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Book review

K. B. Nguyen and D.J. Hunt (Editors) 2007. Entomopathogenic nematodes: Systematics, Phylogeny and Bacterial Symbionts. *Nematology Monographs and Perspectives, Volume 5. (Series editors: David J. Hunt and Roland N. Perry).* Brill, Leiden-Boston, xvi + 816 pp. ISBN – 10 90 04 15293 8. Price 150, US$210.

Five years after the publishers, Brill, started the journal *Nematology* they began publishing a series of books on nematology under the title, *Nematology Monographs and Perspectives.* The overall series editors are David Hunt and Roland Perry. Now the fifth volume in the series has appeared: *Entomopathogenic nematodes: Systematics, Phylogeny and Bacterial Symbionts* edited by Khuong Nguyen and David Hunt. Some of the previous volumes in this series were closer to the 'perspectives' aspect but this latest one is definitely a 'monograph' – a new monograph in the field of entomopathogenic nematodes (EPNs), where in the last 5-6 years at least two books have been published. Unlike other recent books about EPNs, this one is more precisely focused on the topics reflected in the title.

The book starts with an Introduction by David Hunt, which is an artistic narrative about the development of natural history, nematology and studies in nematodes of insects. This chapter outlines still traceable links between our time and prominent pioneers of natural sciences like Aldrovandi, Réaumur and Rudolphi. The Introduction is really fascinating reading; for example, the story of the increased use of molecular techniques in EPN studies is especially important and these methods are presented as our only hope to solve the accumulating problems of EPN systematics.

The editors decided to divide Chapter 2, Overview of taxonomy and systematics by David Hunt, into two separate subsections with species descriptions of Steinernematidae and Heterorhabditidae; this split is completely justified. As indicated in this chapter, people with completely different backgrounds contributed to the field of EPN systematics and this has resulted in a set of descriptions of variable quality. The chapter contains both an analysis of the situation and proposed solutions to the problems that are revealed. The reader will appreciate the need for authors to separate the EPN species with acceptable quality of descriptions from those whose descriptions do not have sufficient diagnostic value. One quote from this chapter is especially precise, and not only for EPN taxonomy: '..it is preferable to follow a more objective course whilst realizing and accepting that the ultimate fate of these binomena [i.e. - poorly described EPN species] may never be unambiguously resolved'. This important statement and explanation, leads to the next logical step – the inclusion of a list of *species inquirendae.* After this 'act of cleansing' the reader can progress to Chapters 4 and 5, which are filled exclusively with valid descriptions. However, before these chapters the editors have inserted a chapter entitled 'Methodology, morphology and identification' by Khuong Nguyen as Chapter 3. This chapter is a collection of all known techniques, sometimes even quite simple ones, used in basic EPN studies. The great value of this compilation is precisely in its exhaustive coverage – even the naïve newcomer to EPN methodology can find everything here. Without doubt this chapter will save considerable time for teachers of EPN science throughout the world. The middle part of Chapter 3 contains explanations of EPN morphology. Each feature is illustrated, often both as ink-drawing and SEM, providing the reader with an unequivocal definition of all known terms of EPN morphology. The final part of chapter includes the tables (polytomous keys) for identification of EPNs. The book also contains instructions on 'How to use the table', where authors accept in advance that in some cases only approximate links can be determined, such as a group of closely related species. We can suppose that this table will be fully workable for heterorhabditids, but the famous edict of De Ley and Blaxter that "morphology does not suffice" is correct for steinernematids as probably for no other group of nematodes. The inclusion of this table is reasonable; it can be used as a first instrument to navigate the diversity of steinernematids.

Chapters 4, by Khuong Nguyen, David Hunt and Zdeněk Mráček, and 5, by Khuong Nguyen and David Hunt, are composed of standardized separate descriptions of steinernematid and heterorhabditid species, respectively. The authors carefully collected all the valid descriptions and have also completed the enormous task of revising the initial descriptions, so diverse in style and content, into something more uniform and comparable. SEM and light microscope photographs were added to many descriptions where they were previously lacking (an enormous contribution by itself to EPN science). Each description is accompanied by exhaustive technical data, like locality, bionomics, deposition of type material, biocontrol capability, references etc. The extensive revision of differential diagnoses for all the species included is especially impressive. We can say that the task of describing new EPN species never was easier than now; let us hope that any subsequent influx of poor descriptions will not undermine this extensive treatment of species descriptions.

