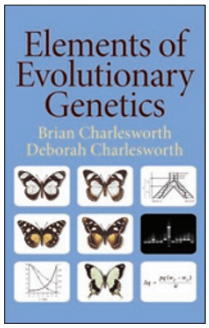
Evolutionary genetics quantified



Elements of Evolutionary Genetics

Brian Charlesworth & Deborah Charlesworth

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Reviewed by Trudy F C Mackay

Evolutionary genetics is the study of how genetic processes such as mutation and recombination are affected by the evolutionary forces of selection, genetic drift and migration to produce patterns of genetic variation at segregating loci and for quantitative traits, within and between populations and over short and long timescales. This theory can then be applied to observed distributions of allele frequencies and the genetic variance of quantitative traits to infer which regions of the genome are evolving as expected from a balance between selectively neutral mutations and genetic drift or to show signatures of departure from the neutral expectation. Such a departure may be attributable to balancing selection, positive selection for an advantageous mutation (a selective sweep), a balance of selective forces, or a balance between the input of new deleterious mutations and their selective removal.

Early in the last century, Wright, Haldane and Fisher developed sophisticated mathematical models that have survived as the foundation for today's population and quantitative genetics theory. However, it was not until the 1960s, with the application of gel electrophoresis to identify enzyme polymorphisms in populations, that empirical data to test these theoretical models became readily available. Since then, the genomics field has provided continually increasing levels of resolution and scale in reporting genetic polymorphism data. These data have been and will continue to be used to understand at an increasingly sophisticated level the evolution of whole genomes and alternative life histories; to identify genomic regions under positive, purifying and balancing selection; to identify polymorphisms associated with diseases and complex traits in humans; to identify genes responsible for adaptive evolution; and to understand the balance of evolutionary forces responsible for maintenance of variation within populations. Now more than ever, population and quantitative genetics need to be incorporated into undergraduate life sciences curricula and into the knowledge base of life science researchers. Brian and Deborah Charlesworth have drawn on their extensive expertise in these fields to produce a textbook that is a comprehensive, up-to-date treatise on the field of evolutionary genetics.

Elements of Evolutionary Genetics is part text, part monograph and part review. It is divided into ten chapters. The first section of the textbook, including the first four chapters, describes genetic variability and its measurement in inbreeding and outbred populations, classic selection theory at a single locus and for quantitative traits, the evolutionary genetics of adaptation, and migration-selection and mutation-selection balance. The fifth chapter introduces the complication of finite population size and the probability distributions of allele frequencies under the joint actions of mutation, selection and drift. The remaining chapters discuss the neutral theory of molecular evolution, population genetic tests of selection, population and evolutionary genetics in subdivided populations, multi-locus theory, the evolution of breeding systems, sex ratios and life histories, and selected topics in genome evolution. The topics are illustrated throughout with examples from a wide range of organisms, including viruses, plants, *Drosophila* and humans.

This textbook provides comprehensive coverage of the broad range of concepts central to the study of evolutionary biology. The authors' presentation of each of these concepts is straightforward, although often heavy with mathematical and statistical explanations. Details of derivations of key formulae are corralled in text boxes and do not interrupt the logical flow of the arguments. Because of this focus, some mathematical expertise is helpful in digesting the entirety of this textbook. Readers with skills in matrix algebra, calculus, statistics and mathematics will be most comfortable with the material. However, the lucid verbal explanations of the key theoretical results and the discussions of their applications to empirical data make the book also accessible to more mathematically challenged readers, and there are helpful appendices on basic mathematics, probability and statistics at the end of the book to assist those readers who have forgotten what they once knew. Problems ranging from simple numerical examples to more advanced derivations are given at the end of each chapter, with fully worked answers at the end of the textbook.

Elements of Evolutionary Genetics is an ideal text for an advanced graduate course in evolutionary genetics. Readers should be aware that the textbook assumes at least a familiarity with basic genetics, molecular biology, statistics and mathematics. This textbook is also recommended for researchers in evolutionary biology and human genetics who wish a general overview of the field for self study and to teachers of population and evolutionary genetics who seek more detailed knowledge of material briefly discussed in less advanced texts.

Trudy F C Mackay is at the Department of Genetics, North Carolina State University, Raleigh, North Carolina, USA.
e-mail: trudy_mackay@ncsu.edu

COMPETING FINANCIAL INTERESTS
The author declares no competing financial interests.