Agustín Estrada-Peña
Andrei Daniel Mihalca
Trevor N. Petney *Editors*

Ticks of Europe and North Africa

A Guide to Species Identification

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EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

Springer

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A Guide to Species Identification

With maps by Cristian Domşa and illustrations by Jacob Gragera

Springer

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ISBN 978-3-319-63759-4 ISBN 978-3-319-63760-0 (eBook)
https://doi.org/10.1007/978-3-319-63760-0

Library of Congress Control Number: 2017946957

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

This book is based upon work from COST Action TD1303 European Network for Neglected Vectors and Vector-Borne Infections (EURNEGVEC), supported by COST (European Cooperation in Science and Technology).

COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. Our Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation.

Funded by the Horizon 2020 Framework Programme of the European Union

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Foreword

Agustín Estrada-Peña, Trevor Neil Petney, and Andrei Daniel Mihalca have undertaken a huge task, bringing together much of the scattered knowledge on the ticks of Europe and the Mediterranean Basin and examining it critically. Animal owners have realized the importance of ticks and the diseases that they transmit, both to agricultural and companion animals, for a long time. In addition, the general public, and more particularly public health authorities, are increasingly recognizing the importance of zoonotic tick-borne diseases to human health, particularly since the discovery of Lyme borreliosis and the realization of how common this infection in fact is.

These three scientists have not only edited and illustrated this book "Ticks of Europe and North Africa", published by Springer, but also figured prominently among the contributors to its text. Other contributors are also among the best specialists of their subject.

The result of this undertaking is admirable and the book will certainly become and remain for a long time an essential tool to all scientists working on ticks and tick-borne agents, particularly in the regions covered.

The editors and contributors also discuss areas in which information is still incomplete or missing and present contradictory opinions about classification and the many problems which remain to be solved. Some of the problems are tenacious and for the moment unsolvable, especially when type specimens have been lost or never existed: using the names under which gene sequences have been deposited in GenBank does not help, as these names are just as unreliable.

One of the vexing problems in the genus *Rhipicephalus* is the *R. sanguineus* complex; many authors distinguish *R. sanguineus* from *R. turanicus* on morphological characters, but gene sequences of some of the ticks identified morphologically as *R. turanicus* are identical with sequences in *R. sanguineus.* It even appears to be impossible to define *R. sanguineus* sensu stricto! Ticks of the genus *Hyalomma* are also difficult to identify and present great morphological variability with some specimens being impossible to identify on their morphology to the species level. Nymphs are particularly difficult, and the recommendation is to allow engorged specimens to molt to the adult stage and then try to identify them.

I would advise scientists in this part of the world, when in doubt, to contact specialists among the editors and contributors of the book for help in obtaining identifications that are as reliable as possible.

Two of the three families of ticks are known to occur in the area covered: The Argasidae, with 2 genera, *Argas* and *Ornithodoros*, and the Ixodidae with 5 genera, *Dermacentor*, *Haemaphysalis*, *Hyalomma*, *Ixodes*, and *Rhipicephalus*. Those occurring in Europe and northern Africa are all treated exhaustively.

There are general parts on each genus, keys for the determination of the species in the area covered by the book, as well as distribution maps. Each species is then dealt with in terms of its life cycle and hosts, its ecology and distribution, and its medical and veterinary relevance. The beautiful, newly prepared drawings of all adults and most immatures will be of great help in using the identification keys. All authors have agreed on these keys and they have been tested independently by other researchers in the field.

References are given for almost all statements, which should make this book a basic one for research on ticks and tick-borne agents and eliminate many of the errors that are usually repeated from publication to publication, without going to the sources of the data.

In conclusion, this book will prove to be essential for all researchers and laboratory personnel involved in identification of European and Northern African ticks and tick-borne infections.