Chapter 6, 'Phylogeny and evolution' by Byron Adams, Scott Pleat and Adler R. Dillman, contains such provocatively titled sections as 'Origins of EPN species'. It is really interesting reading, of a style completely different from the purely taxonomic descriptions of the two previous chapters. An analysis of the modern situation in the studies of EPN phylogeny is presented in this chapter, together with a short

overview of the species concept. The phylogenetic trees depicting the comparative branch lengths for steinernematid and heterorhabditid lineages and the relationships of steinernematids with panagrolaimoid nematodes are very instructive. The longer evolutionary history of Steinernematidae *vs* the short one of Heterorhabditidae is very obvious. The questions of phylogenetic relationships between steinernematids and other panagrolaimoid nematodes (including animal-parasitic Strongyloididae) demands further studies and the tree on Fig. 245 (page 701) presents data not published elsewhere. An interesting fact - *Steinernema* is a group at the base of the phylogeny of panagrolaimoid nematodes, and comparatively distant from strongyloidids.

The discussion of phylogenetic links between different species of *Steinernema* is always interesting, but in this chapter an analysis of the combined data from several publications is presented. The authors reveal the problems of inter-steinernematid relationships and propose ways and tests to solve them. A good example is the lasting problem of the position of *Steinernema rarum* in the generic phylogenetic tree. The authors also indicate the need for morphological re-examination of several species to support their affiliation with the main clades made on the basis of molecular data only. The authors set out their view on the EPN species delimitation. This part of the chapter is very valuable from the practical point of view. We can also agree with the authors' firm stand in favour of molecular autapomorphies as a way to delimit species. With the widening scope of molecular analysis (with the augmentation of studied loci) the amount of the features relevant to solving the problems of species delimitation will increase, so we will be able to support the independence for any species with molecular autapomorphies. The chapter ends with detailed description of several techniques to isolate DNA, and useful PCR and electrophoresis protocols.

The last chapter in the book, Chapter 7, is 'Bacterial symbionts of *Steinernema* and *Heterorhabditis'* by Heather S. Koppenhöfer. The need for such a chapter has been acute for several years. Bacteriology for nematologists is an even more obscure domain than is nematology for entomologists! The methods of bacteriology are changing under the influence of molecular techniques. Laborious work with biochemical tests was obligatory 1-2 decades ago to identify the bacterium, but now sequencing of 16S is providing faster and more informative results. The full list of known 16S primers for EPN-associated bacteria is provided. This chapter also contains a very valuable digest of all recent achievements in the study of *Xenorhabdus* and *Photorhabdus* life cycles and phenotypic variation. The intricate problems of classification of Prokaryotes are difficult to understand for a layman but even such a complicated topic is presented here in a simple and open style. Like the chapters on nematode taxonomy, this bacteriological one contains the species descriptions for all valid bacterial species. A complete description of bacteriological methodology is given in the end of Chapter 7, even supplied with a colour picture of *Xenorhabdus* colonies on Tergitol 7-TTC agar (how would we otherwise know what is the proper appearance of such colonies).

The publication of this book is an event that will send very positive stimuli across this specific field of zoology – EPN studies. Previously published books with reviews of different aspects of nematode-bacterial symbiosis are still important, but the unique feature of this latest monograph is in its direction towards the needs of 'front-line' researchers. The chapter authors surely achieved the main goal of the book, to put in order the heterogeneous (by origin and quality) collection of original descriptions and primary facts. Previously, differential diagnoses of new species of EPN frequently included a comparison with sometimes quite unexpected taxa, often very far from the newly described species in morphological peculiarities and phylogenetic position. Now such arguments to delimit new species can be rectified, and in future comparisons can be concentrated on a few closely related forms. It will be also very important now to have this book close to hand in the laboratory as plenty of laboratory techniques can be found instantly in it.

Misprints and stylistic errors will usually be present in a book of 800+ pages; however, not a single one created problems for comprehension and, thus, do not deserve a mention. Some light-microphotographs are too small to recognize safely the structures of interest; e.g. it is difficult to see the 'characteristic refractile spine' on the terminus of *Steinernema affine* IJ tail (Fig. 34, F, page 143). However, in general, the printing quality is excellent and even tiny surface structures are discernible in SEM photographs. Sometimes SEM photographs help to solve long-discussed points of controversy, like the presence of hook-like structure on the spicula tip of *Steinernema glaseri* male. Comparison of Fig. 84 A-E proves that the appearance of the tip depression (most probably the orifice of intra-spicular sensory structure) is different between specimens. Some spicula tips are hook-like, some are not.

This book will influence studies of entomopathogenic nematodes for years ahead. First of all it will make life easier for anyone intending to describe new EPN species or to isolate associated bacteria, and to use molecular techniques to study their phylogenetic links. On behalf of the people doing taxonomic researches on EPNs, I would like to thank the authors of the chapters in this book, the editors of this edition and the series editors (who surely spent a lot of time making this book so 'reader-friendly') and Koninklijke Brill NV for the support of EPN studies worldwide.

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