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Avian Flight

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Reviews

Edited by R. Todd Engstrom

The following critiques express the opinions of the individual evaluators regarding the strengths, weaknesses, and value of the books they review. As such, the appraisals are subjective assessments and do not necessarily reflect the opinions of the editors or any official policy of the American Ornithologists' Union.

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Avian Flight.—J. J. Videler. 2005. Oxford Ornithology Series, Oxford University Press, Oxford. xv + 258 pp., numerous black-and-white line drawings and a few black-and-white photographs. ISBN 0-19-856603-4. Cloth, $114.50.—Although the subject of bird flight has enjoyed both popular and scientific attention for several hundred years, the past 25 years have witnessed an explosion of published information addressing the functional anatomy, physiology, physics, and evolution of animal flight. This is primarily attributable to advances in recording technology (e.g., micro-biomechanical implants, fluid flow visualization, high-speed digital video, cineradiography, electron microscopy, and satellite telemetry and radiotelemetry) as well as recent discoveries of extraordinary paleontological material. Such activities are stimulating re-evaluation of traditional hypotheses regarding the origin and evolution of flight in birds. J. J. Videler has distilled this vast array of new information into a timely and important volume.

Videler holds the Leonardo da Vinci Professorship of Marine Zoology at the University of Groningen, The Netherlands. His research program has focused on the locomotor biology of vertebrates, specifically fishes and birds, as they move through fluids. His love of natural history and his scientific capacity in the lab make him well prepared to evaluate and summarize the literature surrounding avian flight.

In the opening chapter, Videler provides a historical account of key contributions made over the past three centuries that are relevant to the subject of bird flight. He succinctly recounts efforts made by naturalists, biologists, mechanical and fluid physicists, and pioneering aeronauts to illustrate how each investigator built upon the physical or biological discoveries of his predecessors.

Two chapters concentrate on the internal and external machinery (e.g., musculoskeletal system and feathers) of the avian flight apparatus. Although the feather chapter is thorough and detailed (including numerous illustrations and scanning electron micrographs), there is a notable lack of reference to seminal work on feather growth, phylogeny, and evolution published over the past two decades (e.g., there is no discussion of the work of R. Prum and associates).

Another chapter reviews the basics of aerodynamics, with an emphasis on flow visualization. This includes Kokshaysky's classic study on the visualization of air flow generated by a bird's wing flying through dust, along with Rayner and Spedding's studies employing neutrally buoyant soap bubbles filled with helium, recorded using stereo-photography. A brief discussion is offered of current state-of-the-art flow visualization techniques (digital particle image velicometry) using lasers and high-speed video that visually capture and compute impulse vortices created by the flapping wings of flying birds (Spedding and associates at the Lund laboratory). Videler highlights his recent work on the leading-edge vortices (LEVs) created by swift, fixed wings.

Unfortunately, the chapter on the evolution of flight is dominated by Videler's admittedly controversial theory. Videler hypothesizes that *Archaeopteryx* locomoted by running on water, as observed in extant basilisk lizards (Jesus Christ lizard [*Chrisbala cherepo basilisk*]) of Central and

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South America, and further postulates that this locomotor mode may have represented a transitional stage leading to flight. From my point of view, and I am admittedly not a neutral player in this arena, this is the most disappointing section of the book. His hypothesis, like most other hypotheses on the origin of bird flight, is nontestable, highly speculative, and—even if we accept it—does not really take us beyond a gliding phase or explain powered, flapping flight. Common to this and most other hypotheses on flight, there is no plausible explanation of adaptive transitional forms. I applaud Videler for his valiant attempt to provide a stepwise construct of the morphological, biomechanical, and aerodynamic parameters of his theory. However, this chapter on evolution would have benefited greatly by even a cursory review of other hypotheses and, particularly, those that integrate various disciplines (e.g., paleontological, ecological, ontogenetic, and aerodynamic data) relevant to the origin of flight.

The remaining chapters are excellent, concentrating on different modes of flight and details of the skeletomuscular flight apparatus. Here, Videler does what no previous book on flight has been able to accomplish—he vividly assembles and distills the intricate components of the avian flight system and supplements this with current and past research. The book concludes with two fine chapters dedicated to discussions on the energy required for flight and comparative metabolic studies of avian flight. These chapters are well organized and provide a balanced review of the vast amount of information on these topics.