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Acknowledgements

The following people contributed with georeferenced data for tick species distribution (listed alphabetically according to the surname): Manuela Amorim, Manuel António, Fábia Azevedo, Niina Bang, Susana Baptista, Birgit U. Baumgarten, Silvia Bino, Jovan Bojkovski, Antra Bormane, María Casero, Cristina Cazan, Miguel Cerqueira, Jan Chirico, Dimosthenis Chochlakis, Alexandra Corduneanu, António Cotão, Gianluca D'Amico, Isabel L. de Carvalho, Daniele De Meneghi, Rita de Sousa, Georgiana Deak, Daan Dekeukeleire, Enkelejda Dikolli, Mihael Dinev, Niamh Dolan, Rajkovic Dragana, Justine Dutraive, Agustin Estrada-Peña, Cláudia Fernandes, Leonel Fernandes, Carlos Fonseca, Frederico Freitas, Nickals Fritzen, Helena Garcia, Adriana Geraldes, Diogo S. Gomes, Salomé Gonçalves, Estelle Gonzalez, Mari Haapavaara, Jari Hänninen, Nina Helajärvi, Petr Heneberg, Sara Heponiemi, Václav Hönig, Tapani Hopkins, Sandor Hornok, Lena Hulden, Larry Hulden, Petteri Ilmoinen, Mariana Ioniţă, Ivana Ivanovic, Thomas Jaenson, Aleksandar Jurišić, Perparim Kadriaj, Marita Kallinen, Kari Kaunisto, Matej Kautman, Kieran Kenny, Dorota Kiewra, Tero Klemola, Seppo Koponen, Anna Koskela, Päivi Koskinen, Emma Kosonen, František Krause, Aleksandra Krawczyk, Milos Krist, Anton Kristin, Pipsa Kuusisto, Stina Laine, Jaakko Laitonen, Laetitia Lempereur, Monique L'Hostis, Ivan Literák, V. Lizana, Isis V. Llopis, Carla Maia, Igor Majláth, Viktória Majláthová, Juha Mäki, Jussi Mäki, Alessandro Mannelli, Alexander Mathis, Barry J. McMahon, Pedro Melo, Helena Metiäinen, Andrei D. Mihalca, Caroline Millins, Alexandr Morozov, Fergal Morris, Sara Moutailler, Vicenzo Musella, Marion Nieder, Mikko Niemi, Minna Niemi, Okko Niemi, Marketa Novakova, Maria S. Núncio, Mónica Nunes, Nina Nupponen, Anna Obiegala, Jack O'Connor, Tanja Ojanperä, Manuel Oliveira, Jasmin Omeragic, Ika Österblad, Jose A. Oteo, Domenico Otranto, Evelyn Overzier, Ana M. Palomar Urbina, Elias Papadopoulos, Ricardo Parreira, Anna Pauna, Ritva Penttinen, André Pereira, Aleksandra Petrovic, Martin Pfeffer, Carlos Pinto, Helena Pinto, Manuela Pinto, Olivier Plantard, Sabine Poljak, Arantza Portillo, Aleksandar Potkonjak, Oli Pyysalo, Carla Quintas, Markus Rahikainen, Kalle Rainio, Laura Rinaldi, Veikko Rinne, Monica Robinson, Luca Rossi, Kai Rruohomäki, Cédric Samorinha, Attila D. Sándor, S. Santibéñez, Ana S. Santos, Maria J. Santos, Maria M. Santos-Silva, Karoliina Savolainen, Dino Scaravelli, Henrique Sebastião, Vesa Selänne, Cornelia Silaghi, Domingos Silva, Sílvia Silva, Cristina Soares, Martti Soikkeli, Sanna Soini, Jani Sormunen, Jouni Sorvari, Hein Sprong, Peter Stuart, Ivica Sucic, Snežana Tomanović, Laura Tomassone, Tomi Trilar, Friederike v. Loewenich, Varpu Vahtera, Ana Vasić, Zati Vatansever, Muriel Vayssier-Taussat, Sónia Veloso, Hélène Verheyden, Outi Vesakoski, Cristina Vide, Vracar Vuk, Gernot Walder, Lisa Weis, Nemanja Zdravković, Annetta Zintl. We wish to thank them all sincerely for their help without which this book would not have been complete!

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Presentation

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After years of work on the systematics of ticks, I realized that most of my workplace was occupied by many reprints about the morphology, illustrations, keys, and, in summary, the "tools" to make an identification of a tick. Since it is assumed I am an expert on the topic (but very different opinions exist about this), I have always considered the serious difficulties the topic may present for researchers initiating their work in this field. For example, we can consider experts on microbiology who want to approach some aspect of tick-transmitted pathogens, or specialists working on ecological associations (parasitism is one of these) without an adequate knowledge or the necessary background to approach a project. Furthermore, in the recent years, we have been subjected to an explosion of online material. All of this material has something in common: it is recent. I realized this after contemplating my pile of old reprints dating back from the 1970s and 1980s: if something is not in Internet, it simply does not exist. It is not necessary to state that many sequences already available in GenBank are the product of an unreliable identification of tick specimens. Therefore, they generate a very dangerous background noise that obscures our abilities to identify a tick. If we cannot identify a tick by morphological means, and the molecular data available are "dangerously biased", then every further result coming from that tick is simply unreliable, including reports on pathogens, hosts, or distribution. In my mind, the idea of preparing a book compiling and summarizing our knowledge on ticks took shape. However, I could not make all that effort by myself. Not only to write, but also to prepare illustrations, to compile the known distributions, to separate the facts from the artifacts, or to evaluate what is a good report from others which are unreliable. This should be a task carried out by several specialists, with at least some funds to support the basics of the work. I never abandoned the idea but postponed time after time.

