

few years. It is evident that more thorough, intensive, and long-term studies are needed to confirm and extend the generalities presented in these and other recent papers on shorebirds.

A recurring topic in these volumes is what regulates shorebird numbers, particularly the relative importance of events occurring in the breeding areas versus those in migration or in winter. In a comprehensive and insightful review of shorebird population dynamics, Evans and Pienkowski conclude that regulation *per se* may in fact not occur, shorebird populations being held in check largely by climatic events operating in the breeding and especially in the wintering areas. Puttick in her consideration of winter feeding behavior assumes that winter food is limiting for shorebirds, but she wisely concludes with a plea for experimental tests of this assumption. Goss-Custard demonstrates that, even though wintering shorebirds spend considerable time foraging and have a potential impact on the abundance of their winter food, their mortality in winter may be relatively low. I think any conclusions regarding limiting factors are premature, especially considering that there is not even one shorebird population for which natality, mortality, and other demographic features have been critically assessed. Yet this remains a crucial question that must be addressed before appropriate management or conservation strategies, such as those discussed in these volumes by Senner and Howe, can be established. Evaluations of the importance of migratory stopover and winter areas in the population dynamics of shorebirds are particularly needed, because these estuaries and coastlines are being imminently threatened by development.

Another major topic covered in these two volumes is shorebird social systems. Shorebirds, which include such groups as the sandpipers, plovers, snipe, phalaropes, and other relatively long-legged "waders," exhibit an impressive array of ecological and behavioral traits making them excellent subjects for examination and testing of many aspects of behavioral, ecological, and evolutionary theory. Particularly noteworthy contributions on this topic are Oring and Lank's consideration of the relationship between dispersal and social structure and its evolutionary implications and Walter's thought-provoking review of hypotheses concerning limitations on clutch size and the evolution of parental behavior. Lenington concludes from a theoretical approach that polyandry may best be explained as the outcome of a

historical process, but she provides little new insight into the evolutionary or ecological factors promoting such processes. Miller presents the most comprehensive review to date of shorebird ethology, pointing out the lack of good comparative data, especially on the functions of communication signals. Finally, using an optimization approach, Myers lucidly discusses the spacing patterns exhibited by wintering shorebirds and points to the need for consideration of why individuals within species vary in their spacing patterns at different times and places.

Other papers in these two volumes review shorebirds as marine animals (Burger), abiotic factors affecting migrant shorebirds (Burger), and antipredator behavior (Gochfeld). Also, Morrison presents selected results of the extensive Canadian surveys, which provide much new information on shorebird migratory stopovers and wintering areas in the Western Hemisphere.

Overall, I was impressed by the thoroughness of the reviews and by the quality of ideas presented in these papers. By examining the link between theory and existing data, they quickly bring the reader to the frontier of the subject, elucidate the questions that need answering, and in many cases suggest approaches to providing the answers.

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## Modes of Reproduction

**Fish Reproduction.** Strategies and Tactics. G. W. POTTS and R. J. WOOTTON, Eds. Academic Press, Orlando, Fla., 1984. xiv, 410 pp., illus. \$49. From a symposium, Plymouth, England, July 1982.

A large proportion of the major recent advances in our understanding of evolutionary processes have come from the study of species with unusual and even bizarre (to a tetrapod chauvinist) methods of reproduction. Haplodiploidy in the social insects is one of the most obvious cases.

Though there appear to be no haplodiploid fishes, this group, with over 20,000 species, exhibits an extraordinarily broad range of reproductive modes. The diversity of sex allocation patterns alone rivals that of plants. Fishes exhibit gonochorism, both kinds of sequential hermaphroditism (protogyny and protandry), simultaneous hermaphroditism, androdioecy, and two kinds of partheno-

genesis. In gonochores, both autosomal and heterogametic sex determination occur. Fertilization is external in most species, but internal fertilization occurs in several groups. Though most fishes abandon eggs after spawning, a wide variety of male and female parental care patterns occur, including guarding, mouth brooding, incubation in brood pouches, and various stages of viviparity. The range of mating systems is enormous, from mass spawning to harem and lek-like assemblages to long-term monogamy (including the bizarre male parasitism seen in ceratioid angler fishes). Current evidence indicates that most of these reproductive modes have evolved several times independently.