My overall evaluation of the text is that it is an important and valuable addition to the library of anyone interested in animal locomotion and bird flight. In an effort to provide constructive criticism for potential future editions, I suggest the following: (1) the writing is rather stilted and dense, almost encyclopedic, and would have benefited greatly by using the engaging narrative style found in the preface; (2) although it is perfectly fine to showcase one's work in one's own book, the evolution-of-flight chapter would have benefited greatly from inclusion of current literature on this dynamic subject; and (3) the editor could have been more vigilant in regard to spelling and the clarity of some of the figures.

Avian Flight will particularly benefit upper-division undergraduates, all graduate students, and researchers wanting to ramp-up to the vast body of information now available on avian locomotion. I particularly recommend the book to those interested in general vertebrate locomotion and those interested in the integration of form and function into the ecology and evolution of birds.—Ken Dial, *Division of Biological Sciences, University of Montana, Missoula, Montana 59812, USA. E-mail: kdial@mso.umt.edu*

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Nesting Birds of a Tropical Frontier: The Lower Rio Grande Valley of Texas.—Timothy Brush. 2005. Texas A&M University Press, College Station. xiv + 245 pp., 41 color photographs and illustrations, 6 maps, 2 tables. ISBN 1-58544-436-7. Cloth, $50.00; paper, $24.95.—Texas possesses a remarkable biogeographical brew of bird species. More than 600 species of birds have been documented to occur in the state. South Texas, in particular, is renowned among birders for its overall species richness and unusual mixing of avifaunas. *Nesting Birds of a Tropical Frontier* conveys the sense of perplexed wonderment at being in a place of fantasy—a place where temperate migratory species approach their southern range limits in winter, where Neotropical migrants surge through in multiple waves in the opposite direction in spring and fall, where breeding birds typical of the western United States and the southwestern borderlands reach their eastern range limits, and where tropical species widespread in Mexico and Central America breed at the northern periphery of their ranges. *Nesting Birds of a Tropical Frontier* also captures the excitement of working along the Rio Grande, one of the great rivers of North America, even though it has been altered dramatically (and irrevocably) within the past century by dam and reservoir construction, regulated flows, and accelerating demands for water for intensive agriculture and burgeoning human populations.

It can be said that the more difficult it is to classify a book, scientific manuscript, or article, the greater its relative merit, for this indicates that it bridges gaps in knowledge and perspective that are not filled easily by more traditional

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publications. This book is such a creation. It contains a systematic presentation of bird species accounts, yet also possesses elements of a field guide. Brush synthesizes material from multiple disciplines (e.g., cultural and environmental history, landscape ecology and community ecology, and biogeography), while narratives of his own experiences make the book partly a personal memoir.

Brush's goals in writing *Nesting Birds of a Tropical Frontier* were to (1) present an overview of past and present diversity and ecology of breeding birds and habitats of the Rio Grande Valley and (2) share personal experiences of working in and near the valley. In relating accounts of first-hand experiences gained while working in remaining fragments of dense riparian forest, and by juxtaposing those with descriptions of the Rio Grande floodplain penned by observers of long ago, Brush evokes the awe of what this great river once was and the sadness of realizing what can never be again. In writing this book, Brush has relied on personal field experiences and investigations, class field trips, students' research, books and articles, and field reports and observations of ornithologists and birders. Some of the latter have taken the form of electronic reports of rare and unusual bird sightings posted to listserves. Heavy reliance on information gathered by birders is noteworthy and demonstrates the value of birders in contributing to modern ornithology (e.g., strong participation of birders in Breeding Bird Surveys and Christmas Bird Counts).

The first part of the volume is devoted to an introduction and five relatively short, but informative, chapters on the environment, history, and biogeography of the lower Rio Grande Valley. An overview of physical features (i.e., geography, geology, climate and weather) of the valley is presented in the first chapter, along with the role of the Rio Grande as a main artery in an interconnected network of riparian and forested dispersal corridors in the semiarid Tamaulipan Biotic Province of southern Texas and northeastern Mexico. The second chapter, on ecological diversity and history, describes the lower-valley region at the time of first settlement by Mexico in the mid-1700s and the major factors that contributed to subsequent changes through the 1800s (i.e., conversion of prairies and savannas to thorn scrub and thorn forest by long-term grazing of cattle, sheep, and goats) and the 1900s (i.e., land clearing for agriculture, rapid increase in human population, loss of natural hydrologic regime because of dam construction, and invasions by exotic plant species). Other short chapters provide overviews of the six basic habitat types found in the lower Rio Grande Valley, their characteristic birds, and the changing mix of bird species dictated by the progression of seasons.

