

The Biology of Blood-Sucking in Insects
Second Edition

Blood-sucking insects transmit many of the most debilitating diseases in humans, including malaria, sleeping sickness, filariasis, leishmaniasis, dengue, typhus and plague. In addition, these insects cause major economic losses in agriculture both by direct damage to livestock and as a result of the veterinary diseases, such as the various trypanosomiases, that they transmit. The second edition of *The Biology of Blood-Sucking in Insects* is a unique, topic-led commentary on the biological themes that are common in the lives of blood-sucking insects. To do this effectively it concentrates on those aspects of the biology of these fascinating insects that have been clearly modified in some way to suit the blood-sucking habit. The book opens with a brief outline of the medical, social and economic impact of blood-sucking insects. Further chapters cover the evolution of the blood-sucking habit, feeding preferences, host location, the ingestion of blood and the various physiological adaptations for dealing with the blood meal. Discussions on host–insect interactions and the transmission of parasites by blood-sucking insects are followed by the final chapter, which is designed as a useful quick-reference section covering the different groups of insects referred to in the text.

For this second edition, *The Biology of Blood-Sucking in Insects* has been fully updated since the first edition was published in 1991. It is written in a clear, concise fashion and is well illustrated throughout with a variety of specially prepared line illustrations and photographs. The text provides a summary of knowledge about this important group of insects and will be of interest to advanced undergraduate and to postgraduate students in medical and veterinary parasitology and entomology.

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SECOND EDITION

M. J. Lehane

Liverpool School of Tropical Medicine



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Contents

	<i>List of tables</i>	page vii
	<i>List of boxes</i>	x
	<i>Preface</i>	xi
	<i>Acknowledgements</i>	xiii
1	The importance of blood-sucking insects	1
2	The evolution of the blood-sucking habit	7
	2.1 Prolonged close association with vertebrates	7
	2.2 Morphological pre-adaptation for piercing	13
3	Feeding preferences of blood-sucking insects	15
	3.1 Host choice	15
	3.2 Host choice and species complexes	24
4	Location of the host	27
	4.1 A behavioural framework for host location	27
	4.2 Appetitive searching	29
	4.3 Activation and orientation	32
	4.4 Attraction	49
	4.5 Movement between hosts	52
5	Ingestion of the blood meal	56
	5.1 Probing stimulants	56
	5.2 Mouthparts	57
	5.3 Vertebrate haemostasis	64
	5.4 Host pain	68
	5.5 Insect anti-haemostatic and anti-pain factors in saliva	69
	5.6 Phagostimulants	76
	5.7 Blood intake	78
6	Managing the blood meal	84
	6.1 Midgut anatomy	84
	6.2 The blood meal	87
	6.3 Gonotrophic concordance	96

vi	Contents	
	6.4 Nutrition	98
	6.5 Host hormones in the blood meal	103
	6.6 Partitioning of resources from the blood meal	106
	6.7 Autogeny	109
7	Host–insect interactions	116
	7.1 Insect distribution on the surface of the host	117
	7.2 Morphological specializations for life on the host	121
	7.3 Host immune responses and insect salivary secretions	126
	7.4 Behavioural defences of the host	134
	7.5 Density-dependent effects on feeding success	142
8	Transmission of parasites by blood-sucking insects	150
	8.1 Transmission routes	150
	8.2 Specificity in vector–parasite relationships	163
	8.3 Origin of vector–parasite relationships	167
	8.4 Parasite strategies for contacting a vector	170
	8.5 Parasite strategies for contacting a vertebrate host	177
	8.6 Vector pathology caused by parasites	179
	8.7 Vector immune mechanisms	184
9	The blood-sucking insect groups	202
	9.1 Insect classification	202
	9.2 Phthiraptera	204
	9.3 Hemiptera	208
	9.4 Siphonaptera	213
	9.5 Diptera	219
	9.6 Other groups	257
	<i>References</i>	259
	<i>Index</i>	312