It is surprising, given the potential this diversity offers for investigating evolutionary processes, that there have been few attempts to provide a general synthesis of reproductive patterns in fishes. The classic *Modes of Reproduction in Fishes*, by C. M. Breder, Jr., and D. E. Rosen (Natural History Press, 1966), has been enormously useful, but it is largely a compendium of references.

Though not itself constituting a synthesis, *Fish Reproduction* is a step in the right direction. The book is a collection of papers from an international symposium held by the Fisheries Society of Great Britain. Given the subject and format, it is not surprising that the range of both topics covered and usefulness of papers is large. The topics covered include life history models, sex reversal, the genetics of sex determination, parental care, timing of reproduction, progenesis in deep sea fishes, reproduction in estuarine fishes and in particular taxonomic groups, and the significance of reproductive ecology for fisheries. Both reviews and original research papers are included, though almost all papers report some original work. The papers are generally too short to provide thorough reviews, and they are not generally aimed at defining or illuminating current issues of critical importance. Two exceptions are a discussion of life history models by S. C. Stearns and R. E. Crandall and a report on alternative reproductive strategies in fishes by M. R. Gross. The main usefulness of the book is in giving the biologist interested in fish reproduction a good feeling for the diversity of approaches and topics in the area and in providing an introduction to the current literature. Its bibliographic usefulness is seriously compromised by the exclusion of titles from the listings of citations, however. There are also some important omissions among topics covered. There is no coverage of internal fertilization or

viviparity, and there are only two papers (out of 20 in all) on tropical fishes. Furthermore, the international representation is not well balanced: there are 15 British authors, five Canadians, and four Americans. Nonetheless, the volume is unique in bringing together interesting discussions of so many different aspects of fish reproduction.

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## Books Received

**Ada: Language, Compilers and Bibliography.** M. W. Rogers, Ed. Published on behalf of the Commission of the European Communities by Cambridge University Press, New York, 1984. Various pages. \$17.95. The Ada Companion Series.

**Advances in Carbohydrate Chemistry and Biochemistry.** Vol. 42. R. Stuart Tipson and Derek Horton, Eds. Academic Press, Orlando, Fla., 1984. xiv, 444 pp., illus. \$65.

**Advances in Heat Transfer.** Vol. 16. James P. Hartnett and Thomas F. Irvine, Jr., Eds. Academic Press, Orlando, Fla., 1984. xii, 388 pp., illus. \$70.

**Advances in Heterocyclic Chemistry.** Vol. 36. Alan R. Katritzky, Ed. Academic Press, Orlando, Fla., 1984. xii, 416 pp., illus. \$95.

**Advances in Immunology.** Vol. 36. Frank J. Dixon, Ed. Academic Press, Orlando, Fla., 1984. xiv, 248 pp., illus. \$36.50.

**Advances in Inorganic and Bioinorganic Mechanisms.** Vol. 2. A. G. Sykes, Ed. Academic Press, Orlando, Fla., 1983. x, 388 pp., illus. \$75.

**Advances in Insect Physiology.** Vol. 17. M. J. Berridge, J. E. Treherne, and V. B. Wigglesworth, Eds. Academic Press, Orlando, Fla., 1983. viii, 318 pp., illus. \$50.

**Advances in Surface Treatments.** Technology—Applications—Effects. Vol. 1. A. Niku-Lari, Ed. Pergamon, New York, 1984. xviii, 258 pp., illus., + appendix. \$40.

**Advances in the Biology of Disease.** Vol. 1. Emanuel Rubin and Ivan Damjanov, Williams and Wilkins, Baltimore, 1984. viii, 208 pp., illus. \$29.95.

**The American Atom.** A Documentary History of Nuclear Policies from the Discovery of Fission to the Present, 1939–1984. Robert C. Williams and Philip L. Cantelon, Eds. University of Pennsylvania Press, Philadelphia, 1984. xvi, 333 pp. \$30; paper, \$8.95.

**The Analysis of Animal Bones from Archeological Sites.** Richard G. Klein and Kathryn Cruz-Uribe. University of Chicago Press, Chicago, 1984. xii, 266 pp., illus. \$20; paper, \$9. Prehistoric Archeology and Ecology.

**Annual Review of Ecology and Systematics.** Vol. 15. Richard F. Johnston, Peter W. Frank, and Charles D. Michener, Eds. Annual Reviews, Palo Alto, Calif., 1984. xiv, 601 pp., illus. \$27.

