Bird Hormones and Bird Migrations: Analyzing Hormones in Droppings and Egg Yolks and Assessing Adaptations in Long-Distance Migration

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Shrubb succeeds in conveying that message. However, whereas his sections on populations and agriculture are analytical and provide many anecdotes and references, I found the text dealing with breeding biology and behavior to be more descriptive and summarizing, and less detailed.

It is rather surprising that theories in evolutionary biology and behavioral ecology are hardly ever mentioned in the text. This is unfortunate, because several exciting questions regarding the evolution of lapwing breeding biology are still unsolved. In the description of mating systems, for example, I would like to have seen a discussion of the "polygyny threshold" hypothesis and how it may be affected by female dominance hierarchies (e.g., Grønstøl et al. 2003). It would also have been interesting to compare breeding behavior in lapwings and related species, with reference to the many comparative studies performed on shorebird breeding systems. The author could have related some aspects of lapwing behavior and ecology to relevant findings in other species for which there is better documentation. An example is how the production of replacement clutches may affect evolutionary fitness. Here, references to general life-history theory and some field tests of key predictions would have been worthwhile.

The Lapwing presents few new data and is, therefore, primarily a synthesis of previous research on the species. Still, a number of papers on general breeding biology were apparently overlooked. Of 13 internationally published papers from Norwegian studies between 1996 and 2005, only three are cited by Shrubb. I believe that references to more of these results would have improved the text on themes like mating system, egg size, clutch size, incubation behavior, and general time budgets. Other important but missing references include a study on copulation behavior (Zöllner 2001), one on geographic egg size variation (Chylarecki et al. 1997), and one about factors influencing breeding performance (Parish et al. 2001).

To make the monograph more complete, I also wish the author had presented information about aging birds in the hand and described general plumage variation in more detail. Plumage characteristics can be used for individual recognition of lapwings in the field. In fact, males in the color photographs on plates 1 and 3 show some of the relevant plumage details, but the text erroneously states that the male in the latter is "not quite in full breeding plumage." Moreover, sample sizes are rarely given, which makes it difficult to properly evaluate the strength of statistical results. In still other cases, I am skeptical as to the generality of the described behavior. Shrubb claims that extrapair copulations are common in lapwings, but this cannot be substantiated by reference to the literature. Further, lapwing embryos are said to be extremely resistant to cold, but this is likely age-dependent, as with birds in general. On page 149, it is stated that lapwings will make a new nest cup and continue incubation if the eggs are simply put aside to save them from agricultural activities. In my experience, this is more likely successful if the original nest and surrounding turf are also moved. Finally, it was interesting to see the author mention slurry-spreading as having detrimental effects on nesting success. In Norway, I have the impression that birds will continue incubating unless the eggs get severely smeared in this bad-smelling fluid, which is not always the case. However, there may well be geographic variation in agricultural practices that cause differences in this respect.

Despite the various shortcomings outlined above, *The Lapwing* fulfills my expectations in several ways. Shrubb shares his vast knowledge of lapwings in clear and concise prose. His passion for these beautiful and fascinating birds shines through in all parts of the book, as does his strong interest in conservation of farmland birds. Those interested in behavioral ecology and evolutionary aspects of lapwing biology will find relatively little relevant information in this book. However, I recommend it to anyone interested in how modern agriculture affects bird populations, a topic in which the lapwing makes a thought-provoking example. Undoubtedly, this monograph also provides a good basic introduction to the fascinating biology of lapwings that a broad spectrum of ornithologists will likely enjoy reading.—Terje Lislevand, *Bergen Museum, University of Bergen, Box 7800, N-5020 Bergen, Norway. E-mail: terje.lislevand@bio.uib.no*

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Bird Hormones and Bird Migrations: Analyzing Hormones in Droppings and Egg Yolks and Assessing Adaptations in Long-Distance Migration.—Ulf Bauchinger, Wolfgang Goyman, and Susanne Jenni-Eiermann, Eds. 2005. Annals of the New York Academy of Sciences, vol. 1046. Wiley, New York. 295 pp., 77 figures. ISBN 1–57331-577-X. Paper, $129.95.—This volume compiles research presented at two workshops held at the Max Plank Institute of Ornithology in October 2004 and January 2005. The first was a technical workshop on the measurement of hormones in avian feces and yolk. The second focused on adaptations to long-distance migration in birds. Although the book's appeal will not extend to a very broad audience, it is important reading for anyone interested in avian fecal endocrine techniques or adaptations to long-distance migration. The chapters are organized like journal papers, but readers should keep in mind that the contents are not necessarily peer-reviewed. The book is probably not worth the price for those interested specifically in yolk steroids, which receive relatively little coverage.

In many ways, the two main topics are disparate enough that this could have been two separate books. However, the themes are integrated by the lifework and collaborative spirit of Ebo Gwinner, who founded and developed what is now the Max Planck Institute for Ornithology and who was instrumental in organizing the workshops. Sadly, Gwinner passed away in September 2004, before the workshops were held.