The heart of this volume is the species accounts and summaries, including more than 170 bird species known as current or past lower-valley breeders. Treatment of species is intentionally uneven, favoring those species recognized as "South Texas Specialties." This is an excellent "tilt" in writing this book, because birders and field biologists generally are hard pressed to glean information on these birds. For virtually all of these poorly studied species, knowledge of their life history, breeding biology, and management remains woefully inadequate. For each South Texas specialty species, informative sections on distribution, habitat, habits, other observations, and outlook are provided. Species widespread in North America but with minimal nesting records in the valley are reduced to a short summary paragraph or less.

My criticisms of *Nesting Birds of a Tropical Frontier* are fairly modest. Lists of maps, illustrations, and photographs would have been helpful to readers in navigating within the volume. Likewise, the unnumbered photographs and plates of birds and habitats of the lower Rio Grande would be more effective if they were linked to citations in the text. The maps are too small for their large informational content. Map legends are too small for easy reading, most maps are somewhat difficult to interpret, and in general the maps are excessively "busy." Some typographical errors in the text eluded the editorial filter. Though not very abundant, they nevertheless give occasional pause at first reading. These concerns with the book layout are frustrating, but my overall impression of the volume is highly positive.

The species accounts contain important contributions, especially those of the "South Texas specialty birds," which Brush has chosen wisely to emphasize at the expense of more widely distributed and better-known species. These contributions, which primarily are qualitative, are most evident in the careful attention paid to details on distribution and behavior in the species accounts.

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The large number of references (24 pages), with their wide sweep of subject material, is a valuable resource in its own right.

This book deserves a place on the shelves of personal, community, and university libraries that serve readers eager to learn more of the birdlife of the lower Rio Grande Valley and tropical species at the northern extremes of their ranges in southern Texas. Brush writes in the style of an earlier era, when reading scientific accounts was more a pleasing literary experience and less an arduous exercise in mathematical gymnastics. I recommend *Nesting Birds of a Tropical Frontier* for birders and biologists alike who share an interest and enthusiasm for the biological wonders of the lower Rio Grande Valley.—Marc C. Woodin, *U.S. Geological Survey, Texas Gulf Coast Field Research Station, Corpus Christi, Texas 78412, USA. E-mail: marc_woodin@usgs.gov*

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Occupancy Estimation and Modeling.—Darryl I. MacKenzie, James D. Nichols, J. Andrew Royle, Kenneth H. Pollock, Larissa L. Bailey, and James E. Hines. 2006. Elsevier-Academic, San Diego, California. xviii + 324 pp., 23 figures, appendix. ISBN 0-12-088766-5. Hardback, $64.95.—Species presence and absence (i.e., occupancy) data are increasingly being used by avian biologists to assess the status, distribution, and dynamics of bird populations (e.g., Olson et al. 2005, Tornberg et al. 2005, Karanth et al. 2006) and for developing conservation strategies (e.g., Freemark el al. 2006, Jiguet and Julliard 2006). Unfortunately, complete detection of a species is usually impossible, and the ability to detect a species is often related to species-specific traits and the physical characteristics of sample units (reviewed in Thompson 2002). Consequently, incomplete detection can bias occupancy estimates and impede the ability to make sound conservation decisions. Several methods have recently been developed to incorporate incomplete detection in occupancy models (MacKenzie et al. 2002, 2003, 2004; Dorazio and Royle 2005; MacKenzie and Royle 2005). These pioneering efforts, however, have been presented as separate works and often in a manner that was difficult for all but the most technically savvy to understand. This book is an attempt to synthesize existing ideas on occupancy estimation and modeling in a form that is understandable to biologists and ecologists without strong statistical backgrounds.