**The Bacterial Spore.** Vol. 2. A. Hurst and G. W. Gould, Eds. Academic Press, Orlando, Fla., 1983. xiv, 328 pp., illus. \$52.

**Basic Issues in Econometrics.** Arnold Zellner. University of Chicago Press, Chicago, 1984. xxii, 334 pp. \$48.

**Basic Photovoltaic Principles and Methods.** Solar Energy Research Institute. Van Nostrand Reinhold, New York, 1984. xvi, 249 pp., illus. \$24.50.

**Biochemistry of Steroid Hormones.** H. L. J. Makin, Ed. 2nd ed. Blackwell Scientific, Palo Alto, Calif., 1984. xii, 714 pp., illus. \$125.

**Biography of a Planet.** Geology, Astronomy, and the Evolution of Life on Earth. Chet Raymo. Prentice-Hall, Englewood Cliffs, N.J., 1984. xiv, 176 pp., illus. \$19.95; paper, \$10.95. PHalatope Books.

**The Biology of Idiotypes.** Mark I. Greene and Alfred Nisonoff, Eds. Plenum, New York, 1984. xvi, 507 pp., illus. \$59.50.

**Biomaterials Science and Engineering.** Joon Bu Park. Plenum, New York, 1984. xvi, 459 pp., illus. \$35.

**Biosynthesis of the Photosynthetic Apparatus.** Molecular Biology, Development and Regulation. J. Philip Thornber, L. Andrew Staehelin, and Richard B. Hallick, Eds. Liss, New York, 1984. xx, 405 pp., illus. \$78. UCLA Symposia on Molecular and Cellular Biology, New Series, vol. 14. From a symposium, Keystone, Colo., April 1983.

**Biotechnology in the Marine Sciences.** Rita R. Colwell, Anthony J. Sinskey, and E. Ray Pariser, Eds. Wiley-Interscience, New York, 1984. xviii, 293 pp., illus. \$37.50. Advances in Marine Science and Biotechnology. From a seminar, March 1982.

**Brain Receptor Methodologies.** Part B, Amino Acids; Peptides; Psychoactive Drugs. Paul J. Marangos, Iain C. Campbell, and Robert M. Cohen, Eds. Academic Press, Orlando, Fla., 1984. xx, 336 pp., illus. \$45. Neurobiological Research.

**Building Bridges.** History, Technology, Construction. Hans Wittfoht. Beton-Verlag, Düsseldorf, Germany, 1984 (U.S. distributor, Heyden, Philadelphia). 327 pp., illus. \$99. Translated from the German edition.

**Carbon Dioxide Flooding.** Basic Mechanisms and Project Design. Mark A. Klins. International Human Resources Development Corporation, Boston, 1984. xii, 267 pp., illus. \$58.

**Cell and Tissue Regeneration.** A Biochemical Approach. Margery C. Ord and Lloyd A. Stocken. Wiley-Interscience, New York, 1984. xviii, 221 pp. \$42.50. Cell Biology, vol. 2.

**Cellular and Molecular Neurotoxicology.** Toshio Narahashi, Ed. Raven, New York, 1984. xvi, 304 pp., illus. \$56.50. From a symposium, San Diego, Calif., Aug. 1983.

**Ceramics in Advanced Energy Technologies.** H. Kröckel, M. Merz, and O. van der Biest, Eds. Reidel, Boston, 1984 (distributor, Kluwer Boston, Hingham, Mass.). x, 541 pp., illus. \$79.50. From a colloquium, Petten, Netherlands, Sept. 1982.

**Chemical Oscillations, Waves, and Turbulence.** Y. Kuramoto. Springer-Verlag, New York, 1984. viii, 156 pp., illus. \$28.50. Springer Series in Synergetics, vol. 19.

**Cozumel.** Late Maya Settlement Patterns. David A. Freidel and Jeremy A. Sabloff. Academic Press, Orlando, Fla., 1984. xviii, 212 pp., illus. \$31. Studies in Archaeology.

**Crop Genetic Resources.** Conservation and Evaluation. J. H. W. Holden and J. T. Williams, Eds. Allen and Unwin, Boston, 1984. xvi, 296 pp., illus. \$40; paper, \$14.95.

**Cultural and Sociological Aspects of Alcoholism and Substance Abuse.** Barry Stimmel, Ed. Haworth, New York, 1984. x, 84 pp. \$19.95. Reprinted from *Advances in Alcohol and Substance Abuse*, vol. 4, No. 1.