Tables

1.1	An outline of the early investigations that laid the foundations of medical and veterinary entomology.	<i>page 2</i>
1.2	Rounded estimates for the prevalence of disease, the number at risk and the disability adjusted life years (DALYs) for major vector-borne diseases.	3
1.3	Estimated losses in agricultural production caused by blood-sucking insects.	4
4.1	Generalized opportunities and constraints on host location by blood-sucking insects feeding during the day or night.	32
4.2	Different blood-sucking insects respond in different ways to spectral information.	45
5.1	Adaptations of mouthpart components for different purposes in various haematophagous insect groups.	58
5.2	Blood-sucking insects produce a wide range of anti-haemostatic factors in their salivary secretions. This table gives some examples with a range of different activities.	71
5.3	The size of red corpuscles varies widely in different animals. Given that many blood-sucking insects have mouthparts with a terminal diameter of around 10 μ m, this may be a factor affecting the feeding efficiency of blood-sucking insects on different host species.	80
6.1	The size of the red blood meal and the time taken in its digestion are affected by a range of factors including ambient temperature, age of the insect, mating status, stage of the gonotrophic cycle, previous feeding history, and source of the blood meal. The figures given here are a rough guideline to the 'average' meal size and time for digestion in a variety of haematophagous insects.	88
6.2	The major constituents of the blood are reasonably uniform in most host animals. The exception is the high levels of nucleic acids in the blood of birds and reptiles because of their nucleated red blood cells. Proteins are far and away the most abundant nutrients in blood, and	

viii **List of tables**

	nutrients are unevenly distributed between whole blood (B), red blood cells alone (E) and plasma alone (P).	90
6.3	Symbionts are common in insects relying on blood as the sole food source throughout their lives. An outline is given of their anatomical locations and the means of transmission from one generation to the next in different insect groups.	99
6.4	Three types of female <i>Aedes taeniorhynchus</i> have been identified in terms of egg development: autogenous females (1); females that are autogenous if mated (2); and anaautogenous forms (3). This pattern is influenced by the feeding success of the larval stage, as illustrated in this table.	113
6.5	Some mosquitoes can use sugar meals (10% sucrose in this experiment) to increase the number of autogenously produced eggs.	114
7.1	The choice of feeding site of <i>Aedes triseriatus</i> on eastern chipmunks and grey squirrels is influenced by length and density of body hair. The different feeding patterns on the two hosts reflects the differences in hair cover between them.	119
7.2	The anti-mosquito behaviour of a range of ciconiiform birds, showing that different host species display various types and degrees of defensive behaviour against blood-sucking insects.	137
8.1	Some of the most important associations of disease-causing organisms carried to humans and other animals by blood-sucking insects: (a) viruses, (b) rickettsia and bacteria, (c) protozoa and (d) nematodes.	151
8.2	Blood-sucking insects commonly take meals that are only a small proportion of the total blood present in the host animal (the ratio between total blood in the host and size of the insect's blood meal is given). This minimizes the chances of the insect ingesting any individual parasite during feeding. One strategy adopted by insect-borne parasites to overcome this problem is to produce large numbers of infective stages which circulate in the blood of the host.	171
8.3	The microfilariae of many filarial worms display a pronounced periodicity, with microfilarial numbers in the peripheral blood coinciding with the peak biting time of locally abundant vector species.	173

List of tables		ix
8.4	Tsetse flies infected with trypanosomes feed more readily and probe more often than uninfected flies, thereby increasing the chances of parasite transmission.	178
8.5	Comparison of the rate of formation of the peritrophic matrix among various mosquito species.	189
8.6	The melanization response to subsequent challenge of infected and uninfected <i>Aedes aegypti</i> , as shown by the intrathoracic injection of specific microfilariae (mff) which normally induce a strong melanization reaction.	200
9.1	The groups of insect. Those groups containing blood-sucking insects are shown in bold.	203
9.2	The geographical distribution of triatomine species, which have become highly adapted to the domestic-peridomestic environment of man and so represent a particular threat as vectors of Chagas' disease.	211
9.3	The divisions of the order Diptera and the major families in each division. Families containing blood-sucking species are in bold type.	221