The book is a well-organized and comprehensive treatment of occupancy estimation that entails multiple aspects including sample design, analysis, and interpretation. The first three chapters cover basic ecological and statistical background and introduce terminology and concepts that are used throughout the book. Chapter 1 is a philosophical treatment of the nature of science and management and the role of field surveys and monitoring. This philosophy is reflected in much of the material presented throughout the book. We believe that such context is important and often lacking from statistics-oriented texts. Chapter 2 provides an overview of the ecological aspects of occupancy and includes a description of metapopulation dynamics. Although the chapter is not intended to be a thorough review, the authors have done a commendable job compiling and synthesizing an abundance of information on metapopulation dynamics as it relates to occupancy estimation. Chapter 3 is an excellent and thorough review of the basic principles of statistical estimation and inference that should prove useful for professionals and for graduate-level instruction. The chapter thoroughly details all aspects of parametric statistics: maximum likelihood estimation, hypothesis testing, goodness-of-fit, and model selection. However, none of these topics is covered in relation to Bayesian methods. As such, readers will have no basis for evaluating the goodness-of-fit, convergence, and selection of Bayesian models. Yet later chapters include computer code for fitting Bayesian occupancy models. We believe that this is a potentially hazardous combination and hope that the authors can remedy the problem in future editions.

Chapters 4–7 cover single-species occupancy estimation and gradually build from relatively simple, constant detection-probability estimation (chapter 4) to more complex, multiple-season models (chapter 7). Each chapter begins with a useful general introduction and explanation of purpose. Models are then derived in logical sequences, with sufficient mathematical details and clear, concise explanations that

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should satisfy and enlighten biologists, whatever their level of statistical proficiency. Each chapter contains at least two examples that are used to illustrate model fitting, parameter estimation, and the presentation and interpretation of results. The material in this section of the book is very thorough and is generally presented in a logical sequence. Chapter 6, which covers the design of single-season occupancy studies, includes a thorough evaluation and discussion of factors that are crucial for developing efficient and effective occupancy studies (e.g., study site selection, allocation of sampling effort). However, the chapter is probably of limited use for developing monitoring designs. Chapter 7 (multiple-season models) provides useful study-design guidance that is relevant to monitoring (e.g., the limitations of a rotating panel design), but lacks detail on statistical power. A general treatment of study design that included the details in both chapters 6 and 7 would have been preferable.

Chapters 8 and 9 deal with two ways to investigate multiple-species occupancy patterns: (1) interactions among a small number of species (chapter 8) and (2) changes in species richness (chapter 9). As the authors acknowledge in the introduction to chapter 8, these two chapters are not as well developed as previous sections of the book, providing few, if any, examples for each method. The lack of associated software and example code in this section, with the exception of the two-species interaction model implemented in PRESENCE, version 2 (Hines 2006), will limit the use of these methods to statistically savvy readers with knowledge of computer programming. Despite the lack of implementation detail and the paucity of examples, the authors do an excellent job, as in previous sections, in presenting the material in a logical order and clearly deriving and explaining all models in a way accessible to all biologists. Analysis of occupancy data at the community level is also a very active area of research, and we expect user-friendly software implementing many of the methods described here to become available in the near future.

Chapter 10 concludes the book by discussing areas of ongoing research. It contains short sections detailing possible models and approaches (most of which are untested) for multiple-occupancy states and integration of habitat, abundance, and marked animals in occupancy estimation.

Most of the examples in the book were analyzed using PRESENCE, which is freely available via the internet and includes copies of the example data sets. However, the book is neither intended nor appropriate for instruction in using PRESENCE. Several examples also include code for fitting Bayesian models with WINBUGS, version 1.4 (Spiegelhalter et al. 2003). Their use will require familiarity with the software and Bayesian analysis methodology.