**Current Topics in Membranes and Transport.** Arnost Kleinzelner and Felix Bronner, Eds. Vol. 20. Molecular Approaches to Epithelial Transport. James B. Wade and Simon A. Lewis, Eds. Academic Press, Orlando, Fla., 1984. xx, 324 pp., illus. \$58. From a conference.

**Decomposition of Alloys.** The Early Stages. P. Haasen *et al.*, Eds. Pergamon, New York, 1984. viii, 239 pp., illus. \$50. Acta-Scripta Metallurgica Proceedings Series 2. From a conference, Sonnenberg, Germany, Sept. 1983.

**Delaware Prehistoric Archaeology.** An Ecological Approach. Jay F. Custer. University of Delaware Press, Newark, 1984. 224 pp., illus. \$28.50.

**A Description of Devices Used in the Study of Wind Erosion of Soils.** A. P. Bocharov. Balkema, Rotterdam, 1984. viii, 90 pp., illus. \$15. Russian Translations Series, 14. Translated from the Russian edition (Alma-Ata, 1972).

**Energy.** Vol. 2, Non-nuclear Energy Technologies. S. S. Penner and L. Icerman, 2nd ed. Pergamon, New York, 1984. xxxvi, 852 pp., illus. \$70; paper, \$29.95.

**Epithelial Calcium and Phosphate Transport.** Molecular and Cellular Aspects. Felix Bronner and Meinrad Peterlik, Eds. Liss, New York, 1984. xxiv, 392 pp., illus. \$68. Progress in Clinical and Biological Research, vol. 168. From a workshop, Vienna, March 1984.

**Essays in Otomanguean Culture History.** J. Kathryn Josserand, Marcus Winter, and Nicholas Hopkins, Eds. Vanderbilt University Department of Sociology and Anthropology, Nashville, Tenn., 1984. vi, 225 pp., illus. Paper, \$12.80. Vanderbilt University Publications in Anthropology, No. 31.

**Everyday Memory, Actions and Absent-Mindedness.** J. E. Harris and P. E. Morris, Eds. Academic Press, Orlando, Fla., 1984. xiv, 253 pp. \$45.

**Experimental Social Programs and Analytic Methods.** An Evaluation of the U.S. Income Maintenance Projects. Alexander Basilevsky and Derek Hum. Academic Press, Orlando, Fla., 1984. xiv, 234 pp., illus. \$36.50. Quantitative Studies in Social Relations.

**Eyewitness Testimony.** Psychological Perspectives. Gary L. Wells and Elizabeth F. Loftus, Eds. Cambridge University Press, New York, 1984. x, 374 pp. \$39.50.

**Forest Ecosystems in Industrial Regions.** Studies on the Cycling of Energy Nutrients and Pollutants in the Niepolomice Forest, Southern Poland. W. Grodzinski, J. Weiner, and P. F. Maycock, Eds. Springer-Verlag, New York, 1984. xviii, 277 pp., illus. \$49.50. Ecological Studies, vol. 49.

**Frontiers in Cardiology for the Eighties.** L. Donato and A. L'Abbate, Eds. Academic Press, Orlando, Fla., 1984. xxii, 332 pp., illus. \$45. From a course, Punta Ala, Italy, Sept. 1981.

**Fundamentals of Energy Dispersive X-ray Analysis.** John C. Russ. Butterworths, Boston, 1984. vi, 308 pp., illus. \$79.95. Butterworths Monographs in Materials.

**Future Research in Hungary.** Ervin Bóna, *et al.*, Eds. Akadémiai Kiadó, Budapest, 1983 (U.S. distributor, Heyden, Philadelphia). 384 pp. \$28.

**Gas Phase Ion Chemistry.** Vol. 3, Ions and Light. Michael T. Bowers, Ed. Academic Press, Orlando, Fla., 1984. xiv, 453 pp., illus. \$75.

**The Gastroenterology Annual/2.** A Series of Critical Surveys of the International Literature. F. Kern, Jr., and A. L. Blum, Eds. Elsevier, New York, 1984. xii, 416 pp., illus. \$55.

**Gauge Theory of Elementary Particle Physics.** Tai-Pei Cheng and Ling-Fong Li. Clarendon (Oxford University Press), New York, 1984. xii, 536 pp., illus. \$39.

