

research not only has academic value in understanding the evolution of the organisms' differing environments but, in addition, clearly presents the responses of individual species to environmental changes from year to year. The latter aspect is important for conservation. It is hoped that these and other long-term projects will continue in Galápagos.

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## **REVIEW: ECOLOGY AND EVOLUTION OF DARWIN'S FINCHES**

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**Published 1986, xiv + 458 pages, 101 figures, 24 tables, 63 plates including 8 in color, US - \$55.00 cloth, \$22.50 paper; UK - £36.70 cloth, £15.10 paper. Princeton University Press, 3175 Princeton Pike, Lawrenceville, New Jersey 08648, USA**

**Reviewed By: Peter T. Boag**

John Wiens (1984, *Auk* 101:202-203) commented recently on the importance of long-term studies of avian populations, concluding that for many purposes "a long-term approach that spans the periodicity of the normal dynamics of the system is essential." Peter Grant's sweeping synthesis of more than 12 years of fieldwork on Darwin's finches in the Galápagos provides us with an excellent illustration of the merits of extended field studies. This volume is a state-of-the-art synthesis of past and present research on a group of birds that has become a paradigm of the evolutionary process.

In 16 chapters, Grant not only summarizes his group's research on the ground finches (Genus *Geospiza*), but also provides up-to-date detail on the other, lesser known finches. Aspects of the Galápagos environment ranging from geology, climate, and vegetation to the history of scientific research in the islands are included. Complementing the text are plates, which include 117 black-and-white and 24 color photographs. The photographs not only illustrate inter- and intraspecific morphological variation in the finches, but also vividly describe study techniques, the effects of El Niño rains on vegetation, unusual feeding behaviors, and some of the important food plants for the birds.

The book begins with a description of how the project began and with a brief history of the study of Darwin's finches. Grant sets himself the task of explaining "why so many different types of species

have arisen, and why they vary so much in form, function, and behavior." Two chapters then set the stage by summarizing first the general characteristics of the islands, and next, the general characteristics and distributions of the finches.

The meat of the book follows in six chapters which detail the data collected by Grant and his colleagues since 1973. The results of over 60 scientific papers produced by the group in this time are described and integrated, with many of the original figures and tables reproduced or elaborated upon. Two technical chapters provide an overview of morphological variation in the finches, as well as statistical methods for dealing with both adult morphological patterns and the ontogeny of morphology. Chapter 6 examines the relations between beak morphology and diet, as well as dietary differences within and between species. Chapter 7 follows with a detailed look at the links between food supplies and finch population dynamics, arguing that food is often a limiting resource, and hence a driving force behind the evolution of specific feeding structures and behaviors.

Chapter 8 presents the genetic data now available for Darwin's finches, with an emphasis on the quantitative genetics of morphological characters, and the relationship between heritabilities and the response to natural selection in times of food stress. A major theme is the search for reasons why many *Geospiza* populations are so variable. This chapter also attempts to unravel the mechanisms of natural and sexual selection which are responsible for the observed population means and levels of sexual dimorphism.

The final data chapter looks at mating behavior. There is good evidence that reproductive isolating mechanisms are based on both morphology and song. However, considerable flexibility in species-recognition behavior seems to exist, with some cases of hybridization known, and several instances of misimprinting during song development.

In the following four chapters, Grant turns his attention to interpretation of this wealth of data. He first examines various models for the evolution of finch species, and then compares the relative importance of allopatric divergence on ecologically diverse islands with competition in sympatric situations in the evolution of finch communities. The patterns are complex, and the paucity of fossils or other historical data complicates their interpretation. However, the main conclusion is that during speciation, the finches appear to have adapted both to direct changes in their physical environment and to indirect changes caused by competitors. The effects of competition are most evident in the large scale patterns seen at the community level. The evolution of reproductive isolating mechanisms is dealt with briefly. Two interesting findings emerge; first, the

evidence suggests that most reproductive character displacement probably occurred as a correlated response to ecological character displacement. However, there is also evidence that reproductive absorption of some immigrant populations may occur, and such effects may combine with ecological competition in the development of distinctive island finch communities.

After dealing with the adaptive evolution of features other than trophic morphology, Grant reconstructs the most likely scenario for the evolution of this monophyletic group. He then summarizes the key results of earlier chapters and presents a brief extension and comparison of the findings with other taxa. The main message is that "the allopatric model of gradual genetic change links Darwin's Finch evolution with the radiations of many other groups of organisms as the most probable, general mode of speciation." He concludes with a warning that understanding a complex evolutionary radiation requires knowledge in a broad range of areas. In the finches, as in other examples, there tends to be an uneven distribution of knowledge in areas such as morphology, behavior, ecology, and genetics. Scientists working on different evolutionary radiations are rarely able to cover all these facets of their species in depth and tend to emphasize the importance of those aspects they know best. In Darwin's finches for instance, there is obviously much to be learned about the ecology of the tree finches, and for all the species further paleontological and biochemical research may help describe the sequence and time-scale of divergence between populations.

The book is attractive and well produced, with few typographical errors. In addition to the general summary in the final chapter, each chapter contains a complete summary of its own. Couple this with a carefully constructed Table of Contents, an abundance of subheadings, and comprehensive author and subject indices, and the result is very easy and quick retrieval of information. The bibliography, with more than 300 references, is the most complete available on avian evolution, ecology, and behavior for the Galápagos.

The focus of the book is a complete summary of Darwin's finch biology. Grant has not belabored the theoretical or epistemological implications of his study. Indeed, the real strength of the work is that it brings together in one place what has grown to be an increasingly large and specialized literature. This clearly written overview will be of interest to a wide range of readers, including scientists specializing in avian and evolutionary biology, as well as amateur naturalists interested in learning more about this fascinating group of birds.

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