Sometimes dreams come true. One day I had a telephone talk with Trevor Petney, and other than a long discussion on our research projects, he suggested that we collaborate on preparing exactly what I wanted along the lines of a kind of "Atlas" on the ticks in the Western Palaearctic: compiling basic texts on all of the species present, as well as keys and illustrations in only one book. Of course, some other texts already existed, namely the one headed by Alan Walker, in which I also participated. But we anticipated including every stage of every species reported in the target territory. A monumental work! Let me repeat: sometimes dreams come true. A few days later I met Andrei Mihalca for the first time. He was leading an action funded by the European Union under the umbrella of the COST (European Cooperation in Science and Technology) Office. After the kick-off meeting of the COST Action TD1303 in Brussels, we had another meeting in Cluj-Napoca (Romania) and immediately it was obvious that both Andrei Mihalca and I were completely "tuned-on" about how to carry out this immense project. Therefore, around a good glass of Transylvanian wine in the city of Cluj-Napoca, Andrei and I realized all these caveats. And the idea quickly developed involving the three coeditors who originally planned this work. The keys were developed after an intensive 2-year work and validated using a blind test (Estrada-Peña et al. 2017a, b). In parallel, for each species and developmental stage, professional technical illustrations were prepared to accompany the keys. The result of all this work is the most comprehensive set of identification keys published so far for Western Palearctic ticks.

Thanks to the policy of "putting researchers in contact" carried out by the COST Action, we identified the potential contributors, who are obviously the coauthors of this book. It is not necessary to explain the gigantic task of compilation of records of every species of tick, the preparation of adequate keys, and of the illustrations, which should be academic, clear, and informative. All of this could not be possible without the voluntary contributions of many researchers (listed in the acknowledgments section) and the labor of the coauthors. A special person must be introduced here: Gerrit Uilenberg, although already retired he had never left his real work. Gerrit "Oele" Uilenberg, who has been a fundamental pillar in tick studies for decades, agreed to prepare the foreword for this book. As expected, he immediately became involved in the revision of potentially unreliable statements in the book, and he finished making an almost complete revision of the text. My personal special thanks, for many years of friendship, correspondence, support, and collaborations, are my tribute to his contributions to this book.

After a brief section on collecting ticks, we discuss first the Family Argasidae and then the Family Ixodidae. For each family, there is a key to the genera for all life history stages. For each genus, there is a relatively long revision of the basic references (commonly not available in Internet), which should be studied before considering the identity of each species, together with an explicit mention of the keys found in each reference, and that were drawn from the publication by Estrada-Peña et al. (2017a). All of these relatively old references are adequately included in the main text for each genus. After the discussion of the genus, we present newly developed keys for all life history stages of the species therein. The book was planned with a "morphological design" in mind, and therefore the keys and illustrations are parts of the basic "recipe" for identifying a tick. After the keys, each species is individually treated: we provide basic data about the ecology, hosts, life cycle, distribution, and potential involvement in the transmission of agents with medical and/or veterinary significance. At the end of each species chapter, the illustrations for each stage are included together with maps that show the recorded species distribution. The maps contained in this book are based on a GIS database, compiled from the information sent by the contributors (the final database contains more than 65,000 records). The species distribution maps were compiled using a 10 $\times$ 10 km grid (the ETRS89 LAEA European official grid, expanded to cover North Africa). For some countries, we found records of certain tick species without georeferenced data, therefore we also produced country distribution maps so this information could be included.

The keys are far from complete, since some species lack adequate features for the separation of some stages. This is particularly the case of immatures of the genus *Hyalomma*, and, to some extent, for genus *Ixodes*. Some species may be relatively easy to separate, while others share the most prominent morphological features. We therefore preferred not to include those species for which we were unable to find reliable diagnostic characteristics. We do provided adequate coverage of previous references which may help the readers. The same applies to the illustrations. It is probably paradoxical that we still do not know many of the most basic features of some species of ticks. Probably the best example are the species of *Ixodes* that are parasites of pelagic birds. Information about the morphology of these species is scarce, specimens are unavailable, and therefore adequate material to prepare adequate illustrations is simply missing. These few species lack illustrations.

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