**Gel Electrophoresis and Isoelectric Focusing of Proteins.** Selected Techniques. R. C. Allen, C. A. Saravis, and H. R. Maurer. De Gruyter, New York, 1984. xiv, 255 pp., illus. \$39.95.

**Geochemistry of Organic Matter in the Ocean.** Evgenii A. Romankevich. Springer-Verlag, New York, 1984. xvi, 334 pp., illus. \$59. Translated from the Russian edition (1978).

**Hepatitis A.** Robert J. Gerety, Ed. Academic Press, Orlando, Fla., 1984. xiv, 282 pp., illus. \$49.

**Hormonal Regulation of Development II.** The Functions of Hormones from the Level of the Cell to the Whole Plant. Tom K. Scott, Ed. Springer-Verlag, New York, 1984. xvi, 309 pp., illus. \$66. Encyclopedia of Plant Physiology, New Series, vol. 10.

**Human Abilities.** An Information-Processing Approach. Robert J. Sternberg, Ed. Freeman, New York, 1984. xii, 259 pp., illus. \$19.95; paper, \$13.95. A Series of Books in Psychology.

**Human Milk Banking.** A. F. Williams and J. D. Baum, Eds. Nestlé Nutrition, Vevey, and Raven, New York, 1984. xx, 196 pp., illus. \$23.50. Nestlé Nutrition Workshop Series, vol. 5.

**Introduction to Electric Power Engineering.** Richard D. Shultz and Richard A. Smith. Harper and Row, New York, 1984. viii, 264 pp., illus. \$37.95.

**Inverse Semigroups.** Mario Petrich. Wiley-Interscience, New York, 1984. x, 674 pp., illus. \$62.50. Pure and Applied Mathematics.

**Invertebrate-Microbial Interactions.** J. M. Anderson, A. D. M. Rayner, and D. W. H. Walton, Eds. Cambridge University Press, New York, 1984. xii, 349 pp., illus. \$79.50. British Mycological Society Symposium Series, 6. From a symposium, Exeter, England, Sept. 1982.

**Involvement in Learning.** Realizing the Potential of American Higher Education. Final Report of the Study Group on the Conditions of Excellence in American Higher Education. National Institute of Education, Washington, D.C., 1984 (available from the Superintendent of Documents, Washington, D.C.). xii, 101 pp. Paper, \$4.50. Stock No. 065-000-00213-2.

**Ion Channels.** Molecular and Physiological Aspects. Wilfred D. Stein, Ed. Academic Press, Orlando, Fla., 1984. xx, 394 pp., illus. \$75. Current Topics in Membranes and Transport, vol. 21.

**The Jurassic of the Gulf Rim.** William P. S. Ventress *et al.*, Eds. Gulf Coast Section, Society of Economic Paleontologists and Mineralogists Foundation, 1984 (distributor, Earth Enterprises, Austin, Texas). viii, 408 pp., illus. Paper. From a conference, Baton Rouge, La., Nov. 1982.

**Klinefelter's Syndrome.** H.-J. Bandmann, R. Breit, and E. Perwein, Eds. Springer-Verlag, New York, 1984. xiv, 229 pp., illus. Paper, \$35.

**Laboratory Manual of General Ecology.** George W. Cox. 5th ed. Brown, Dubuque, Iowa, 1984. xii, 248 pp. Spiral bound.

**Medical Microbiology.** Vol. 3, Role of the Envelope in the Survival of Bacteria in Infection. C. S. F. Easmon *et al.*, Eds. Academic Press, Orlando, Fla., 1983. xiv, 264 pp., illus. \$47. From a meeting, Birmingham, England.

**Membrane Transport in Plants.** W. J. Cram *et al.*, Eds. Wiley-Interscience, New York, 1984. 592 pp., illus. \$44.95. From a symposium, Prague, Aug. 1983.

**Methods and Tools for Compiler Construction.** An Advanced Course. B. Lorho, Ed. Cambridge University Press, New York, 1984. viii, 398 pp., illus. \$49.50.

**Methods in Marine Zooplankton Ecology.** Makoto Omori and Tsutomu Ikeda. Wiley-Interscience, New York, 1984. xvi, 332 pp., illus. \$44.95. Translated and revised from the Japanese edition (Tokyo, 1976).

**Methods in Molecular Biology.** Vol. 1, Proteins. John M. Walker, Ed. Humana, Clifton, N.J., 1984. xii, 365 pp., illus. \$45. Biological Methods.

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