Preface

Soils need energy for their biota. Most of this energy comes indirectly from the sun via the primary producers. These deliver energy-rich organic compounds into soils either in the form of litter or by direct exudation through roots. Besides microbes, earthworms are highly involved in energy and carbon cycling in soils. Finally, various compounds with biogeochemical and climatic relevance are realized from soils into atmosphere. The most important are carbon dioxide, methane, and diverse nitrous oxides such as N_2O, NO, and NO_2, often cited under the term NO_3. Organic matter is the second most important constituent in soils next to the mineral phase.

Traditionally, organic matter is subdivided into nonhumic substances and humic substances. The former encompass all nonaltered or weakly altered plant materials that are still morphologically identifiable and are composed of defined biomolecules. In contrast, humic substances represent strongly altered organic materials that do not show macroscopically identifiable structures. The process that leads to the formation of humic substances is called humification.

The soil food web is extraordinarily complex; its trophic structure and the relationships between components are poorly understood. By recycling plant material and mineralizing nutrients therein, the belowground decomposer system provides the basis for soil fertility and plant life.

Decomposition process is dominated by microorganisms with their vast array of enzymes for the breakdown of organic matter. However, the microbial environment and, therefore, the activity and composition of the microbial soil community are strongly structured and influenced by an exceptionally diverse community of soil-dwelling invertebrates. Interactions between microorganisms and soil invertebrates include not only direct predator–prey relationships but also indirect effects, such as competition for resources and habitat formation. Macrofauna species such as earthworms, millipedes, and isopods also ingest microorganisms, but in contrast to predator–prey interactions, they predominantly affect microbial life indirectly by forming their habitat. New techniques and methodological developments including molecular and stable isotope techniques provide the opportunity to analyze the

complex interactions between microorganisms and micro-and mesofauna grazers in unprecedented detail, promising fundamental progress in the near future.

The Soil Biology volume *Biology of Earthworms* has 18 chapters. Each chapter provides a general review and statement of current understanding, recent developments and advances, priorities for future research, and applications:

A general protocol of antibacterial vermipeptide preparation methods from earthworms, including crude peptide preparation and purification by ultrafiltration, ion-exchange chromatography, gel-filtration, and HPLC chromatography is discussed in Chap. 1 by Zhenjun Sun. The optimization of earthworm sampling in terms of how to sample, where to sample, and how many samples to take are expressed in detail by Jan Valckx, Gerard Govers, Martin Hermy, and Bart Muys in Chap. 2. Influences of earthworm on soil aggregate formation and soil structure is discussed in Chap. 3 by the author Yasemin Kavdir. In the next chapter (Chap. 4), Maria Jesus Iglesias Briones and Trevor George Piearce perform a comparative anatomical study of the gland of 30 earthworm species belonging to thirteen genera of the family Lumbricidae to identify the main morphotypes present and to unravel their taxonomical and ecological significance within the family.

Several issues regarding sexual selection such as the role of spermathecae, copulatory behavior, allohormone injection, or adjustment of the donated sperm volume are reviewed by Darío J. Díaz Cosín, Marta Novo, and Rosa Fernández in Chap. 5. In the following chapter, Kevin R. Butt focuses on a method to encourage the natural engineering qualities of soil-dwelling earthworms to assist soil improvement and examines one direction taken by a group of researchers who sought to develop a technique to maximize the possibility of successful soil-stimulation by the addition of earthworms.

Controlled cultivation of endogeic and anecic earthworms seek to describe methods that have been progressed to allow production of specific groups of (temperate) soil-dwelling earthworms and demonstrate how their beneficial activities can be harnessed by Kevin Richard Butt and Christopher Nathan Lowe in Chap. 7. In the next chapter (Chap. 8), Visa Nuutinen reviews the sporadic discussion, which has mainly occurred within evolutionary biology, recently within the niche construction theory, while it consists of diverse and partly opposed views.

In Chap. 9, the relationships between soil earthworms and enzymes in different extents are discussed by Ridvan Kizilkaya, Oguz Can Turgay, Sema Camci Cetin, and Ayten Karaca. They discuss Interactions in Microscale, Mesoscale, and Macroscale and also Effects of Agricultural Activities on Earthworm–Enzyme Interactions. Avril Rothwell, Keith Chaney, and Pat Haydock review the effects of conservation tillage and conventional tillage on earthworm populations in Chap. 10. The scope of present review "Assessing the Role of Earthworms in Biocontrol of Soil-borne Plant Fungal Diseases" is to evaluate the role of earthworms in controlling soil-borne plant fungal diseases by Mukesh K. Meghvansi, Lokendra Singh, Ravi B. Srivastava, and Ajit Varma in Chap. 11. Yurdagul Ersahin focuses on comprehensive utilization of vermicompost products, either solid or liquefied, for the inhibition of a variety of plant diseases and pest attacks in Chap. 12. Mohammadi Goltapeh, J. Tajbakhsh, and Ajit Varma discuss the

characteristics of vermicompost and the effect of worm castings on crop yields in Chap. 13.

Earthworm innate immune system is presented in Chap. 14 by Péter Engelmann, Edwin L. Cooper, Balázs Opper, and Péter Németh. In Chap. 15, "Earthworms A Potent Herbal Target for TCM (CAM) Research" is discussed by Yung-Ming Chang, Wei-Yi Chi, Edwin L. Cooper, Wei-Wen Kuo, and Chih-Yang Huang. In Chap. 16, Heinz-Christian Fründ, Ulfert Graefe, and Sabine Tischer give an overview of the use of earthworms as bioindicators and biomonitors. Fatma Lazrek, Velavan Thirumalaisamy Palanichamy, Jérôme Mathieu, and Lise Dupont discuss current molecular markers appropriate to address various issues of earthworm ecology in Chap. 17.

Finally, some key literature on earthworm population dynamics generally and the influences of organic farming systems in temperate climates specifically are reviewed by James Kotcon in Chap. 18.

In planning this volume, invitations for contributions were extended to leading international authorities working with Earthworms. The editors would like to express sincere appreciation to each contributor for his/her work and for their patience and attention to detail during entire production process. We sincerely hope that these eminent contributors will encourage us in the future as well, in the greatest interest of academia.

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