



ALL CREATURES, GREAT AND SMALL

Tudge, C. (2002) *The variety of life. A survey and a celebration of all the creatures that have ever lived*. Oxford University Press, Oxford. xv + 685 pp, two-colour line illustrations, index, index of organisms. Paperback: Price £14.99. ISBN 0-19-860426-2. Hardback (2000): Price £25.00. ISBN 0-19-850311-3.

This interesting, informative and relatively inexpensive book is divided into three parts. In the first (90 pages), Tudge sets the scene by discussing issues of classification, in the context of the enormous diversity of living things. He notes Norman Pace's estimate that classical microbiology has probably described only about one in 10 000 to one in 100 000 of the 'species' of bacteria and archaea that actually exist, and stresses the speculative conclusion that there could therefore be 400 million species of prokaryote. Adding high-end estimates of the diversity of organisms such as insects and nematodes, he suggests that there could be a further 100 million species of eukaryote. He argues convincingly in the first part of the book that, when faced with such variety (even if it were several orders of magnitude less than his figures suggest), we have to classify. And we have to do it well, using appropriate and meaningful criteria. On page 13, he states that the book is 'meant to be an introductory text — an introduction to the true implications of biodiversity and of the means by which biologists try to come to terms with it.' It is also an argument for the use of cladistics in classification. There is little argument in biological circles that we should base taxonomy on evolutionary principles — and the modern science of systematics reflects this. However, all this is not well known by non-biologists. Indeed, the words 'systematics', 'cladistics' and even 'phylogeny' and 'clade' are not even recognized by Microsoft's® spell-checker (at least, not in my version of it)! And the term 'symplesiomorphy', which is fundamental to cladistics, is not even in my 1998 Chambers Dictionary, which claims to be 'The authority on English today' and 'the most comprehensive single-volume English dictionary'. The need for such a book, then, is great.

Part II, which is by far the majority of the book, is what Tudge calls the 'survey of living things': a tour right through the tree of life. The two prokaryote domains (bacteria and archaea) are dealt with first. Tudge stresses that these two domains contain most of life's variety and biomass. Despite this, they are covered in only 20 pages between them, while the third domain (Eucarya) is surveyed over the next 480 pages. Within the eukaryotes, there are similar inconsistencies.

For example, it is acknowledged that the nematodes include 'some of the most ecologically and economically significant of all animals', that about 20 000 nematode species have been described, and that the true list could run into tens of millions because there could be a specialized nematode species for most other kinds of animal. And yet the nematodes only get half a page devoted to them. The Lepidoptera, with about 120 000 known species and numerous enthusiasts worldwide, are accorded only a quarter of a page. The thing is that life's variety is so huge that most organisms are going to get short shrift in a book that numbers fewer than several million pages. Tudge is open and honest about the imbalances in his 'survey' and, reasonably enough, he tends to stick to his strengths — hominid evolution and diversity, for instance. To be honest, while I lamented the lack of space devoted to some of my favourite organisms (particularly some plant groups), I was rather glad, in a guilty kind of way, when he skipped over other groups that both he and I acknowledge as extremely important.

The sub-title of the book tells us that it is not just a survey of organisms, but also a celebration of them; and not just of extant creatures, but of all organisms that have ever lived. This is a bold undertaking indeed! It is why the adoption of the sort of imbalances mentioned above seems to be the only way to avoid a flat and boring commentary — and the book certainly is not that. In fact, I found it hard to put down. The whole book is personal and idiosyncratic, which to me is one of its strengths. It is full of emotive language, and Tudge's enthusiasm comes over abundantly: 'Overall, we simply have to concede that the angiosperms are brilliant' (p. 581); 'What is certain, though, is that the molluscs are wonderful' (p. 225).

The sheer amount of attention that Tudge pays to issues of phylogeny and hence the details of classification, perhaps make the title/subtitle of the book a little misleading. It is in large part an assessment of current phylogenetic knowledge throughout the tree of life. But he goes beyond simple reporting, and adds value. In constant attempts to be tidy, he boldly presents phylogenetic trees which, though they are rarely fully resolved, go beyond simply sitting on the fence. He is careful always to give the sources and influences of these phylogenies, and generally does a good job in outlining where the areas of dispute lie. He also suggests some of his own explanations for various phenomena — such as the possible role of sexual selection in the evolution of feathers (p. 518). One thing I like in particular is his common-sense approach. He is sensitive to issues of detail, and I would certainly not regard his approach as lacking rigour, but he is not one for over-indulging in pedantry.

