chapters on remote sensing. This coverage is usually not included in books aimed at biologists and is a pleasant surprise. The chapter by Robinson is particularly informative. The second section covers photosynthesis and development and is reasonably balanced. The chapter by Tett entitled "The Photic Zone" is one of the best overall introductions to primary productivity theory and algal photobiology I have come across—this in spite of the heavy math! Vision and behavior are covered in the next two sections which are, for the most part, excellent.

The contributors are all expert and the editors have allowed for personality and speculation to remain in the contributions. I was particularly happy to find a remarkable synthesis of vision at depth by Denton. The chapters by Land and Partridge are also excellent compilations. While it is an excellent review, the chapter by Matthews covering photoreceptor cell transduction and adaptation does not fit as nicely into the theme of the book. The last section addresses bioluminescence and is, except for the excellent contribution by Herring on bioluminescent communication, the weakest. This assessment does not imply that the other two contributions are poor. On the contrary, I found them interesting. They are, however, really out of place thematically. The chapter on the chemistry of bioluminescence is exactly that—pure chemistry. Only the first few paragraphs on the origins of bioluminescence really address life in the sea. The same is true for the next chapter, which outlines how bioluminescent reactions are used in a medical setting. Again, these chapters are interesting, but out of place in this volume.

The book is well produced, with excellent figure reproduction. All of the references are grouped at the end of the book, which I found to be quite handy. I feel that this book is an excellent addition to the library of any biologist who is interested in a synthetic, broad approach to the interactions between living systems and light in the sea. It should also be of use to graduate students and senior undergraduates who are looking for specific reviews in the topic areas covered.

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THE SONAR OF DOLPHINS.

By Whitlow W. L. Au. Springer-Verlag, New York. $79.00. xi + 277 p.; ill.; index. ISBN: 0-387-97835-6. 1993.

Au has written a quite thorough and cohesive account of the dolphin sonar system as exemplified by behavioral performances in laboratory experiments using standard operant conditioning techniques. He provides additional material from relevant anatomical and physiological studies of sound reception and production mechanisms. The volume has a comprehensive Introduction. It includes very brief material on the history of research dealing with animal sonar processes, a fundamental and clear exposition of underwater acoustics, and a rather succinct but complete review of animal psychophysics and signal detection theory and their application to the biology and bionics of the dolphin sonar system.

Au has assembled all this and more in a well-organized text with a wealth of clear illustrations and tables presenting experimental configurations, performance data, echo wave forms, transmission beam patterns, and anatomical diagrams of the dolphin's head. I think the pioneers of dolphin bioacoustics (including Schevill, Kellogg, Norris, Scott Johnson, Evans, Wood, Purves, Dubrovsky, Ayrapet'yants, Bel'kovich, Supin, and others) would be quite impressed by how well Au has integrated their findings with those of his own and co-workers at the Naval Ocean Systems Center in Kaneohe Bay, Oahu, Hawaii.

As an animal behaviorist, I especially welcomed Au's emphasis on the use of receiver operating characteristics to describe behavioral data, particularly in three of the largest chapters in the book dealing with hearing, target detection, discrimination, recognition, and classification. The author points out that changes in the likelihood of a target or a signal being present, or a payoff occurring or changes in the magnitude of the payoff, can produce rather dramatic behavioral biases without changing the dolphin's ability to detect a target or to differentiate between two or more targets. Such concern about dolphin decision processes on sonar tasks has played a role in the recent construction of the first artificial neural network to mimic a dolphin performing a sonar recognition task.

I have always been impressed with the similarities between Simmons's findings on the depth perception of big brown bats and Murchison's results on range resolution in bottlenose dolphins; therefore, I was delighted by Au's chapter comparing the sonar of bats with that of dolphins. He concludes that although signal types, transmission beam pattern, hearing sensitivity, and prey pursuit are vastly different, the sonar performance of insect-eating bats and some dolphins, with respect to discrimination of size differences, echo delay time, and target shape, are quite comparable.

