BOOK REVIEWS

Avian Travelers

Neotropical Migratory Birds. Natural History, Distribution, and Population Change. RICHARD M. DEGRAAF and JOHN H. RAPPOLE. Comstock (Cornell University Press), Ithaca, NY, 1996. xii, 676 pp., illus. Paper, $27.50 or £21.50.

The Ecology of Migrant Birds. A Neotropical Perspective. JOHN H. RAPPOLE. Smithsonian Institution Press, Washington, DC, 1996. xviii, 269 pp., illus. $35 or £27.25.

Ecology and Management of Neotropical Migratory Birds. A Synthesis and Review of Critical Issues. THOMAS E. MARTIN and DEBORAH M. FINCH, Eds. Oxford University Press, New York, 1995. xvi, 489 pp., illus. $65 or £50; paper, $35 or £25.

On 11 May 1996, "International Migratory Bird Day," a variety of events around the Western Hemisphere marked either the return of many migrants to their temperate-zone breeding grounds or their departure from tropical wintering ranges. All of this fuss was focused primarily on a group of more than 300 species that are neotropical migrants, dividing their annual cycle between the Nearctic and the Neotropics. These migrants have been a conspicuous preoccupation of avian ecologists and bird conservationists for nearly 25 years because the populations of about a third of them are declining and the underlying causes are often obscure. Among a rapidly expanding literature, the three books reviewed here represent, in different ways, a synopsis of what has been discovered and what remains unknown about these evocative species.

Neotropical Migratory Birds is primarily a compendium of facts about the life histories and ecology of 361 species; its synthesis of these facts is brief and superficial. Five-hundred ninety-three pages are devoted to species accounts and tables that provide details on the geographic ranges, habitat affinities, and status of migrants. I was surprised that the authors make no attempt in these accounts to at least speculate on which of their nine suspected causes of declines (loss of breeding-ground habitat, habitat fragmentation, successional changes to breeding-ground habitat, breeding-habitat alteration by white-tailed deer, contaminant poisoning, normal population fluctuations, stopover-habitat alteration, winter-habitat alteration, procedural biases) might be associated with the various species. The unique features of these species accounts are range maps that illustrate where the birds spend their breeding and nonbreeding seasons. Comparing these 1995 maps with Rappole's first mapping attempts in 1983 reveals that much has been clarified. Still, the maps are obviously crude representations of where birds are found, especially in the Neotropics, and there is no indication of where birds are abundant or scarce within the depicted ranges. For most readers, this will be a reference book, not an engaging explanation of the mysteries surrounding the declines of these birds.

As its subtitle suggests, *The Ecology of Migrant Birds* explores the neotropical portions of the annual cycles of the birds. (338 species; for reasons unexplained, 23 species included in the previous book are not treated here). Whereas the first book was organized around species, this book is devoted to key topics (habitat, resource use, migrants as members of tropical communities, migration, migrant evolution, Old World versus New World migration systems, migrant population change, and conservation). Each of these topics is reviewed well with a good sampling of the literature and illustrative examples. The author's neotropical perspective makes this book different from others on migrant birds, and it highlights clearly the significant gaps in our knowledge of the ecology of migrants on their winter ranges. Rappole makes it clear that generalizing about these birds is risky; the more we discover about them, the more we find individual species differences. Populations of some species seem to be limited by events on the breeding grounds, whereas others seem limited by events on the winter range. Tropical deforestation destroys habitat for some species while it creates habitat for others. Despite the rapidly accumulating knowledge about the dynamics of migrant populations, there remains a key missing link in most attempts to assign the causes of declines to the Neotropics, including Rappole's. There are still few data on overwinter survival, especially across the range of habitats and regions occupied by most species. Until we have such data to complement more detailed information on population trends and reproduction, conservationists will have to settle for correlations rather than causality to guide their strategies in the Neotropics. The level of the writing in *The Ecology of Migrant Birds* is appropriate for general readers with some biological or environmental background.

Blackburnian warbler, *Dendroica fusca*. [From the dust jacket of *Neotropical Migratory Birds*; photograph by Barth Schorre]

Ecology and Management of Neotropical Migratory Birds provides the best review yet of the scientific issues surrounding migrants. The book's 17 chapters are written by 51 of the researchers who have thought most critically about these issues. Their reviews provide a cross section of the diverse opinions and conclusions about when, where, and why populations are being limited and what can be done about it. And there is diversity in what they have to say because so many of the facts require interpretation. The first chapter, for example, presents the best available evidence that widespread declines are occurring (from 30 years of continent-wide Breeding Bird Surveys), while the second chapter challenges some of that evidence and raises provocative questions about the science and interpretation of long-term bird population studies. The core chapters of the book deal with how a variety of natural and artificial factors affect migrants. A recurring theme is the importance of temporal and spatial scale in understanding ecological phenomena so complex that they span decades and continents. The chapters have a strong bias toward the temperate zone, especially those on conservation applications, which are further biased toward temperate forests. Indeed, only two contributors are nominally from the neotropical

region. An important conclusion of this volume is that although research and conservation must be intimately interwoven, the obvious gaps in our knowledge about these complex species must not stand in the way of applying what we already know to conservation activities. This book is aimed at ornithologists, ecologists, and conservation biologists. For those participating in coordinated efforts, such as the international, interagency "Partners in Flight—Aves de las Americas" program, the analyses in this book provide an important scientific basis for informed decision making.

