



BOOK REVIEWS

Coalescing Microbiology and Ecology: Microbiome Food for Thought

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A review of Rachael E. Antwis, Xavier A. Harrison, and Michael J. Cox, editors. *Microbiomes of Soils, Plants and Animals: An Integrated Approach*. Cambridge University Press, Cambridge, UK, 2020.

In recent decades, there has been an exponential increase in research focus on the microbiome, particularly for host-associated microbiomes (e.g., humans). Our growing insight into the importance of host-microbial interactions has led to a surge in studies aimed at manipulating the microbiome to improve health prospects, agricultural yields, and ecosystem services, to name a few. Because of the vast amount of microbiome knowledge that currently exists, it can be a significant problem to get a solid handle on the breadth and depth of current and foundational microbiome research; this is further exacerbated by new technologies and techniques, which facilitate microbiome examinations in differing ways (e.g., metatranscriptomics, metabolomics, etc.). In that sense, the book *Microbiomes of Soils, Plants and Animals: An Integrated Approach* provides a great snapshot of current microbiome knowledge for those new to the field or wanting to increase the breadth of their existing knowledge. This book covers microbiomes from numerous systems (e.g., grasslands, forests, peatlands, corals, plants, insects, and humans), as well as the microbiome association with disease, responding to environmental change, and harnessing the microbiome for applied purposes. In particular, this book should be of particular interest to traditional ecologists or physiologists (e.g., plant physiology) who recognize the important intersection of their model system and their associated microbiome and wish to develop their knowledge.

I remember beginning my marine microbial ecology PhD, following a molecular biology-heavy Honors degree, and being barraged by an avalanche of technical microbiome language, particularly from the approaches used to study microbiomes. Likely, I was not the only student who could have used an

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introduction into the microbiome world. Now that I am taking on a new challenge by studying soil and plant microbiomes, this book helped me in grasping the sheer amount of microbiome knowledge in diverse terrestrial systems. Personally, I found the symbiosis (chapter five) and host behavior (chapter six) sections to be particularly interesting. Similarly, I would expect most budding scientists and members of the general public with a passing interest in microbiology to be most interested in the effect of the microbiome on host behavior and health, and symbiosis. This book does an excellent job introducing these concepts and broadening them to many differing species. Importantly, and for scientists who are interested in other microbiome concepts (e.g., me and symbiosis), this book is certainly less time-intensive than having to sort through recent literature for a broad literature review.

The methodological approaches that are now used to characterize microbiomes can be hard to keep straight, as the area is constantly evolving with new techniques. Every approach has its pros and cons. This was one area where I thought the book particularly shined, as chapter two directly addressed microbiome methodology. In particular, Figure 2.1 provided a great snapshot of existing tools and their uses. Chapter two also addresses the need for measuring microbiome function rather than just characterizing microbiome composition. One area that should not be understated is the vital importance of “basic” microbiology, as without the functional and taxonomic information from microbial strains, it would be difficult to generate databases and to make any inferences to the functional role of microbes in the environment.

The basic microbiome knowledge in this book is abundant, but many stakeholders in society (e.g., farmers, government, pathologists, etc.) are actually more interested in the applied side of the microbiome and being able to harness the microbiome functional potential. Fortunately, this book encompasses multiple chapters that directly address microbiome manipulation (e.g., chapter seven and chapter nine). In particular, my current laboratory has a strong research focus in applied agriculture and microbiome biotechnology, including microbial inoculants and the challenges they face during application and establishment (Kaminsky et al. 2019), and chapter nine addresses these concepts nicely. For those interested in harnessing the microbiome to mitigate disease and improve host health, chapter seven delves into probiotics, prebiotics, and microbiome manipulations. Of particular interest was the discussion around amphibians and microbiome probiotics to reduce fungal pathogen infection (chapter seven, Harris et al. 2009) and the need to understand the commensal (or “natural”) microbiome because of hit-and-miss results with the same probiotic in numerous amphibian species. Further, and for those individuals with an interest in human microbiomes, manipulations of the human microbiome (e.g., Gupta et al. 2016) are also discussed in chapter seven.

While this book does an excellent job introducing microbiome concepts, techniques, and differing study systems, there were a few areas where I thought extra emphasis or improvement could be made. Firstly, it would be helpful to update the terminology used for the plant root microbiome. Specifically, in Figure 4.2, the endosphere is depicted to only include the above-ground portions and does not extend into the root system, and there is no mention of the rhizoplane, which includes the surface-associated and tightly attached soil particles. It may help to break up the “Chapter Four – 4.2.1 Rhizosphere” section into the root endosphere, rhizoplane, and rhizosphere. We recently identified differences in bacterial composition at very fine scales for the root rhizoplane, which are likely driven by differences in selective pressure (King et al. 2021). Secondly, a section discussing microbiome dataset analysis could be helpful for newer audiences, but understandably it is likely outside the scope for this book and is a very contentious, and continually evolving, issue in the microbiome field (e.g., Kuczynski et al. 2010).

Overall, I would certainly recommend this book for any individual with an interest in understanding the interconnected multi-kingdom world that we live in. For students and the general public, this book provides an excellent starting point to build a foundation in microbiome knowledge. For those with vested applied microbiome interests, this book covers concepts related to manipulating microbiomes and will provide an important understanding of these microbial systems so they can be harnessed. Lastly, because of the breadth of microbiome research discussed in this book, it is an excellent starting point for those wanting to increase their breadth of microbiome knowledge.

Literature Cited

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