Book Review

DOI: 10.21570/EDGG.PG.52.106-107

De Bello, F., Carmona, C., Dias, A., Götzenberger, L., Moretti, M. & Berg, M. 2021. Handbook of Trait-Based Ecology: From Theory to R Tools. – Cambridge University Press, Cambridge. ISBN (hardback): 9781108472913 -£74.99, ISBN (paperback): 9781108460750 - £34.99, with available discounts at publisher. doi:10.1017/9781108628426.

During the last two decades plant community ecology has seen a gradual but fundamental shift of attention from species to their characteristics (i.e. functional traits; sensu Violle et al. 2007), as evidence shows that ecosystem processes are linked to species traits rather than species identities (Díaz & Cabido 2001; de Bello et al. 2010). This paradigm shift has stimulated a vast amount of research focusing on the generality and predictability of ecological processes using the 'trait-based approach', while abandoning the classic 'taxonomic approach' (McGill et al. 2006; Webb et al. 2010). As new theories and related methods have developed, so has the requirement for a comprehensive synthesis of these.

This textbook, or as the authors put it "a hitchhike-R's guide to functional ecology" primarily targets students and those who are familiarizing themselves with trait-based ecology. However, it could find its way onto the shelves of ecologists already working with traits, as a must-have reference book. The book offers a synthesis of both theoretical concepts and analytical tools, focusing on different trophic levels and organisms. It covers a broad range of topics, starting from the history of functional traits, trait-based community assembly, the relationship between traits and phylogeny, as well as the role of traits in applied ecology.

The authors have a decade long experience of teaching trait -based ecology in courses across Europe, and are experts in the fields discussed in the different chapters of the textbook. As the book is probably intended to be used as potential course material, the authors have put a strong emphasis on practicality; each chapter is accompanied by freely accessible R material, where related methods are explained through <u>example analyses</u>.

The book contains 12 chapters, each of which is dedicated to a certain aspect of trait-based ecology. The first chapter is the introduction, which explains the history of the paradigm shift from species-based to the trait-based approach, as well as establishing what a 'functional trait' is. The second chapter focuses on the practical decisions one has to make upon deciding to study functional traits. This part is intended as an introduction to functional traits from a practical point-of view, including trait measurements, standardized protocols,



trait databases and handling missing values. The third chapter focuses on species level ecological differences, and how trade-offs between functional traits determine ecological strategies. In the next chapter, one can learn about how species respond to environmental gradients through their functional traits. In this chapter, not only species but community-scale approaches are discussed, which carries on to the next chapter, which is specifically dedicated to community scale metrics. This chapter summarizes what the reader needs to know about community weighted mean and functional diversity indices, when to use which index and how to compute them (also see R material). The sixth chapter is dedicated to within-species trait variability. In the next chapter, the reader can dive deep into (trait-based) community assembly rules and mechanisms, including the classical and modern coexistence-theory, null models and species pools. In the eighth chapter, the focus is on trait evolution.

The reader is introduced to fundamental phylogenetic concepts such as the Brownian motion evolutionary model, indices like phylogenetic signal, phylogenetic diversity as well as different phylogenetic comparative methods. The computation of each of these indices are explained in the attached R practicals. The following two chapters are less technical, but rather focus on larger scale trait variability. Chapter 9 explores the relationship between functional traits and ecosystem processes; and chapter 10 extends the study scale to multiple trophic levels. The final two chapters are more practical. Chapter 11 focuses on the challenges of trait sampling, such as choosing the ideal sample size and number of replicates across different scales. Chapter 12 highlights the importance of functional traits in applied ecology, in the context of agriculture, urban planning, ecological restoration, and invasive species.

The book is written in a style that is easy to understand, bursting with colorful examples and analogies, the illustrations are both informative and artistic, and overall this book is an enjoyable read.

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Flower-rich Xilingol grassland, Inner Mongolia. Photo: K. Uchida.