Measurement of hormone metabolites in feces holds great promise as a noninvasive method of obtaining endocrine profiles for wild or captive animals. Many endocrinologists, conservation biologists, wildlife managers, zookeepers, and vets are now trying to use fecal endocrine techniques. However, application of these measures is not simple. Although extensive validations have proved the biological relevance of fecal steroid measures for some species, the approach is fraught with challenges, particularly when applied to birds. These include the fact that, unlike hormones in the blood, the chemical structure of hormone metabolites in feces may vary with species, sex, and diet. For this reason, extensive biochemical and physiological validations are critical for each species to which fecal endocrine techniques are applied.

Four papers in this volume emphasize the importance of appropriate validations. Four others provide examples of rigorous validations for fecal corticosterone metabolites in Black Grouse (*Tetrao tetrix*), Capercaillies (*T. urogallus*), three North American owls (*Strix occidentalis caurina, S. varia*, and *Bubo virginianus*), and Greylag Geese (*Anser anser*). Another paper illustrates the importance of repeated sampling within individuals to accurately characterize the stress response in Greylag Geese. The paper by Goymann titled "Noninvasive Monitoring of Hormones in Bird Droppings: Physiological Validation, Sampling, Extraction, Sex Differences, and the Influence of Diet of Hormone Metabolite Levels" is a particularly important contribution to the field. It and the following paper by Touma and Palme should be read by anyone interested in measuring hormone metabolites in feces (avian or otherwise). Palme also provides an additional chapter intended to be, as he writes in the abstract, "a checklist that addresses the main topics of concern such as sample collection and storage, time delay extraction procedures, assay selection and validation, biological relevance, and some confounding factors." It is convenient and concise, and complements the more thorough treatment these issues get in other chapters.

As these papers point out, many issues have not been resolved and more work is needed to optimize methodologies. One difficulty that has plagued every study of avian fecal hormone metabolites to date is the seemingly strong effect of sample mass on hormone metabolite concentration, which Goymann suggests may be spurious. Another unresolved issue is how best to process samples once they have been collected in the field. This book cannot provide solutions to all the problems with avian fecal hormone measures, but it provides a very thorough inventory of the pitfalls, an essential starting point for all related studies to come. The field has benefited greatly from this contribution.

Although measurement of steroids in yolk is superficially related to measurement of hormone metabolites in feces, the technical issues involved in each are very different. Two of the three papers in this volume that address yolk steroids take a similar approach to the first of the fecal-steroid papers, reviewing methodologies employed to date and pointing out potential hazards. The third presents results of research on the transfer of maternal corticosterone to chicken eggs. A final paper on steroids combines yolk with feces by demonstrating that steroids can be measured noninvasively in allantoic waste, representing a combination of steroids from maternal and fetal origin.

Switching gears completely, the last 80 pages of the volume are devoted to studies that address potential adaptive syndromes related to long-distance migration in birds. Although representing only a few labs, contributors hail from a range of backgrounds, including "functional morphology, stopover ecology, behavioral ecology, evolutionary ecology, quantitative genetics, eco-physiology, dynamic modeling and molecular biology." They met to share perspectives toward better understanding the relationships among specific adaptations to long-distance migration. Such understanding may, for example, help explain why so many migratory species are currently imperiled and help predict the effects of climate change. It has been suggested that the large amounts of time and energy devoted to long-distance migration may impose rigidity in other life-history stages that constrain adaptation to a changing environment.

Unlike the previous section, the first six migration papers present primary research with a comparative approach, on topics ranging from plasticity in the timing of life-history traits to heritable variation to eco-morphology to spatial behavior at stopover sites. The final paper, written by Theunis Piersma, Javier Perez-Tris, Henrik Mouritsen, Ulf Sauchinger, and Franz Bairlein, provides a summary of the consensus among workshop participants. Their conclusion is that the long-standing assumption of biologists that migratory birds express a suite of integrated adaptations constituting some recognizable "migratory syndrome" may be unfounded. Or, as the authors put it: "A provisional conclusion that, perhaps apart from a capacity for night-time compass orientation, there is little evidence for deeply rooted co-adapted trait complexes that could make up such a migratory syndrome, is suggested."

These seven papers are worthwhile in their own right, and the synthesis of disparate approaches to the question of migratory syndrome in birds is important. Anyone involved in the study of migration should read the second section of this volume, which represents the consensus of many migration biologists at work today.

Bird Hormones and Bird Migrations is an expensive book and will not appeal to a lay audience, particularly given the lack of a subject index. However, anyone active in the study of fecal endocrine measures or adaptations to migration should read this book with great interest (and a little healthy skepticism). They will likely find that their research benefits from it.—LISA S. HAYWARD, *Department of Biology, University of Washington, Seattle, Washington 98195, USA. E-mail: lhayward@u.washington.edu*