

BOOK REVIEW

The Flexible Phenotype, a Body-Centered Integration of Ecology, Physiology, and Behaviour by Theunis Piersma and Jan A. van Gils. 2010. Oxford University Press, 248 pages, Pbk: ISBN 978-0-19-959724, \$52.95 USD (OUP.com). Hbk: ISBN 978-0-19-923372-4, \$117.00 USD (OUP.com).

Theunis Piersma and Jan A. van Gils utilize examples from a broad range of taxa and levels of organization to illustrate that understanding phenotypic flexibility is vital to the fields of ecology, physiology and behaviour. *The Flexible Phenotype* conveys, very convincingly, the importance of truly integrative thinking as a means to fully understand and study biological phenomena.

Defined as the reversible and seasonally cyclic changes of phenotype within an individual, phenotypic flexibility has been well documented in many organisms, but some of the most extreme examples come to us from the study of shorebirds. As such, it is only fitting that *The Flexible Phenotype* is written through the unifying narrative of these birds, yet each section of the book is teeming with astonishing examples from many other taxa.

The book is divided into four parts, each laying the foundation for the next. Part one, the *Basics of Organismal Design*, introduces the reader to the importance of maintaining homeostasis through the balance of heat, water, nutrients, and energy. Symmorphosis, that the capacity of one part of a system is usually closely matched by the rest of the system within an organism, becomes an important theme throughout the rest of the book.

Part two, *Adding Environment*, expands on the concepts introduced in part one, and explains through a number of amazing examples, again punctuated by examples from shorebirds, how organisms are well matched to their environment. Here metabolic ceilings are introduced as a segue to physiological constraints as a whole. Through a number of stunning examples, from the metabolic constraints of human Antarctic exploration and the amazing migration of the Bar-tailed Godwit, to the gut dynamics of feeding Burmese pythons, in this section of the book the authors go to great lengths to illustrate phenotypic plasticity as a means for organisms to cope

with physiological constraints and environmental demands.

Part three begins to integrate behavioural flexibility as the most rapid way for an organism to respond to a changing environment. Again, a number of examples from many taxa illustrate various behavioural adaptations that allow organisms to survive a quickly changing environment. Optimal foraging strategy is presented in this section of the book and, in line with the theme of the previous sections, particular emphasis is placed not only on the behaviour associated with diet choice and patch selection, but also on the physiological constraints and energetic demands of food processing.

Part four of this book brings together all the themes of the book into a “fully integrated view”. The flexibility of the immune system is presented as of the utmost importance, as is the maintenance of pectoral muscle size and optimizing behaviour in order to avoid predation. It is this section of the book where the authors elegantly apply the concepts laid out previously to the fields of conservation and management, making the case that phenotypic flexibility allows organisms to cope with a changing climate, for example, but at a cost. Therefore, understanding the limits to phenotypic change, “when organisms can cope no more” and the associated fitness costs, could allow a better understanding of population dynamics. The final chapter offers a unique perspective on how to integrate phenotypic flexibility with evolution, and finishes by emphasizing the view that organisms and their environments are inseparable; each should be considered when studying the other.

The Flexible Phenotype is a truly integrative book and has something for all scientists interested in how animals live in their environments. The unique perspective gained by reading this book is one that will serve biologists of all disciplines.

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