Boxes

- | | | |
|-----|---|----------------|
| 3.1 | The importance of rates of mosquitoes biting humans for the transmission of malaria. | <i>page</i> 20 |
| 3.2 | Identification of the source of a blood meal. | 21 |
| 7.1 | Histopathology of the various stages in the sequence of host response to insect bites. | 130 |
| 8.1 | Four blood cell types characterized in <i>Aedes aegypti</i> are compared to haemocytes described in previous studies on a variety of insects. | 197 |

Preface

Blood-sucking insects are the vectors of many of the most debilitating parasites of humans and their domesticated animals. In addition they are of considerable direct cost to the agricultural industry through losses in milk and meat yields, and through damage to hides, wool and other products. So, not surprisingly, many books of medical and veterinary entomology have been written. Most of these texts are organized taxonomically, giving details of the life cycles, bionomics, relationships to disease and economic importance of each of the insect groups in turn. I have taken a different approach. This book is topic-led and aims to discuss the biological themes common to the lives of blood-sucking insects. To do this I have concentrated on those aspects of the biology of these fascinating insects that have been clearly modified in some way to suit the blood-sucking habit. For example, I have discussed feeding and digestion in some detail because feeding on blood presents insects with special problems, but I have not discussed respiration because it is not affected in any particular way by haematophagy. To reflect this better I have made a slight adjustment to the title of the book in this second edition. Naturally there is a subjective element in the choice of topics for discussion and the weight given to each. I hope that I have not let my enthusiasm for the particular subjects get the better of me on too many occasions and that the subject material achieves an overall balance. The major changes in this second edition most often reflect the revolutionary influence that molecular biology has had on the subject in the past 12 years.

Although the book is not designed as a conventional text of medical and veterinary entomology, in Chapter 9 I have given a brief outline of each of the blood-sucking insect groups. This chapter is intended as a quick introduction for those entirely new to the subject, or as a refresher on particular groups for those already familiar with the divisions of blood-sucking insects. There are several introductory textbooks of medical and veterinary entomology available to those requiring more information.

The book is primarily intended for advanced undergraduate and for postgraduate students, but because it looks at topics that cut across the normal research boundaries of physiology and ecology, behaviour and cell biology, I hope it may also be useful for more established scientists who

xii **Preface**

want to look outside their own specialism. I have tried to distil this broad spectrum of information, much of which is not readily available to the non-specialist, into a brief synthesis. For those who want to look further into a particular area I have included some of the references I found most useful in writing the text, and these will provide an entry into the literature. Clearly the subjects covered by the book encompass a vast number of publications and I am sure to have missed many important and interesting references for which I apologize in advance both to the reader and my fellow scientists. Many of the topics discussed in the different chapters are interrelated. To avoid repetition, and still give the broadest picture possible, I have given cross-references in the text which I hope the reader will find useful.

From a comparative point of view it is an unfortunate fact that most of the work on blood-sucking insects has been carried out on a few species. Consequently, tsetse flies and mosquitoes pop up on every other page. In many instances it remains to be seen how widely the lessons we have learned from these well-studied models can be applied. Where possible I have tried to point to general patterns that fit whole groups of blood-sucking insects. To help me in this I have divided the blood-sucking insects into three convenient but artificial categories: temporary ectoparasites, permanent ectoparasites and periodic ectoparasites. These categories are based solely on the behaviour biology of the blood-feeding stadia in the lives of these insects. Temporary ectoparasites are considered to be those largely free-living insects, such as the tabanids, mosquitoes, blood-feeding bugs and blackflies, that visit the host only long enough to take a blood meal. I also include insects such as the tsetse here, even though the male may be found in swarms closely associated with the host for large parts of its life. Permanent ectoparasites are considered to be those insects that live almost constantly on the host, such as lice, the sheep ked and tungid fleas. Finally, periodic ectoparasites are considered to be those insects that spend considerably longer on the host than is required merely to obtain a blood meal, but that nevertheless spend a significant amount of time away from the host. Insects that fall into this category include many of the fleas and *Pupipara*. These categories are no more than a useful generalization in the text; I make no claims for their rigour and I realize that it could be argued in several instances that an insect will sit as easily in one category as another.

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