can better conceptualize this problem.

Multiple chapters examine the evidence and controversy surrounding the contention that a handful of species have already been driven to extinction by contemporary changes in climate. I found this section to be thorough and quite useful. For example, I have been aware of the controversy over whether the golden toad (*Bufo periglenes*) was a victim of climate change, but I have not previously seen the evidence (and counterevidence) that is clearly presented and discussed here.



Four chapters delve into the evidence linking extinctions in the fossil record to changes in climate. These chapters are particularly well done and collectively provide a depth of insight into the current climate crisis. For instance, paleontological evidence suggests that our concerns over globally conserving species should not be allayed if we see increases in regional diversity following changes in climate, because these increases often foretell pending extinction events that take some time to manifest. Indeed, differences in the time it takes for immigration and extinction to manifest following changes in climate could lead to short-term increases or decreases in regional diversity, which might belie outcomes that play out over longer time periods (Jackson and Sax 2010).

Six chapters explore future risks to particular groups (insects and freshwater faunas), particular systems (tropical forests, coral reefs and other

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portions of the oceans), and to biodiversity in general after analyzing feedback from initial extinctions. In these chapters, some of the principal challenges that species will face in coping with climate change are superbly laid out. Many tropical species are unlikely to adjust to climate change solely by shifting their geographical distributions, for example. In some lowland areas of the tropics, certain species would need to migrate at a rate of 32 meters per day to keep ahead of the warming trend. Likewise, freshwater faunas often have no viable route through which to shift their natural range because of a lack of waterway connections to areas projected to have a suitable climate in the future.

The last two chapters of *Saving a Million Species* focus on conservation strategies for reducing extinction risks and provide an overview that urges us to proceed with actions that will reduce risk now, even if important aspects of that risk remain uncertain. The final chapter, written by Hannah, urges us to use incentive-based complements to regulation in order to reduce emissions, such as the Reduced Emissions from Deforestation and Degradation (REDD) program under the United Nations Framework Convention on Climate Change. He also encourages us to take action to preserve biodiversity by strengthening the network of corridors that connect reserves, so that species can more easily shift their geographical distributions in response to changes in climate.

With the understanding that it is impossible to address every line of evidence that is relevant to this topic in a single volume, I submit that there are arguably a few additions that would have improved the book further. A few of the chapters, such as “Extinction Risk at High Latitudes” (chapter 8), felt a bit thin, having useful content but too little detail. Given the excellent chapter on future risks to freshwater faunas (chapter 17), it would have been helpful to have a paleontological chapter with a focus on those groups of species (such as trees and freshwater fishes) that saw

major extinction events during the Pleistocene, since these groups provide important insights into the synergies among climate changes, dispersal barriers, and habit loss (Schwartz et al. 2012). Finally, a greater focus on recent advances in reducing the risks of extinction would have been pleasing to read, although the constraints of an edited volume are certainly real and understandable.

This book is a tour de force overall and an excellent summary of the issues relating to extinction risk from climate change. Each chapter is well written and provides useful inroads to the relevant literature. Hannah has done an excellent job of inserting the right amount of overlap between contributions, and the result is a unified volume that reads like a book and not like a collection of chapters. But the book’s greatest strength comes from its collection of ideas, perspectives, and reviews on this complex topic, resulting in the whole being much greater than the sum of its parts. *Saving a Million Species* provides a single reading source for anyone who wants to quickly get up to speed regarding the risks that changes in climate pose for species extinction. This book would serve well in a seminar at either the advanced undergraduate or graduate level. Edited volumes this useful are few and far between. I recommend *Saving a Million Species* to anyone interested in the conservation of biological diversity.

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EVOLUTION: EVIDENCE AND ACCEPTANCE

The Evidence for Evolution. Alan R. Rogers. University of Chicago Press, 2011. 128 pp., illus. \$18.00 (ISBN 9780226723822 paper).

Although scientists view evolution as an indisputable feature of the natural world, most Americans simply do not believe that it occurs, or they reject naturalistic explanations for biotic change. Empirical studies have revealed that students and teachers often know quite a bit about evolution but still do not accept it. This somewhat counterintuitive finding has been empirically corroborated and has led science educators to investigate this pattern in order to provide suggestions for effective evolution instruction (e.g., Rosengren et al. 2012). Within the lucid, compact, up-to-date, and highly readable pages of *The Evidence for Evolution*, author Alan R. Rogers takes an approach that most science educators have found inadequate: exclusively using logic, parsimony, and the force of evidence to precipitate conceptual change about evolutionary belief. Reactions from both supportive and dissenting readers to this nicely written text will depend on how much faith they place in the use of logic to challenge the worldviews of intelligent-design creationists.

Two premises appear to frame this short book: Biology courses and textbooks are focused on evolutionary mechanisms at the expense of the evidence for evolution, which most people are not aware of, and once disbelievers of evolution are exposed to