

BOOK REVIEW

Life-history evolution: understanding the proximate mechanisms

Mechanisms of life history evolution

Thomas Flatt and Andreas Heyland

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Reviewed by N. G. PRASAD*

Several years ago as a fresh graduate student in a laboratory focussed on life-history evolution, I was required to write a term paper for a course on 'Advanced evolutionary biology'. Having worked in the laboratory for about six months and read through numerous papers on life-history evolution, I was convinced that nothing in life-history was more important than 'trade-offs'. So, I choose to write my term paper on trade-offs in life-history evolution. In the course of writing that term paper I realized that while studies had established the ubiquity and importance of trade-offs through a multitude of approaches, there was frustratingly little material about the proximate causes of such trade-offs. The general assumption in most studies was that trade-offs were somehow related to the partitioning of limited resources. Now, after several years of having read the book edited by Flatt and Heyland, I wish that I had access to this excellent book as a fresh graduate student! For this book does something that has long been overdue—try and bridge the gap between the ultimate and proximate explanations of life-history evolution.

Life-history, the timing of onset and distribution of reproductive output of an organism over its entire lifespan is of central importance in evolutionary biology since it is the life-history that forms the interface between an organism and its Darwinian fitness. Life-histories are extremely variable within and across species and explaining such variation is the primary goal of research into life-history evolution. Research within this area focusses on life-history traits such as age-specific mortality and fecundity which are directly related to the fitness of the organism and several other life-history related traits that are only indirectly related to fitness. Previously several books have synthesized the research in this field from the point of view of ultimate questions. The present

book, however very clearly has a different agenda. It synthesizes the present understanding of life-history variation from a mechanistic perspective.

Over the last several years, information about mechanisms has been generated by people working in various fields and model organisms. Very aptly, the present book represents a synthesis across various approaches such as developmental biology, demography, endocrinology, immunology, anthropology, molecular genetics etc. In terms of organisms, information is synthesized across algae, plants, worms, insects, lizards and humans. All this synthesis happens across 28 chapters distributed into seven different parts with each part addressing an important aspect of life-history evolution. It is interesting to note that the largest part (with about 100 pages) is the one addressing trade-offs. The chapters are carefully written and are a wealth of information. They not only synthesize the current understanding but also suggest future directions of research. Also, each chapter has a pointwise summary to round it off. Wherever relevant, the chapters are cross referenced within the book, thus holding the book together more tightly. Each part starts with a helpful introduction by the editors which serves to integrate the chapters within each part as well as different parts together. In the last part of the book, S. C. Stearns in an extremely well-written and thought-provoking chapter synthesizes the entire book, which is followed by an equally interesting exchange between the editors and Stearns.

So, does this book add any value to the field of life-history evolution? Definitely yes! To me, the book is a must read for three reasons: (i) it collates the proximate causes of life-history variation in a wide variety of taxa. While the general framework of life-history theory guides majority of research in the area, an understanding of the underlying mechanisms that bring about such variation in life-history related traits is important to better appreciate the nuances of life-history evolution. For example, while it had been predicted that rapid preadult development would lead to a competitive advantage, in *Drosophila melanogaster*, it has been

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found that rapidly developing larvae are at a competitive disadvantage (Shakarad *et al.* 2005). Sometimes the explanation of such unexpected results is possible only if one looks at the mundane mechanics of food acquisition and utilization.

(ii) The book collates some surprising results that question our long-held assumptions about life-history evolution. There are at least two such observations. First, for a long time, it has been assumed that physiological trade-offs are resource based. However, several chapters in this book raise the possibility that this might not be the case always. At least in some cases, trade-offs can be caused by signalling networks with or without the involvement of resource partitioning. It is quite possible that the mediation of a trade-offs is environment specific thereby explaining the absence of well characterized trade-offs in some environments. Second, some features of the signalling pathway that seems to mediate trade-offs in life-history traits seems to be shared across taxa.

(iii) Hormones are recognized as important mediators of physiology in terms of growth, resource allocation, repro-

duction and ageing, and are expected to be important in life-history evolution. The book has a series of chapters on the role of hormones in mediating life-history which help develop a view of the mechanistic relationships between life-history traits (as opposed to the genetic architecture of fitness components developed by classical studies).

As Stearns and the editors point out, the study of mechanisms underlying life-history variation is still in its infancy and much needs to be done before one can start integrating mechanisms with life-history theory. However the present book does an admirable job of consolidating the present state of knowledge in the field. To sum up, this book is required reading for people working in the area.

References

- Shakarad M., Prasad N. G., Gokhale K., Gadagkar V., Rajamani M. and Joshi A. 2005 Faster development does not lead to correlated evolution of greater pre-adult competitive ability in *Drosophila melanogaster*. *Biol. Lett.* **1**, 91–94.