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Sea Measurements

Ocean Acoustic Tomography. WALTER MUNK, PETER WORCESTER, and CARL WUNSCH. Cambridge University Press, New York, 1995. xiv, 433 pp., illus., + plates. $59.95 or £45. Cambridge Monographs on Mechanics.

Acoustic tomography is one of the most potent techniques at the disposal of present-day oceanography. To measure climate-relevant natural or anthropogenic changes in the ocean, temperature signals of the order of a tenth of a degree Celsius and hundreds to thousands of kilometers in horizontal scale have to be detected against the background of large-amplitude but small-scale local temperature fluctuations that are caused by mesoscale eddies of about 100-kilometer scale and internal waves ranging from less than one to tens of kilometers in scale. The book demonstrates that acoustic tomography can accomplish such objectives. Why then is the technique not widely applied?

The main reason is obvious from studying this book: Acoustic tomography, by comparison with other oceanographic observational techniques, is probably the most challenging (and expensive) to start up, and a number of hurdles have to be overcome before even arriving at oceanographically relevant data. First, the technical level necessary to make the instruments work reliably is very demanding, and past tomographic experiments had their share of technical problems at sea. Second, the identification and analysis of ray-arrival patterns and their correction for mooring motion, that is, for separation changes of instrument pairs, is complicated. And third, the sound-propagation anomalies have to be converted into changes of temperature structure (and currents for reciprocal transmissions). However, these are now integrals through the slice of ocean traveled by the sound waves, distorted by various effects of stratification, currents, and topography, and new ways to interpret them had to be found. It is this analysis that makes up the major part of the book. The book is a thorough compendium of the possible methods and approaches in application to various case studies of ocean stratifications, with hypothetical cases always accompanied by practical physical scaling arguments, which makes it interesting to read.

Because of the inherent technical difficulties, tomography was, in the first part of its history, during the '70s and early '80s, too much applied in an engineering sense—that is, experimental sites were selected in ocean areas where the sound-propagation conditions were right, but in which in the end there was not much interest on the part of the oceanographic community in the scientific questions the tomographers posed. Consequently, the section on past oceanographic results in the book is short compared to the presentation of methods. In addition, as the authors also mention (p. 28), tomography in its first decade, rather than making use of the integral qualities of the measurements, tried to compete with conventional (point) measurements in the ocean by scanning through a volume from all sides and then decomposing the products by inverse methods into small sub-elements for which the results would presumably resemble point oceanographic measurements—hence the name tomography. Only recently has it been used to its full potential by scanning through winter convection areas of the Greenland Sea or the northwestern Mediterranean and thus obtaining volumetric time series of changes in water-mass distributions that could not have been obtained in such quality by conventional means.

The authors are the leaders of the field, having worked together over the past two decades to develop it. Munk, as the godfather of tomography, has continuously pushed it to new limits. Now his ultimate objective is to install a global system entitled "Acoustic Tomography of Ocean Climate" (ATOC) for monitoring the ocean's role in climate, and operations are already under way in the Pacific (the difficulties recently uncovered in interpreting long-range acoustics are explained in the book). Worcester is the expert on instrumentation and signal analysis, and Wunsch has developed the inverse technology for ocean applications, an essential element for successful tomography.

At this time, when tomography is needed more than ever for monitoring the ocean's role in anthropogenic and natural climate fluctuations, the unfortunate fact is that the community of ocean tomographers is small. May this excellent book help to give new impulse to this exciting technique, which should play a key role in forthcoming ocean-climate observing programs within the context of the Climate Variability and Predictability Study (CLIVAR) and the Global Ocean Observing System (GOOS).

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Quantum Optics

Optical Coherence and Quantum Optics. LEONARD MANDEL and EMIL WOLF. Cambridge University Press, New York, 1995. xxvi, 116 pp., illus. $49.95 or £30.

During the last two years several books in the rapidly developing field of quantum optics have appeared. D. F. Walls and G. Milburn's *Quantum Optics* (Springer-Verlag, 1994), W. Vogel and D. G. Welsch's *Lectures on Quantum Optics* (Akademie Verlag, 1994), and E. R. Pike and S. Sarkar's *The Quantum Theory of Radiation* (Oxford University Press, 1995) are only a few of the efforts that have been made to summarize this field. The latest addition is *Optical Coherence and Quantum Optics* by Leonard Mandel and Emil Wolf. But—what is quantum optics?

The idea that light is a wave, supported by the numerous observed interference phenomena, was generally accepted during the last century. Then, at the end of that century (1889) Max Planck postulated that light is not continuous but comes in bunches or, as he called them, quanta. This discovery marked the beginning of a new era in physics. In 1917 Albert Einstein found that the process of stimulated emission of radiation, that is, a light quantum interacting with an excited atom, can stimulate the emission of a second light quantum. This is the fundamental process driving a laser. The theory of quantum mechanics as developed by Paul Dirac, Werner Heisenberg, and Erwin Schrödinger in the mid 1920s describes the microscopic world, comprising such entities as atoms and molecules, where Isaac Newton's theory of classical mechanics fails. However, quantum mechanics also applies to the electromagnetic field, and the resulting quantum theory of radiation puts the insights of Planck on a solid foundation.