Nowhere is this better illustrated than in his advocacy of what he terms 'Neolinnaean Impressionism', in which 'when it comes to naming, we should temper logic with pragmatism' (p. 81). He stresses the dual role of nomenclature: to reflect underlying phylogeny ('the truth') and to aid information retrieval ('librarianship'). In essence, the approach he advocates is to use nomenclature primarily to indicate true clades, but to 'cut a few corners' with names sometimes, when strict cladistics become cumbersome. He uses asterisks to denote paraphyly, when the name concerned has obvious usefulness. 'Reptilia*', for example, is used to refer to those organisms in the Amniota that are not Aves or Mammalia. Similarly, he distinguishes between anglicised words with lowercase initial letters and Latin names with capitalized initial letters: reptiles are those amniotes that are not birds or mammals. The point, of course, is that what most of us call 'reptiles' does not represent a true clade, but it does represent a perfectly useful and understandable name for a group of animals (a 'grade'). Such an approach neatly avoids the sorts of semantic problems that strict cladists tend to run into, while maintaining rigour via the explicitly-stated naming conventions.

In a similar spirit, Tudge draws a distinction between 'jargon' and 'technical terms' (p. 13) — the former being unnecessary barriers to the nonspecialist, and the latter being essential for describing specialist concepts or complexity — and required in any good introduction to a subject. He does a good job of avoiding jargon and explaining technical terms when necessary, though with a few omissions — for instance, the lack of explanation of what ribosomes are seems out of keeping with the rest of the book. His aim is to 'guide the readers from a position of essentially zero knowledge to the point where they can, if they choose, begin to read the specialist literature' (p. 13). I think he largely achieves this aim, partly through clear explanation of a large number of technical terms, and partly through a thoughtful and interesting tour through the tree of life, and the problems associated with classifying it. Many of the key features that define the major groups of organisms are covered in a clear and understandable way, though inevitably not in much detail. It left me, for one, wanting to know more.

There are some faults. The copy-editing is of a lower standard than I would expect from such a high-quality publisher as OUP. Some important points are occasionally lost in attempts to simplify complex issues. It is not entirely clear whether this book was written so that you can dip into it, or whether one is expected to read the whole thing sequentially. It has ended up somewhere in the middle, with the text being overly repetitive at times, while some sections could be hard for the non-specialist to follow without their having read the preceding chapters. The liberal use of

bold and coloured text befits the introductory nature of the book, but the lack of a glossary seems strange to me — though the general index does indicate the defining entry of listed terms, and this goes some way towards alleviating the omission. However, given the nature of the huge task Tudge set himself in writing this book, such faults are minor and certainly detract little from the book's impact and usefulness.

The third and final part of the book is a 19-page essay entitled 'Saving what is left'. Again, Tudge is on familiar ground, and I suggest that there is as much wisdom in these few pages as in many a book on conservation. This section stands out from most overviews of conservation issues in being decidedly optimistic — perhaps too optimistic, but it makes a nice change! He finishes with the argument that emotion matters, and that it is a privilege to be conscious in the midst of nature's wonders. Economic and utilitarian arguments for conserving biodiversity all have their place, but ultimately, to him and many others (including me), life's variety is something that just is worth preserving. It's a bit like my view of this book: I'm not sure exactly why I like it so much; I just do.

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AN EVOLUTIONARY PERSPECTIVE ON PLANT-ANIMAL INTERACTIONS

Herrera, C.M. & Pellmyr, O. (eds) (2002) *Plant-animal interactions: an evolutionary approach*. Blackwell Science Ltd, Oxford, UK. Xii + 313 pp, figs., tables, line diagrams, halftones, colour photographs, index. Paperback: Price £35.00. ISBN 0-632-05267-8.

The information that has accumulated in the field of terrestrial plant-animal interactions in the last few decades is great. Most studies, however, have examined only the ecological relationship between plants and animals, without any evolutionary perspective. Such perspective is crucial if we are to understand how these interactions originate in the first place, how they are maintained, and how they are and will be modified in the present and future scenario of global change. In this volume, Herrera and Pellmyr have pulled together the diversity of information relating to the evolutionary ecology of plant-animal interactions, by carefully selecting authors who could cover the main topics of this subject.

The book is divided into four parts. Part 1 (Introduction) concerns all types of interactions that exist between plants and animals, the history of these associations, the importance

of such interactions to ecosystems and the ways that they have fostered the creation of diversity on earth. The introductory Chapter 1 by Price is a 'must-read' chapter for any ecologist not familiar with the field of plant-animal interactions, and is a good start for graduate students who may want to learn about it. Chapter 2 by Lavandeira examines the origins and evolution of plant-animal associations, convincing us of the importance of complementing phylogenetic with ecological approaches, on the one hand, and palaeobiological with biological research, on the other. This is the most illustrated of all the chapters, with good photographs (showing the fossil history of different interactions, such as the production of galls, seed predation and pollination) that are explained in detail in a 14-page appendix.

