Ticks

Widespread and increasing resistance to most available acaracides threatens both global livestock industries and public health. This necessitates better understanding of ticks and the diseases they transmit in the development of new control strategies. *Ticks: Biology, Disease and Control* is written by an international collection of experts and covers in-depth information on aspects of the biology of the ticks themselves, various veterinary and medical tick-borne pathogens, and aspects of traditional and potential new control methods. A valuable resource for graduate students, academic researchers and professionals, the book covers the whole gamut of ticks and tick-borne diseases from microsatellites to satellite imagery and from exploiting tick saliva for therapeutic drugs to developing drugs to control tick populations. It encompasses the variety of interconnected fields impinging on the economically important and biologically fascinating phenomenon of ticks, the diseases they transmit and methods of their control.

Alan Bowman has worked at the Universities of Edinburgh, Oxford and Oklahoma State and is now at the University of Aberdeen. His research interests include tick physiology, bioactive factors in tick saliva, drug target development and ecological aspects of borreliosis. Funding for his tick research has come from national funding bodies and both large animal-health and small biotechnology companies for which he also acts as a consultant.

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Ticks

Biology, Disease and Control

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Preface

Tick statistics are impressive. Some 907 tick species have been named. Their only food is blood, of which some ticks consume relatively vast quantities (several hundred times their unfed body weight). Some take 2 weeks or more to feed. Often they only feed three times during the whole of their life cycle (which may take 7 years to complete). They feed on mammals (including humans), birds and reptiles. Their geographical distribution ranges from sub-arctic through equatorial to antarctic regions, and habitats range from desert to rainforest. They even survive submersion in seawater as they feed on seabirds diving for fish. But the most important tick statistics concern their ability to transmit pathogens (disease-causing agents). And our greatest challenge is to devise efficient and effective means of controlling ticks and tick-borne pathogens.

Ticks transmit a great variety of disease-causing agents to humans (viral, bacterial and protozoal), including bacteria that cause Lyme disease, the reports of which increase in number year on year. About 80% of the world’s cattle are infested with ticks. As a result, ticks are the most economically important ectoparasite of livestock. The impact of ticks on livestock producers in the developing world is a contributing factor to poverty.

In this book we have brought together experts from the tick world to express their views on the key advances in tick biology, diseases and control. Tick systematics and evolution highlight fundamental changes in our understanding, particularly for hard (ixodid) ticks, their life cycles and historical zoogeography (Barker & Murrell). While the ecology of ticks is a fundamental influence in pathogen transmission dynamics (Randolph), tick salivary glands perform a key function in survival (water balance) and pathogen transmission (Bowman, Ball & Sauer). For good reason, ticks have been called ‘supreme pharmacologists’, manipulating their hosts’ attempts to get rid of them by secreting hundreds of antihaemostatic, anti-inflammatory, anaesthetic and immunomodulatory molecules in their saliva. Not surprisingly, the ‘sialome’ has become the frontier in understanding the role of tick saliva in blood-feeding and pathogen
transmission (Anderson & Valenzuela). Saliva also contains
toxins, a non-infectious cause of disease, though we know
little of their functional significance (Mans, Gothe & Neitz).
Besides saliva production, blood-feeding also enhances tick
lectin activities, which play a role in defence reactions and
pathogen transmission (Grubhoffer et al.), and triggers the
endocrine system about which comparatively little is known
(Rees). Similarly, the mechanisms used by male ticks to
assure their paternity are largely virgin territory (Kaufman).

One of the reasons why ticks transmit so many pathogens
is found in the dynamic interactions that occur at the tick–
host–pathogen interface (Brossard & Wikel) where saliva
assists pathogen transmission (Nuttall & Labuda). Because
ticks transmit such a diversity of pathogens, we have had
to be selective. For humans, the most common tick-borne
infection is Lyme borreliosis (Piesman & Gern) though sev-
eral tick-borne viruses cause human disease and even death
(Labuda & Nuttall). More common are diseases of live-
stock, including babesiosis, the most economically impor-
tant arthropod-borne disease of cattle (Bock et al.), theile-
riosis, a particular problem in developing countries (Bishop
et al.), and anaplasmosis, caused by *Anaplasma marginale*,
a bacterium (rickettsia) (Kocan, de la Fuente & Blouin).

Few ‘emerging’ tick-borne infections are new to science
(Telford & Goethert).

Controlling ticks and tick-borne pathogens requires new
approaches, such as satellite-based remote sensing for land-
scape epidemiology to identify spatial and temporal dis-
tribution (Daniel, Kolář & Zeman). But the mainstay of
tick and disease control remains acaricide use, despite the
alarming problem of acaricide resistance (George, Pound &
Davey). Although a commercial tick vaccine became avail-
able in 1994, progress in developing new and improved
vaccines is slow (Willadsen). Development of biological
agents to control ticks is still in its infancy (Samish, Gins-
berg & Glazer), as is the use of pheromones and other
semiochemicals (Sonenshine) although some show great
promise.

This book follows on from the *Parasitology* Supplement,
*Ticks: Biology, Disease and Control*, published in 2004. As
a result of interest in the Supplement and requests from
workers in the field, we went back to the authors and asked
if they would update and revise their contributions. Where
the book chapter has replaced valuable information in the
Supplement, the appropriate Supplement reference has been
cited. We hope this book inspires your interest in the remark-
able world of ticks.

ALAN S. BOWMAN and PATRICIA A. NUTTALL
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