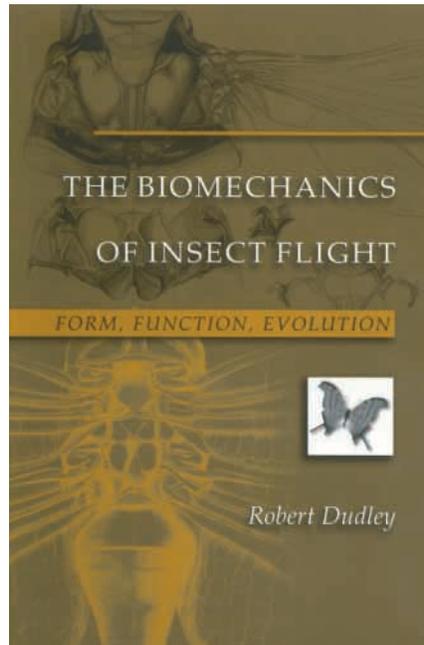


MORE THAN A FLITTING TOUR OF FLAPPING FLIGHT



The Biomechanics of Insect Flight

By Robert Dudley

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By most measures, insects are remarkable: whether considering number of species, biomass, economic importance or range, insects are impressive. One key attribute that accounts for much of this 'success' is the ability to fly; with flight comes improved speed, range, opportunity for feeding and escape, and consequently a vastly expanded number of potential ecological niches. Hence, an understanding of the evolution and mechanics of flight provides insight into many aspects of insect biology. Now that the *Biomechanics of Insect Flight* by Princeton University Press is reissued in paperback, it has become accessible to more than a specialist readership.

After an introduction briefly covering the evolution and taxonomy of insects, with the essence of an advertising campaign for the insect taxon, Dudley runs through the basics of flight and relevant morphology (including some fluid dynamics and an

introduction to the flight apparatus). He continues with coverage of the kinematics and aerodynamics of insect flight, before approaching the energetics and physiology of flight and issues of stability and maneuverability. Having dealt with what is known about the physics of flight, subsequent chapters discuss more biological themes: the evolution of flight, the significance of miniaturization and the relationships between flight ability and pollination, predator avoidance and dispersal. These areas introduce some truly fascinating aspects of biology. For instance, Dudley argues that the multiple independent origins of evasive flight behaviors indicate the intense selective pressure imposed by aerial predation, and he discusses some remarkable survival strategies, including beetles with the capacity for ultrasound production, possibly to confuse bats, crickets that induce erratic turns by positioning hindlegs into the path of beating wings, and Batesian mimicry of flight style and flight-related morphology.

Despite the great wealth of work presented in the literature, and extensively detailed throughout the text (a notable strength of this book), Dudley reminds the reader how much remains uncertain, unknown or unconsidered. A final chapter focuses on future directions in insect flight biomechanics research, although deficiencies in the current state of knowledge are discussed throughout. By doing this, he highlights many areas where further work would be valuable, particularly in understanding more of the diversity of insect flight strategies.

One of the appeals of insects for study is their relatively small size and amenability to laboratory work. However, as Dudley emphasises in the final chapter, advances in instrumentation now permit studies in the field. These have the potential to demonstrate the links between aerodynamics and many aspects of insect ecology, sexual selection, maneuverability and predation under natural conditions. The linking between the 'how' of physics and the 'why' of biology is one of Dudley's favourites, and this is a fascinating area that deserves attention in the future.

Dudley provides an excellent balance between lumping ideas into broad, understandable themes and realising the diversity of insects; he discusses the many aspects of insect biology relating to flight from a 'big picture' perspective, highlighting scaling relationships

(particularly of kinematics, aerodynamics and energetics), while retaining an awareness of phylogenetic relationships, presenting instances of convergence and divergence.

As the book was published in hardback three years ago, there is always a danger that it might become obsolete very quickly, as important developments continue in the field. However, the general physical principles discussed are well founded, and subsequent findings, such as the continuing discoveries concerning unconventional aerodynamic mechanisms, do not devalue this contribution. The hardback issue has quickly become appreciated as a source of

inspiration and an effective reference: I find 17 citations to it in 2002 alone, and its popularity both to people touching the edge of the field and those firmly entrenched in it will continue to rise with the new paperback.

One slight note of caution is that, throughout, the language can be sophisticated. Whether due to Dudley's writing style or due to the subject matter, the text can be quite technical, both requiring a good memory for terminology and an understanding of degree-level biological concepts; a non-biologist might find it difficult to dip into this book.

In conclusion, the paperback issue of *Biomechanics of Insect Flight* is a worthwhile book for investigators of any aspect of insect biology, a necessary book for those in the field of animal flight, and certainly a valuable reference book for the casual reader.

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James Usherwood
Concord Field Station
Harvard University
100 Old Causeway Road
Bedford, MA 01730 USA
e-mail: jusherwood@oeb.harvard.edu

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