

Evolutionary genetics for organismal biologists

Evolutionary Genetics: Concepts and Case Studies

C.W. Fox & J.B. Wolf (Eds.). 608 pages, Oxford University Press, Oxford, 2006, ISBN13: 9780195168181

Which research fields and biological subdisciplines should we classify as “evolutionary genetics”? To some purists, evolutionary genetics should primarily include the two major branches that historically gave rise to the field: Population genetics and quantitative genetics. Those who hold this view would point to the historical roots of both these branches of genetics and especially the important role of the three founding fathers of mathematical population genetics: J.B.S. Haldane and R.A. Fisher in the UK, and Sewall Wright in the US (Provine, 1986). To others, including myself, evolutionary genetics is a much broader discipline that does also include studies that have little to do with genetics *sensu strictu*, but would also include, for example, studies estimating the strength and form of natural and sexual selection in natural populations (Lande and Arnold, 1983; Kingsolver et al., 2001). Others take an even broader definition of evolutionary genetics, and do also include other areas of organismal biology, such as epigenetic inheritance, species concepts, life-history evolution and developmental biology. This is apparently the broad definition that is preferred by Charles W. Fox and Jason B. Wolf, who have edited an excellent volume called *Evolutionary Genetics: Concepts and Case Studies*.

A book like this includes a variety of topics and perspectives and should therefore be of interest not only to evolutionary geneticists *sensu strictu*, but also to evolutionary ecologists like myself, physiologists, organismal biologists and students of developmental biology. In other words: this book should be highly attractive to an audience which should include many of the readers of *Animal Biology*. A volume like this will certainly be of interest both to fresh Ph.D.-students as well as to established researchers. I learned a lot by reading through the different chapters, and got many new ideas, which is a sign of a very good book, given the

flood of similar books in ecology and evolutionary biology that are published every year, and the corresponding difficulty of following all these new volumes.

The chapters in this volume are interesting and written by established and leading researchers in the field, which makes this book an excellent book to return to check up the latest views and conceptual advances. I will only mention a few chapters in this review that I found especially thought-provoking. Michael J. Wade (Chapter 4) writes about “Natural selection”, and reminds us about the shared and common underlying analytical framework between single-locus population genetic theory and quantitative genetic theory, namely the covariance between fitness and genotype (or phenotype). The difference between these two approaches is that whereas knowledge about selection coefficients alone is sufficient to predict the evolutionary response in the single-locus situation, we also need information about the covariance between parents and offspring (“heritability”) in the quantitative genetic model. Wade also reminds us about the crucial distinction between two equally important goals of evolutionary biology: to study inheritance and selection. Although these two separate goals are connected, they are not the same thing, and we should always keep in mind the words by late population geneticist R.A. Fisher: “Natural selection is *not* evolution” (Fisher, 1930). Studies of selection, that is, the covariance between phenotypes and fitness, can in principle be performed without any knowledge at all about the inheritance of the traits under selection and is thus largely an ecological enterprise that should ideally also include ecological information about selective agents (Wade and Kalisz, 1990).

Allen J. Moore and Patricia J. Moore contributes with an interesting chapter about the genetics of sexual selection, and points out that the “environment” that drives sexual selection could also have a genetic component, since sexual selection is process of *interacting* phenotypes. In other words: the heritable traits in some phenotypes (say, females) also provide a selective environment to other phenotypes (say, males), which leads to the important insight that the distinction between “environment” and “genes” is not always that easy to make. For instance, if female choice is heritable to some degree, this heritable variation will drive sexual selection among males, which in turn will lead to a genetic covariance between female choice alleles and male trait alleles, a covariance that will be present even if these traits are governed by entirely different loci. Such genetic covariance can in turn lead to a positive evolutionary feedback loop, also known as the famous “Fisherian Runaway sexual selection” (Fisher, 1930). However, as Moore and Moore shows, such indirect genetic effects caused by interactions between phenotypes are by no means restricted to sexual selection, but could also arise through maternal effects between parents and offspring or through interactions between completely unrelated phenotypes.

Mark L. Siegal and Aviv Bergman (Chapter 16) and Eva Jablonka and Marion J. Lamb (Chapter 17) touch upon similar themes as Moore and Moore, although from somewhat different perspectives. Siegal and Bergman discuss the concept of “canalization” from a historical perspective, based on the ideas of late developmen-

tal biologist C.H. Waddington. They point out that canalization and plasticity are not strictly each others opposites, and reviews the fascinating recent findings of how Hsp 90, a stress-induced molecular chaperone, buffers the expression of mutational genetic variation under normal circumstances but exposes such accumulated genetic changes when its function is overwhelmed, such us under stress. This can have some important consequences, among them that Hsp 90 could act as an “evolutionary capacitor”, an idea that is still subject to controversy and discussion. Jablonka and Lamb reviews the accumulating evidence for Epigenetic Inheritance Systems (EIS) in evolution, of which there are now four recognized mechanisms: self-sustaining feedback loops, structural inheritance, chromatin marking and RNA-mediated gene silencing. The findings of EIS have renewed interest in non-mendelian inheritance patterns, and some have even argued that “Lamarckian” inheritance mechanisms could work in some situations. It remains to be investigated how evolutionary important these EIS are to phenotypic traits that are targets of selection in natural populations, but it is clear that they are much more prevalent than has previously been thought.

Finally, I would also recommend field biologists to carefully read Chapters 30 (Daniel E. Promislow and Anne M. Bronikowski) about senescence and 31 (Adam K. Chippindale) about experimental evolution. Chippindale’s chapter is of interest also to those of us who have never worked with experimental evolution assays in the laboratory (or do not even intend to do that!), because his general message, the need to replicate studies at the population level and not only at the level of individual phenotypes, should also be highly relevant to field biologists working in natural populations. Indeed, strong evolutionary inferences about selective causes and selective agents requires replicated studies across several populations with similar ecologies, and the important insights from experimental evolution studies could therefore be incorporated in field situations as well (Reznick and Travis, 1996).

In summary: If you are professor or established researcher, buy this book, show it to your students and start a reading group about the various chapters. If you are a postdoc or Ph.D.-student, buy this book, show it to your advisors and start a reading group about the various chapters. I can guarantee that you will learn a lot and get many new insights.

ERIK I. SVENSSON

Section for Animal Ecology, Ecology Building, Lund University,

SE-223 62 Lund, Sweden

Phone: +46 46 222 3819

Fax: +46 46 222 4716

e-mail: erik.svensson@zoekol.lu.se

REFERENCES

Fisher, R.A. (1930) *The Genetical Theory of Natural Selection*. Clarendon Press, Oxford.

- Kingsolver, J.G., Hoekstra, H.E., Hoekstra, J.M., Berrigan, D., Vignieri, S.N., Hill, C.E., Hoang, A., Gibert, P. & Beerli, P. (2001) The strength of phenotypic selection in natural populations. *Am. Nat.*, 157, 245-261.
- Lande, R. & Arnold, S.J. (1983) The measurement of selection on correlated characters. *Evolution*, 37, 1210-1226.
- Provine, W.B. (1986) *Sewall Wright and Evolutionary Biology*. University of Chicago Press, Chicago.
- Reznick, D. & Travis, J. (1996) The empirical study of adaptation in natural populations. In: M.R. Rose & G.V. Lauder (Eds.), *Adaptation*, pp. 243-289. Academic Press, San Diego.
- Wade, M.J. & Kalisz, S.M. (1990) The causes of natural selection. *Evolution*, 44, 1947-1955.