The authors have done a commendable job of synthesizing the existing knowledge on occupancy modeling and have succeeded in presenting it in a format that is understandable to avian biologists with varying quantitative skills. We believe that the book would be an excellent textbook for a graduate-level course on occupancy estimation and is a must for all avian ecologists.—James T. Peterson *and* Rua S. Mordecai, *U.S. Geological Survey, Georgia Cooperative Fish and Wildlife Research Unit, D.B. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, Georgia 30602, USA. E-mail: peterson@forestry.uga.edu*

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Birds of Oregon: A General Reference.—David B. Marshall, Matthew G. Hunter, and Alan L. Contreras, Editors. 2003. Oregon State University Press, Corvallis. 752 pp., line illustrations. ISBN 0-87071-497-X. Cloth, $65.00.—This voluminous work is an excellent reference of the spatial and temporal distribution of birds in Oregon and its coastal waters. It is a rich avifaunal natural history with useful habitat and foraging descriptions. The book covers the 486 species recognized at publication by the Oregon Bird Records Committee. The breeding distribution maps, derived from the Oregon Breeding Bird Atlas, are presented for the 205 confirmed Oregon-breeding species. Species nomenclature and sequence follow the 7th edition of the *Check-list of North American Birds*, the 42nd and 43rd supplements (American Ornithologists' Union 1998, 2000; Banks et al. 2002), and subsequent supplements. Coverage of subspecific taxa is based on specimens verified by the book's taxonomic editor, M. Ralph Browning. We have actively used this book as a reference for just over a year, and we apply that experience in writing this review.

The book opens with a synopsis of avifaunal changes in Oregon since 1935 (chapter 1). The editors acknowledge that their effort is the successor of the previously essential, though outdated, *Birds of Oregon* by Gabrielson and Jewett (1940; reprinted in 1970 as *Birds of the Pacific Northwest*). Gabrielson and Jewett included data and reports compiled through 1935. This and the following chapter, which describes avian habitats in Oregon ecoregions, document the considerable changes to the physical state of Oregon, avifaunal distribution, and the coverage by investigators and birders since 1935 that made this new Oregon avifaunal reference necessary.

The second chapter, "Avian Habitats in Oregon Ecoregions," provides complete and accessible delineations of the state's diverse biomes. The editors made the astute decision to incorporate the state's ecoregion concept, described in the most recent editions of the *Atlas of Oregon* (Loy et al. 2001) and the Oregon Natural Heritage Plan (Oregon Natural Heritage Advisory Council 2002). The sections on the Klamath Mountains, the Cascades, the "Eastern Cascades Slopes," and the "Foothills Ecoregion"—state delineations with which we are familiar—are very accurate. The descriptions, accepted by Oregon conservation organizations and state and federal agencies, are the most thorough and inclusive of the various state physiographic delineations to date. The extent and content are appropriate for this kind of reference work.

The species accounts in chapter 3 are the body of this book, in which the editors have done an exemplary job of compiling a complete

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list of Oregon birds. One hundred authors, including some of Oregon's most accomplished ornithologists, contributed the accounts. Each account begins with an introductory section that provides a physical description, as well as any appropriate notes of interest. Sections of each account follow the format of "General Distribution, Oregon Distribution, Habitat and Diet, Seasonal Activity and Behavior, Detection, and Population Status and Conservation." The species accounts blend metrics (counties or specific locations, dates, and numbers) and anecdotal reports, and are quite readable for both the professional and the layperson.

The habitat and diet, seasonal activity, and behavior sections provide accessible detail for birds within Oregon. These accounts address habitat-specific information that, in a brief examination, was much more detailed in many cases than other references (e.g., Birds of North America accounts).

Overall, we have found excellent information in referencing distribution, population, and conservation status of most species. A conspicuous shortcoming we found at times, however, was the uneven inclusion of Partners in Flight (PIF) conservation concepts, whether avifaunal biome delineations, or conservation status and plans for focal landbird species. An examination of the 29 focal species from three Oregon–Washington PIF habitat conservation plans (Altman 1999, 2000a, b) revealed just two that included PIF population status and conservation information. The completeness of "Population Status and Conservation" accounts of the remaining focal species, with or without PIF-plan reference, varies from brief to excellent.

The book has been useful in researching rare or unusual encounters. However, close examination has brought to light some inconsistencies and shortcomings. There is a general tendency for the species accounts to be rich in the breeding status and distribution of birds, but a bit paltry in postbreeding dispersal, fall migration, and winter (except Christmas Bird Count data) status and distribution. Several species accounts lack winter distribution or status information. This is very likely attributable, in large part, to the dearth of consistent monitoring or research work done during these months, and not to any fault of the authors. There is an occasional inconsistency between species accounts in the use of unpublished data from research and monitoring projects in the state, and museum specimen data. Some account authors included much of these resources, whereas others included very little to none. The authors who sought out and included this information compiled richer accounts for the effort. The accounts generally lack reference to data collected in long-term mark–recapture databases, such as the U.S. Geological Survey Bird Banding Laboratory or continental and regional long-term monitoring programs using banding data; these data would have provided additional information on fall and winter records.

