

Preface

A common man marvels at uncommon things; a wise man marvels at the commonplace.

—Confucius.

The motivation for writing this book originally came from our mutual, yet independent, admiration of Paul Colinvaux's 1978 book 'Why big fierce animals are rare' (Princeton University Press), which dares to tackle major questions such as 'why the sea is blue?' and 'why there are so many species?' Colinvaux helped us both realize, more than any teacher did at school, that ecology was a science, and one that asked important questions. He also posed new questions about everyday observations that simply had not occurred to us, such as 'why do birds sing in the morning?' and 'why are tundra plants so close to the ground?' As our opening quotation indicates, it is all too easy for us to accept widespread phenomena like gravity, ageing, and sex without wondering why they occur. However, once the questions are posed, and answers offered, then the reader instantly becomes the detective, weighing up in his or her own mind whether an explanation makes sense and whether there are more plausible alternatives. In this way, one gets closer to the way science is done.

It is now nearly 30 years since Colinvaux's book was published and while it remains fresh and engaging, the scientific community's understanding of the subjects he covered has clearly moved on. To take one small example related to Colinvaux's 'blue sea' chapter, the green photosynthetic picophytoplankton *Prochlorococcus* dominates primary production in the tropical and subtropical oceans and is probably a good candidate for the title of the commonest organism on Earth, yet it was only discovered in 1988, 10 years after the publication of Colinvaux's book.

While the idea for this book was inspired by Colinvaux's approach, this is explicitly *not* an update of Colinvaux's work. There are several reasons for this. Of course, one of the attractions of Colinvaux's book was his style, so the only person who can update Colinvaux is Colinvaux himself. 'Why big fierce animals are rare' was also a product of its time, introducing the science of ecology to a wider audience, just as some universities were starting to offer degrees in the subject. Now that ecology has become firmly established as an academic discipline, we have ended up writing a slightly more technical book than Colinvaux's original. Most importantly, Colinvaux's book was primarily, though not exclusively, ecological, but it struck us that a similar approach could be taken to shed light on many of the main questions in evolutionary biology—why do we age?, why sex?, why cooperate? This has several advantages beyond simply increasing the book's scope—as will be evident throughout our text, ecology and evolution are closely related disciplines. It may sound clichéd, but many ecological questions cannot

be fully understood without a consideration of evolution, and almost all evolutionary questions have significant ecological components.

In essence, this book is intended as an introduction to several key ideas in ecology and evolution. However, it introduces readers to these subjects not in the traditional way, but through posing a range of fundamental questions, and discussing the plausibility of solutions that have been offered. These questions lead our entire approach—fundamental ecological and evolutionary concepts are introduced only as and when they are needed to explain the question at hand. Asking big questions and examining solutions have their challenges from an educational perspective—concepts need to be built up. Nevertheless, it is our hope that by introducing the science in this way, our readers will immediately feel involved. Who does not want to know why they age, why so many species engage in sex, why the tropics have so many species, or when humans first started to affect world climate? We hope that our approach also helps to put ecology and evolution firmly on the map: through our book readers can see the immense breadth of the field, its fundamental importance, and learn about some of the exciting breakthroughs that have been made in recent years.

Our book is not intended as a formal textbook, but something designed for background reading, perhaps to support tutorials, which aims to transmit the excitement of the field by discussing major, yet not fully answered, questions. To this end, we decided at the outset to limit our technical language so that readers are more likely to understand the plain meaning of what we are trying to say. Only common species names are used in the text (except for those species without such names), yet backed up with a list of scientific species names, along with definitions of key terms in a glossary. One of the most elegant languages for summarizing the way one sees the world is that of mathematics, but we have invoked very little here because qualitative arguments will serve our purposes. However, we will often describe the results of mathematical reasoning. Similarly, although we discuss aspects of the chemistry of nutrient cycling, we have avoided using chemical equations in our text.

Other considerations have helped shape our philosophy and style. To avoid a 'text-book' look, we have limited the use of graphs but instead have included photographs with the aim of linking theoretical ideas to aspects of natural history that can be seen in the field. Since we are inherently interested in the way ideas are arrived at, we find it natural to describe some of the key players as well as the insights they delivered. However, our accounts are primarily aimed at searching for answers to questions and we could not possibly contemplate the idea of paying homage to every contribution along the way. Thus, although we try to summarize major experiments and insights, we could not consider a comprehensive description of the history of attempts to answer our questions.

Our taxonomic bias has bordered on positive discrimination. Of course, both of us appreciate the attraction of vertebrates but we are also concerned at the continued under-representation of other groups of organisms, such as microorganisms and fungi, which are the prime players in a wide variety of ecological processes. Therefore,

whenever several examples could be chosen, we have opted to highlight the most appropriate rather than the most charismatic. We also wrestled for some time with how to approach references. After taking the advice of our students, we decided to cite all of our major sources, but only as indexed notes so that they do not obscure the text. We hope that these references will make the book more useful to advanced students and our professional colleagues. Of course the text can be read without these backup references but we would hope that readers will be sufficiently curious, or disbelieving, to check up on some of the articles we cite.

Finally, a word should be said about our title, and how we came to it. Rather like the movie 'Snakes on a Plane', this was a working title that simply stuck. No doubt some readers may wonder why their pet question has not been addressed. Ecology and evolution are full of 'big' questions: 'why are males often more brightly coloured than females?', 'are complex ecosystems more stable?', 'why are some species common and other species rare?', 'why is nitrogen fixation restricted to so few organisms?', and our selection was primarily motivated by our combined backgrounds and experience. It is not intended as a compendium of all the top questions, or even the 10 most important questions, just 10 fundamental questions that have attracted a lot of interest and can teach us new ways of looking at the world.

Finally, readers should not think for a moment that we are offering the definitive answer to all of the questions we have identified. By their very nature answers to these questions are highly controversial. We have done our best to rule out earlier answers that are now obviously wrong, and to highlight the directions that researchers are currently taking. Nevertheless, it is our fervent hope that the book is read critically, and with alternative explanations in mind.