

## Book Review

**Losos, J.B.** (2009): *Lizards in an Evolutionary Tree: Ecology and Adaptive Radiation of Anoles*. University of California Press, Berkeley, Los Angeles and London. 527 pages. ISBN 978-0-520-25591-3.

The University of California Press's series "Organisms and Environment" focuses on the diversity of organisms and the ways they interact with each other and with their environment. The present book is the tenth volume of this series, and describes in great details one of the most spectacular, and probably the best-studied example of adaptive radiation, the diversification of the ca. 400 species of the lizard genus *Anolis*.

The main objective of this book is to synthesize the enormous body of research conducted on anoles in order to understand what are the processes at the origin of biological diversity. Specifically it presents lines of evidence suggesting that inter-specific interactions have been the driving force of anoles diversification. Also, by pinpointing the numerous unanswered questions on anoles biology, the author hopes to stimulate new research to increase our knowledge of these fascinating animals and understand the reasons of their incredible diversification.

After a first introductory chapter, Chapters 2-4 describe the ecological and evolutionary diversity of anoles, separating them in five different faunas. Chapter 2 describes the general characteristics of anoles and their geographical distribution, and also introduces the anole species concept that will be central to the rest of the book. Chapter 3 presents the first anole fauna, the Greater Antillean ecomorphs that will be the focus of most of this book. Here Losos describes in details the characteristics of the six ecomorph classes that are found in the largest islands of the Greater Antilles (Cuba, Jamaica, Hispaniola, and Puerto Rico). Chapter 4 illustrates the

four other, less studied faunas, namely (1) the Greater Antillean unique anoles that, despite living in the Greater Antilles, do not fit in any ecomorph class, (2) the anoles of the smaller islands of the Greater Antilles, (3) anoles of the Lesser Antilles, and (4) anoles of Central and South America.

Chapters 5-7 introduce a phylogenetic perspective to the study of the evolution of anoles. First, Chapter 5 presents generalities and conceptual issues regarding phylogenetic inference emphasising the great interest of phylogenetic approaches but also their limitations, in particular for ancestral states reconstruction. This chapter also presents the current knowledge on *Anolis* phylogeny that will be used all along the rest of the book to test various evolutionary hypotheses. Then, Chapter 6 focuses on the timing and biogeography of anoles evolution. Since very few fossil remains of anoles are known, current knowledge on the timing of anole diversification relies heavily on molecular dating, and Losos clearly introduces the interest and the limitations of these methods. The geographic origin of anoles is then presented in a phylogenetic framework allowing to test alternative hypotheses. Finally, Chapter 7 analyses the patterns of ecomorphological diversification of anoles, using the phylogenetic information to test whether the different ecomorphs arose early in anoles history and colonised subsequently the Greater Antilles, or if they evolved independently on each island.

Chapters 8-10 describe various aspects of anole biology and behaviour that are essential to understand the diversity of this group. First chapters 8 and 9 present anole life-history, and their social and sexual behaviour. The latter chapter focuses on the importance of sexual selection on these organisms. Then Chapter 10

introduces various informations on anole habitat use and their thermal biology that can be used to describe the ecological niche of the different species.

This leads to Chapters 11-13 describing the anole adaptive radiation and its origin. First, Chapter 11 describes the ecological interactions between sympatric anoles species in order to test the hypothesis that anoles adaptive radiation was primarily driven by resource competition. Here again, the author clearly presents testable hypotheses and then reviews the evidence supporting their predictions, i.e. that sympatric anoles do compete for resources, and can alter their resource use to avoid competition. Then, Chapter 12 describes the importance of natural selection in anole evolution. This chapter presents different experimental studies showing how anole populations respond to natural selection, describes geographic variation in relation to environmental differences, and presents recent evidence that this variation is heritable and hence can lead to adaptations. Finally, Chapter 13 focuses on the phenotypic aspects of the adaptive radiation, testing the hypothesis that phenotypic differences are really adaptive. In this chapter, Losos examines the relationships between phenotype and performance to test whether traits variation relates to variation in functional capabilities, and if this variation relates to ecological or behavioural differences.

Chapters 14-16 examine how anole species multiplied and how the anole radiation in the different islands unfolded. First, Chapter 14 describes how anoles speciate since an adap-

tive radiation does not only involves morphological and ecological diversification, but also the multiplication of the number of species. Next, Chapter 15 investigates the patterns and the sequence of the anole radiations in the Greater Antilles, and analyses what factors are at the origin of the diversification of the genus. Finally, Chapter 16 synthesises all previous information and reanalyses the diversification of the five faunas described previously to examine the hypothesis that their diversification relates to the adaptive landscapes they occupy. This chapter also evaluates the roles of evolutionary constraints and historical contingencies in anole evolution.

Finally, Chapter 17 places the anole radiation into a broader context by comparing it with other adaptive radiations, and describes what makes anoles so special and such a good model for studies of biological diversification. This final chapter terminates by considering the fate of *Anolis* and the threats to these species.

In summary, despite focusing on anoles, this book explores fundamental aspects of evolutionary biology and ecology. The questions and hypotheses raised in this book are applicable to many taxa, and Losos clearly describes the main concepts involved, and explains how to experimentally test the hypotheses. Hence, this book will be of great interest not only to herpetologists, but to all biologists interested in the processes at the origin of adaptive radiations and biological diversification.

Yann Surget-Groba  
University of Geneva