1982

Book Review: Estimating the Size of Animal Populations

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The Journal of Wildlife Management, Vol. 46, No. 2 (Apr., 1982), pp. 563-564

BOOK REVIEWS

Estimating the Size of Animal Populations. By J. Gordon Blower, Laurence M. Cook, and James A. Bishop. George Allen and Unwin Ltd., London, U.K. 1981. 128pp. $16.95.

The array of methods available to estimate animal populations is as bewildering as its literature is overwhelming. Consequently, a short book that promises to "outline the procedures involved" and give "a concise account of the theory" is warmly welcomed. This book offers all of that in a short text designed for both undergraduate and graduate students.

Because of its brevity, the book is perhaps easier to criticize for errors of omission than errors of commission. Of the 3 population estimation techniques that might be considered as most important—counts on sample areas, capture-recapture, and line transects—only the first 2 are covered. Moreover, the authors neglect to pose the initial question in Chapter 1: Is an estimate of the size of an animal population truly necessary? Quite often an index to the size will serve very nicely, and at far lower cost. Only a thoughtful examination of the purposes of the intended study will resolve this question. However, the authors neither raise the question nor address the needs of the biologist who can get by with an index.

If an index will not do, then perhaps the population can be counted in its entirety. Complete counts are not discussed in the book and are too hastily dismissed by stating that "places where absolute counts can be made are merely *samples* from which generalisations are made about larger places" (emphasis in the original). This statement is obviously not so for many populations, such as the whooping crane, a species that demands and receives closer attention.

Chapter 2 presents counts of animals made on sample areas. The authors devote a disproportionate amount of discussion to estimation of populations that are randomly distributed in space, a circumstance pleasant enough when it occurs, but one that a biologist can rarely know with enough certainty to use effectively. Nearly always, one must rely on methods that permit the spatial distribution of animals to be arbitrary. The discussion of stratification misses the point: gains can be made in accuracy if the area can be divided into strata that are relatively homogeneous (not perfectly homogeneous, as is implied). Moreover, the authors do not mention the substantial improvement that can be made by varying the intensity of the sampling according to the size of the stratum and the variance of the density of the animal within the stratum. The example the authors present (Fig. 2.3) represents a modified systematic sample, treated as a simple random sample, and not a stratified sample as they claim. The variance they compute is not strictly valid. They also present a ratio estimator, animals seen per unit area, but claim that the relationship between these variables need only be linear; it should in fact be linear with an intercept of zero.

The fullest treatment is accorded mark-recapture methods. Chapter 3 presents basic principles of the technique, including a brief historical account, a lucid explanation of the logic of the Lincoln index for 2 trapping occasions, and an overview of the triple-catch. The authors do not, however, clearly state the critical assumption that all animals in a population have an equal chance of capture. Chapter 4, the longest in the book, presents mark-recapture methods appropriate for more than 3 occasions; the emphasis is on populations that are not closed, but may involve births, deaths, and migration. The methods discussed include Jackson's, Fisher and Ford's, Jolly's, and Manly and Parr's. I found it odd that the authors failed to cite Otis et al. (Statistical inference from capture data on closed animal populations, Wildl. Monogr. 62, 1978), which provides a comprehensive and modern survey. Although the monograph deals with closed populations, it is often possible to design a mark-recapture study so that the closure assumption is met and the population more accurately measured.

The presentation of the mark-recapture material is too "cookbookish"; undue emphasis is given to methods of recording data, which numbers go in which columns and rows, while the biological and statistical assumptions supporting each method are somewhat neglected. More useful to biologists would be a guide that describes the assumptions critical to a method, which would permit comparison to the biology of the animal under investigation, followed by a description of the method and instructions on its use. Students should be made aware of the need to examine assumptions critically, and not be permitted simply to plug numbers into given formulas.

Chapter 5, on time samples with constant sampling effort, presents estimators based on trapping and removal, frequency of capture, and change-in-ratio procedures. This material is generally well presented and the authors demonstrate that the same set of data can yield different results, depending on the model used and on the estimation technique, e.g., maximum likelihood vs. regression.

The discussion of error estimation (Chapter 6) presents a useful compendium of variance estimators associated with procedures described earlier in the book, together with some suggestions on how calculators can be used for some of the complex formulas.

The final chapter (7) concerns the choice of a method, compares the performance of selected methods on simulated data with known parameters, and reiterates the conditions under which recapture methods are appropriate.

The authors neglect to discuss line transect methods, an omission that may reflect their emphasis on methods appropriate to terrestrial invertebrates and small mammals. The line transect is particularly important in studies of birds and large mammals. Recent developments in line transect methodology have greatly enhanced its usefulness and given biologists some confidence in the results. The monograph by K. P. Burnham, D. R. Anderson, and J. L. Laake (Estimation of density from line transect sampling of biological populations, Wildl. Monogr. 72, 1980) is perhaps the most valuable of several recent references on the topic.

I believe this book will be of limited value to students or practitioners of wildlife biology. For a brief overview of the various methods, the reader's time would be spent more profitably with appropriate chapters in either Graeme Caughley's book (Analysis of vertebrate populations, John Wiley & Sons, 1977) or the latest Wildlife Management Techniques Manual (The Wildlife Society, 1980). A more comprehensive treatment can be found in Seber (The estimation of animal abundance, 2nd ed., Griffin, 1980). For a biologist who has settled on a particular technique, e.g., mark-recapture, a direct appeal to references in Seber's book or in the present review will be rewarding.—**Douglas H. Johnson,** U.S. Fish and Wildlife Service, Northern Prairie Wildlife Research Center, Jamestown, ND 58401.