

Book reviews

SEX RATIOS: CONCEPTS AND RESEARCH METHODS

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Published by Cambridge University Press, 2002

ISBN 0 521 66578 7 (paperback), 0 521 81896 6 (hardback)

Why do Seychelles Warblers produce mostly daughters when they are on good territories, and why would a female Eclectus Parrot produce 30 sons in a row? Why do most species produce roughly the same number of males and females whereas some show dramatic skews towards one of the sexes? Sex allocation was first mused over by Darwin but was raised to the status of a field in its own right when R. A. Fisher formalised many of the arguments in his landmark 1930 book *The Genetical Theory of Natural Selection*. Sex allocation, or the differential investment by parents in offspring of either sex, is now remarkably well understood to the point where it has been hailed as a triumph of evolutionary theory.

But not necessarily so for birds! Explicit theoretical predictions of adaptive sex ratios can be made for many of the simpler taxa, but birds and mammals have proven much more difficult for four main reasons. First, chromosomal sex determination means there are fewer potential mechanisms for adaptive sex allocation in these groups. Second, there have been difficulties in observing the primary sex ratio (i.e. at conception versus birth, hatching or fledging). Third, scientists have been poor at reporting both the context and occurrence of the seemingly less interesting cases when sex ratios are even. Finally, theory for predicting sex ratios in birds and mammals is sometimes lacking as they often have complex structured societies, overlapping generations, and other complicating factors that violate the assumptions made by sex ratio theory.

Birds only feature in some of the chapters of *Sex Ratios: Concepts and Research Methods*, which is largely designed as an aid to researchers in the broad field of sex allocation. This multi-authored book aims to explain the complex theory and genetics underpinning the field, and the broad range of statistical techniques for examining sex ratio data, and to summarise the wealth of research on taxa ranging from bacteria, malaria, plants, parasitic wasps, mites, aphids to humans. I found the book well laid out, and felt that researchers would have little difficulty extracting the subject matter relevant to their particular needs without having to read the whole book. Ornithologists hoping for an overview of the field and a summary of the theory and data relevant to birds could start with the chapters from Part 1 (Sex ratio theory) and Part 4 (Animal sex ratios under different life-histories). If they were aiming to become practitioners in the field, Part 2 (Statistical analysis of sex ratio data) lays out many of the statistical procedures for dealing with binomial data.

Of particular relevance to ornithologists is the chapter by Cockburn, Legge, and Double on 'Sex ratios in birds and mammals'. It outlines the entire range of hypotheses that explain biased sex ratios in birds, and evaluates the status of each. For example, Fisher's original hypothesis that parents converge on an evolutionarily stable sex ratio, where the investment in males and females is approximately equal, is inherently problematic to study as measurement of the relative costs of sons and daughters is exceedingly difficult. In contrast, the influential Trivers–Willard hypothesis, which states that mothers in good condition should invest most heavily in the sex with the highest reproductive variance and hence highest potential returns, has probably been interpreted erroneously in many cases. For example, biased sex ratios amongst mothers in poor condition could equally result from one sex simply being more costly to rear. Cockburn *et al.* conclude that current theory may still be inadequate as some key empirical patterns are hard to explain, that more research is required on the mechanisms of sex allocation, and that researchers should resist the temptation to interpret short-term data too readily as data from multiple breeding seasons almost always reveals greater complexity.

Sex Ratios is primarily intended for behavioural and evolutionary ecologists, but because of its excellent overviews, summary boxes, and 'how to' sections is an ideal reference for any researcher in ornithology to have on the shelf. For those like myself who have been drawn further into this field (in my case via observations of massively skewed sex ratios in Eclectus Parrots), it is also a fascinating overview of the interactions and gradations between theoretical and empirical enquiry.

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