The treatments of extirpated, introduced, escaped, and unaccepted-record species in the "Supplemental Species List" (chapter 4) were thorough and presented in an appropriate historical perspective. The chapter covers extirpated and questionable species as well as those that have been introduced but have not become established. This list includes accounts for "Unaccepted Records of Wild Birds."

The book's concise glossary will be useful to readers for defining or clarifying ornithological and biological jargon used in the book. The editors also included several helpful references as appendices. There is a complete "List of Common and Scientific Names of Plants and Animals" (appendix A). Appendix B is a compilation of "Changes in Scientific Bird Names Since Publication of Gabrielson and Jewett (1940)," which is helpful for cross-referencing historical and modern records. Appendix C contains descriptions of the three most-referred-to survey methods for bird population trends: the Oregon Breeding Bird Atlas, the Breeding Bird Survey, and the Christmas Bird Count.

Besides synthesizing most of the knowledge of Oregon's avifauna in one source, the book provides a thorough bibliography for further detailed reference. The vast list of sources cited, both published and personal communications (including unpublished reports and data), is well documented and is a valuable reference work in itself. Continuing their meticulous stewardship of the references, the editors have posted and maintain errata for the book, including recent (since publication) Oregon Rare Bird Committee-recognized species (available at home.comcast.net/~matt.hunter/bogrerrata/).

In the course of our professional reporting and writing since we acquired this book, we have often cited it as a reference. Although its size—752 pages and ~1.5 kg—

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makes it a bit cumbersome, this book will serve the professional, student, avid birder, and those otherwise ardently interested in Oregon's avifauna very well. It is the new definitive identification guide, companion, and species status reference for the birds of Oregon. We highly recommend it as the most thorough, up-to-date, and serviceable regional and state reference.—Robert I. Frey *and* John D. Alexander, *Klamath Bird Observatory, P.O. Box 758, Ashland, Oregon 97520, USA. E-mail: bif@klamathbird.org*

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Wildlife Demography: Analysis of Sex, Age, and Count Data.—John R. Skalski, Kristen E. Ryding, and Joshua J. Millspaugh. 2005. Elsevier-Academic, San Diego, California. xiii + 636 pp., 90 text figures. ISBN 0-12-0088773-8. Cloth, $69.95.—Collection of data on the age and sex composition of birds harvested by state and federal agencies has a long history, whereas less effort has been focused on estimation via capture–recapture, distance sampling, and other procedures. Yet in reading the literature on wildlife statistics, one would obtain the opposite impression, with most of the advances since the 1960s having been in areas of capture–recapture, tag recovery, and distance sampling (e.g., Otis et al. 1978, Burnham et al. 1980, Brownie et al. 1985, Pollock et al. 1990, Buckland et al. 1993, Williams et al. 2002). By contrast, there has been relatively little progress in the analysis of count-based data since the development of these methods between the 1940s and 1960s. Until recently, little formal statistical theory existed for many of these methods, so that variance estimates, confidence intervals, and assumption tests were generally unavailable. This book attempts to remedy the situation.

Chapter 2 provides an excellent review of population dynamics, especially of harvest theory, which is important because many of the data sources later considered derive from hunter and angler harvests. Subsequent chapters cover count-based approaches (direct counts, harvest surveys, age, and sex ratios) but also include methods such as capture–recapture and distance sampling for comparison and assumption testing. Chapters cover estimation of sex ratios (chapter 3), productivity and survival (chapters 4 and 5), harvest and harvest morality (chapter 6), population change (chapter 7), population indices (chapter 8), and abundance (chapter 9). Chapter 10 provides examples using multiple approaches to estimate parameters. Despite the chapter title, most of these are not "integrated" analyses. A notable exception is a study of Ring-necked Pheasants (*Phasianus colchicus*) in which change-in-ratio, catch–effort, and capture–recapture data were incorporated into a single likelihood, providing more precision (and fewer assumptions) than each method separately.

