generally, we believe that only examining plasticity from the perspective of condition dependence ignores many important and interesting aspects of plasticity, including its role in the origin of novel secondary sexual traits and its impact on the direction of evolutionary trajectories (including the evolution of condition dependent expression of sexual traits [9]) [7,10,11]. We believe examining plasticity in sexual traits more generally than just condition dependence is a more encompassing approach that will draw direct links with other areas of evolutionary ecology [10–12]. In fact, it has been noted that a proper understanding of the role of plasticity in evolution, using empirical and theoretical approaches, is considered one of the greatest challenges in evolutionary research [10–12]. Studies of sexual traits in this context might hold important insights and are well worth pursuing [7,9].

Finally, Safran *et al.* [2] disagree with our opinion by stating 'plasticity is not a cause of natural or sexual selection'. We, and others, believe it is [7,10,11]. Simply put, if organisms change their phenotype in response to environmental conditions (plasticity), this can change their interactions with other individuals. It is well recognised that biotic interactions are an important component of selection. Consequently, plasticity can cause changes in selection acting on surrounding individuals and in this sense plasticity is a cause of selection [7]. A similar effect could also be achieved if organisims change their abiotic environment [13]. In fact, Safran *et al.* [2] again probably agree more than they disagree since they state that 'plasticity facilitates or constrains evolutionary change by altering the form and direction of selection'. If plasticity alters the form and direction of selection, it seems reasonable to us to call it a cause of variation in selection.

To summarize, we reiterate our original point [1], which seems to agree in part with Safran *et al.*'s main message, that theory on the evolution of sexual traits should incorporate fluctuating selection and the responses of individuals to such fluctuations (phenotypic plasticity). However, in contrast to Safran *et al.* [2] we believe that studying the evolution of sexual traits purely from the traditional perspective of 'sexual selection' and developing theory without empirical input will lead to disappointment.

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Book Review

'Go to the ant thou sluggard...'

Ant Ecology edited by Lori Lach, Catherine L. Parr and Kirsti L. Abbott. Oxford University Press, 2010. £80.00 hbk (432 pages) ISBN 978-0199544639.

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If you walk into almost any habitat around the globe and pick up an insect at random, it is very likely to be an ant. Because of this abundance, the way that ants interact with their biotic and abiotic environments is the key to understanding the functioning of many ecosystems. The social organisation of these insect societies, paralleled in scale and intricacy only by those of the termites, is one of the factors that have allowed them to arrive at this position of dominance. Their dominance means that many of the group's ecological activities have direct effects on human well-being, both positive (e.g. species providing ecosystem services) and negative (e.g. invasive species). The appeal of these eusocial insects is not limited to the scientific community alone, as demonstrated by the success of animated films based in and around ant colonies (Antz 1998, A Bugs Life 1998, The Ant Bully 2006). In this peer-reviewed, multi-authored volume, Lach, Parr and Abbott bring together contributions from 53 authors from four continents to give an overview of the current state of research into the ecology of the group. Why ant ecology, specifically?

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It might be argued that concept-specific, rather than taxon-specific works are more likely to reveal new insights. However, the near-universal eusociality of ants, coupled with their extraordinary ecological dominance, means that they form a unique ecological case that merits special attention.

The book is divided into four parts, covering global ant diversity and conservation, community dynamics, population ecology, and invasive ants. Distributed throughout the text are boxes covering related but discrete topics, each of which has its own authors. This has allowed the editors to draw on an even larger pool of expertise than would have been possible otherwise (a third of the authors contribute solely to boxes). The first three parts of the book focus on ant ecology at progressively smaller spatial scales, from global distributions (Part 1) down to the dynamics of individual ant colonies (Part 3). The final part shifts the focus back out again to a global problem: the invasion of various habitats by non-native ant species. This work is put in the context of what is known about ant ecology in general, with input from conservation practitioners actively involved in control and eradication schemes. Overall, the logical sequence of chapters facilitates the passage of the reader through the gamut of information presented here.

The authors of the various sections provide their ideas of future directions that research in ant ecology might take, and this is for the most part both comprehensive and stimulating. However, the importance of chance events in determining community structure is an underdeveloped field in ant ecology, and despite passing references to its importance the subject is not dealt with comprehensively in this volume. Although there is widespread use of null models of species co-occurrence in the literature, there has been no attempt made to fit fully parameterised neutral models to ants. Just because competition strongly structures ant communities does not necessarily mean that they are highly deterministic. Given the fact that plant communities have been pivotal in developing and testing neutral theory [1,2], and given the parallels between plants and (relatively) immobile ant colonies that make use of resources within a defined local area [3], this is a research direction that merits further exploration. The continuing development of large-scale databases of ant distributions [4] provides a possible source of datasets for this purpose.

A cause for concern for the continuing development of research in ant ecology is reflected in the geographical distribution of relevant expertise, which does not seem to match global patterns of ant diversity (Chapter 2), with only three of the 53 contributors being affiliated to institutions in developing countries. This is not a criticism of the editors, who have invited authors with expertise in their respective fields. Rather it indicates the importance of fostering research to a greater extent in those biogeographic regions that are rich in ant biodiversity but relatively poor in ant ecologists.

This is the most comprehensive current volume covering ant ecology, in effect a multi-authored update of the ecological chapters of Hölldobler and Wilson's Pulitzer Prize winning *The Ants* [5]. The editors have successfully woven together pieces from a wide range of contributors to create an enjoyable volume that provides both a comprehensive overview for those new to the field, and a useful reference volume for experienced myrmecologists.

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Film Review

Return to Pandora

Avatar by James Cameron. 20th Century Fox Home Entertainment, 2010. US$ $39.99/£28.97. 155 minutes. AISN: B002HEXVSK.

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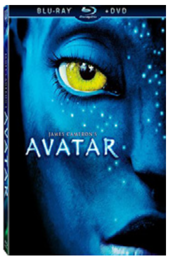

James Cameron is a biologist's director. His first film was *Piranha II: The Spawning* (1981) which, to judge from the title at least, was all about fish life-history. Then, in 1986, he brought us *Aliens.* Of course *Aliens* was the offspring of *Alien* (1979) directed by Ridley Scott and featuring the designs of Swiss surrealist H.R. Giger, but there is no doubt that until *Avatar*, Scott and Giger's *Internecvicus raptus* (yes, it has a Latin binomial) with its eusocial caste system, ecdysis, endoparasitic larva and low pH haemolymph, was the most detailed vision of extraterrestrial life ever seen on film [1].

But the Alien was a creature without an ecology. It had left its homeworld far behind; in poor shape, we suspect, given its nasty habits. *Avatar*, by contrast, gives us a virgin ecosystem, a rainforest world even more splendid than Brazil's. There are immotile photosynthesizers ('plants') and motile heterotrophs ('animals') and some creatures

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