There is one major omission in this otherwise authoritative and brilliant reference work on dolphin sonar. Except for the comparison of a few small odontocete cetaceans with the insect-eating bats, Au makes few other relevant comparisons about

other marine mammals. For example, he makes no attempt to review and evaluate the current evidence for echolocation by mysticete cetaceans. He omits references to experimental failures in demonstrating sonar in pinnipeds, and he makes no attempt to compare the underwater hearing of pinnipeds with that of dolphins, even though both taxa have auditory systems well adapted to an aquatic environment. Nor does he attempt to deal with what may be a significant comparative finding, namely, that dolphin sonar signals are much more similar to the short duration clicks emitted by such terrestrial echolocating animals as fruit bats, oilbirds, and cave swiftlets, and not at all similar to the frequency-manipulated tonal signals of insect-eating bats with whom their sonar performances in the laboratory appear equivalent. Moreover, Au has little to say about the selective forces shaping dolphin hearing and sonar.

In short, Au is primarily concerned with the proximal factors influencing dolphin sonar adjustments, and not concerned much with ecological and evolutionary influences. Nevertheless, *The Sonar of Dolphins* is an invaluable volume for those readers primarily interested in what is currently known about its experimental analysis (behavioral, anatomical and physiological), and the construction of mathematical models and electronic analogs to its signal processing system.

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GENETIC CONSERVATION OF SALMONID FISHES. *Based on meetings held in Moscow, Idaho, and Pullman, Washington, 23 June–5 July 1991. NATO Advanced Science Institutes Series A: Life Sciences, Volume 248.*

Edited by Joseph G. Cloud and Gary H. Thorgaard. Published in cooperation with NATO Scientific Affairs Division by Plenum Press, New York. $89.50. xii + 314 p.; ill.; index. ISBN: 0-306-44532-8. 1993.

I like to think that humans can avoid obliterating the planet. The editors of this volume are less optimistic: Their preface states that "we are nearing the time in which the decline of specific fish stocks is irreversible. As members of the scientific community, we need to define which fish stocks to preserve and collectively decide on the most plausible way to reach that goal." These essays focus mostly on how to reach the latter objective.

General reviews attempt to establish a basic understanding of problems and methodologies. Guyomard is assigned an impossible 22 pages in the opening chapter to lay out everything in fish genetics, from Mendel to fingerprint DNA and cladistics. It ends up too terse for a debutante, and probably too general for specialists. Levings looks at the evidence for genetic adaptations by salmonids to their environment. This chapter was particularly scary. Despite the economic and social importance of this group of fishes, evidence for genetic-environment linkages falls mostly into the categories of "maybe," "probably," "some evidence," "considered to be," and "however, the situation is complex. . . ."

Threats discussed include artificial selection owing to fishing pressure, and genetic swamping posed by present stocking programs and a rapidly growing aquaculture industry. Proposed solutions lie in better management of hatchery programs and genetic engineering of cultured fish. For extinct populations and species, Thorgaard and Cloud examine the as yet unproven possibilities of bringing them back with genetic manipulations.

Case studies of specific salmonid populations or groups are presented. Of these, I found Riddell's "Spatial organization of Pacific salmon: What to conserve?" particularly good. The others were variable in depth and scope.

The book was relatively free of typographic errors, but I thought the chapters could have been grouped better. Three things bothered me. I got a sense that we need a headlong charge into the genetics laboratory if we are to have any hope at all. This reflects the authors' interests, but our bioengineering abilities will probably not match the needs in time for many species and populations. Second, the main problem for salmonids is habitat loss owing to impacts from humans. These lost habitats are going to have to be restored and reclaimed for the genetically engineered fish of the future. No chapter is devoted to the successes and failures of habitat conservation approaches. Finally, Behnke indulges in some bureaucrat bashing: "The bureaucratic mindset typically finds the quantitativeness and repeatability of simplistic notions such as the discrimination grid or CD values to be irresistibly seductive. Such minds are already deluded by the illusion of technique they are proposing." It is not clear exactly which bureaucrats are being bashed, but I found it reassuring that they were interested in quantitative measures, and knew about discrimination grids. I am also quite sympathetic to bureaucrats who can actually be held responsible for consequences and/or failures resulting from their use of my research results, whereas I can retreat untouched back into my university research laboratory, stimulated by the failure of the test and planning new work to find out what went wrong.

This is a serious, thought-provoking book.

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