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The material in chapter 8 on finite sampling is very well written, but because these concepts apply generally, coverage earlier in the book would have been better. A useful appendix on "Statistical Concepts and Theory" covers maximum-likelihood estimation, interval estimation, hypothesis testing, and other topics. However, I could find no mention in the book of bias, accuracy, or precision—which is surprising, given the fundamental importance of these concepts to estimator assumptions.

The authors have done a thorough job of gathering many disparate methods together and providing a comprehensive description of data structures, statistical models (including likelihood formulas where possible), and assumptions. In several cases (e.g., chapter 3), they have also incorporated detection probabilities into the statistical models, so that, given appropriate data, parameters of biological interest can be estimated without making critical and untestable assumptions. Each chapter closes with a schematic decision tree, which can be used to guide selection of an appropriate sampling–estimation approach.

Unfortunately, few of the methods described here can provide, by themselves, reliable inference on populations. In contrast to methods such as capture–recapture, distance sampling, and detection-adjusted visual counts, most do not provide data that can be used to avoid untenable assumptions, or test those that cannot be avoided. In chapter 3 (pp. 65–66), the authors note that "in the absence of auxiliary information about detection rates [sex ratio] is not estimable…[so that]…in populations with different detection probabilities for males and females, an unbiased estimate…is not possible." However, sex-biased detection is common, and I question the value of a methodology that is not robust to an assumption that cannot be tested. Likewise, many of the methods described for harvest mortality (chapter 6, p. 287) "require the detection process to be stationary before, during and after the periods of harvest.…[but] the data usually collected by these techniques are insufficient alone to assess the validity of [these assumptions]." More serious is the use of vertical life-table (VLT) analyses to estimate age-specific survival and other parameters (chapter 5). Here, restrictive assumptions are required, including stationarity ($\lambda = 1$) and stable age distribution (SAD), which are seldom true in practice, especially in harvested populations. Unfortunately, these assumptions cannot be tested with the most common data structures (e.g., single, time-specific age distributions, as obtained via harvest surveys). Finally, it is not true (p. 163) that the assumption of age stability can be relaxed if the population is at SAD for a portion of the year. The SAD assumption is related to the fact that time-specific age distributions are, by definition, a mixture of ages from several cohorts, and this mixture only reflects age-specific survival when the age distribution is both stable and stationary between years.

A number of methods described are so-called "indirect methods" and are not statistical-estimation procedures *per se*, but model-based projections. In some cases (e.g., sex-ratio projections), these require independent estimates of survival to project sex ratios, and typically they also require assuming SAD and $\lambda = 1$. Despite a disclaimer (p. 76) that these are projections, they are later referred to as "estimates," and the "estimation" [*sic*] formulas are indicated by hats. Unfortunately, this blurs the distinction between estimates (which are functions of data) and model projections (which may or may not be) and will be confusing to managers, who may see these views of "estimation" as interchangeable. Likewise, methods for "estimating" λ (chapter 7) based on Lotka and Leslie models provide projection of λ at SAD, and so cannot be used with estimates that assume that SAD and $\lambda = 1$ have been attained.

Chapter 8 covers population indices, and the authors frankly admit (p. 360) that "without [auxiliary information on detection probabilities] it is usually impossible to assess [the validity of the index assumptions].…Thus population indices are, in part, a matter of faith.…" I concur with this, and with the statement that "science is not based on faith but rather on the interpretation of empirically derived facts." However, they assert that "despite the inferential weaknesses of indices, they remain a cornerstone of wildlife science." I cannot deny that these methods have appeal in being "cost efficient" (well, at least low-cost—the benefits are debatable), but the contradiction here is jarring. The authors later refer to "calibration" of indices, but the examples principally involve conversion between index and estimate units, without verification of the assumptions of either.

Overall, this book is a useful contribution to the literature on wildlife demography. My concern is

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that the book will be cited by some in defense of index and count methods in lieu of other, more robust approaches (e.g., Williams et al. 2002), or more recent work on count-based occupancy estimation (MacKenzie et al. 2006). Wildlife ecology is better served by sampling to obtain data that can be used in statistical models without requiring assumptions that are likely false—and that, when false, lead to unreliable inferences.—Michael J. Conroy, *Georgia Cooperative Fish and Wildlife Research Unit, D.B. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, Georgia 30602, USA. E-mail: mconroy@uga.edu*

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