The second part of the volume (Mostly Antagonisms) includes three chapters that cover many aspects of herbivory. Chapter 3 by Strauss and Zangerl is a fascinating synthesis of what is known about herbivory by insects, from which it is concluded that much of the earth's biodiversity results from the arms race between the many adaptations and counter-adaptations of plants and their insect herbivores. These authors deal with lots of examples of adaptations by insects in response to selection exerted by plant defences, the role of insects as selective agents of those defences (physical and chemical), their effect on plant fitness and, on a larger ecological scale, on plant distribution, abundance and community diversity. Chapter 4 by Danell and Bergström reviews what is known about mammalian herbivory, describing the traits of (1) plants as food, including spatial and temporal variation in their availability and their quantitative and qualitative components and (2) herbivorous mammals, dealing with their morphological and physiological adaptations to feeding upon plants, their food selection, and their impact on plants at different scales: individual, population, community and ecosystem. The effect of herbivore trampling on vegetation is not mentioned in this chapter, and I wonder if it is because there is not much information about this topic or because it has been shown to be generally irrelevant? Chapter 5 by Hulme and Benkman deals with a special form of herbivory, the consumption of seeds by animals (granivory). The authors give an overview of the subject, comparing the importance of pre- vs. post- (seed) dispersal seed predation; describing the different guilds of granivores and the degree of dependence upon seeds as food; examining what determines fruit or seed choice and how seed predation varies in relation to spatial and temporal scale; and reviewing when and how these animals have an impact on plant population dynamics and on community structure. They end with a section on the evolutionary implications of seed predation, with examples that show how seed predators may select for physiological and morphological seed traits and for fruiting phenologies, and the animals' counter-adaptations. An additional chapter in this

Part 2 could have included what is known on herbivory by reptiles, a phenomenon that is more common in nature than previously thought, and from which we have gathered much information in the last decade. I refer those readers interested in this subject to the review book by G. King (1996), not cited in the present volume.

Part 3 (Mostly Mutualisms) concerns the interactions that usually benefit both plants and animals: pollination (Chapter 6) and seed dispersal (Chapter 7). In the former, Pellmyr reviews the origins of animal-mediated pollination, explaining how this mutualism may have acted as a catalyst of reciprocal diversification. He goes through all types of plant and animal traits relevant to pollination and that may be susceptible to selection, and examines specialization and specificity in both plants and animals, and selection on both floral and pollinator traits. With neat examples, Pellmyr also shows how useful phylogenetic methods can be in understanding plant-pollinator interactions. In the next chapter, Herrera gives us an overview on different aspects of seed dispersal interactions, with a new categorization of the benefits of dispersal (departure-related vs. arrival-related benefits), which is helpful for theoretical models and for explaining some evolutionary patterns in this mutualism. As in Pellmyr's chapter, he also goes through all plant and animal adaptations evolved in seed dispersal interactions, and the factors that hinder reciprocal specialization, concluding that the mutual dependence between plants and animals is generally weak, significantly more so than in plant-pollinator systems. Those readers wishing to delve further into the field of seed dispersal can also consult the recent book by Levey *et al.* (2002). In both chapters in Part 3 (especially Chapter 6), reptiles are largely forgotten. A good review of the role of reptiles (lizards, in particular) as pollinators and seed dispersers can be found in Olesen & Valido (2003); this is mainly an island phenomenon, but islands are important hot spots of biodiversity and thus cannot be disregarded. In this part of the book, I would have liked an extra chapter on the causes and consequences of known disruptions to mutualisms.

Chapter 8, on ant-plant interactions, is included within the last part of the book (Synthesis). This is because this special group of animals interacts with plants in such a variety of ways, either antagonistically or mutualistically. Beattie and Hughes thoroughly review all these kinds of interaction, with many illustrative examples. They end with an interesting section on convergent evolution, competition and asymmetry. The book could not finish in a better way, with a superb analysis by Thompson (Chapter 9) on the major, general questions that remain to be answered on the ecology and evolution of plant-animal interactions. This chapter includes interesting suggestions for the approaches needed to obtain those answers, which I hope will stimulate students willing to delve into this fascinating world.

Overall, I think that Herrera and Pellmyr have succeeded in providing a general synthesis of the diverse topics relating to the study of plant–animal interactions from an evolutionary perspective. All chapters have been rigorously edited and typographical errors seldom occur. Just to mention one minor editorial criticism, there is a figure that is repeated in two different chapters, with only slight modifications (Figs 3.15 and 5.9). It would have been good if all chapters, not just some, had an ending section on ‘pending issues’ or ‘questions for the future’. The book is user friendly, with a comprehensive and useful subject and taxon index. I unreservedly recommend the volume to all graduate students in ecology and evolution, and also to post-doctoral researchers who are about to embark on any study of plant–animal interactions.

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