new knowledge and insights into population regulation. Of special interest are his observations on reproductive suppression at high densities and the resulting hierarchies and on the contributions by nonbreeding females to rearing of the young. Lindström, using some of MacDonald's results, presents a hypothesis to explain population regulation of foxes in Sweden. The essentials of this hypothesis are that a range of regulation exists with food supplies at one end and social factors at the other. In unstable environments where food supplies fluctuate drastically, nutritional factors suppress productivity. In stable environments population density is related to food supply, but the proximate regulating factor is socially induced suppression of reproduction. The theory can also be used to explain variations in sex ratios.

In the introductory chapter the editor points out that the book should not be considered a comprehensive summary of present-day knowledge of the fox but rather a stimulant for further research. The editor is being modest. This book contains exciting information that should be of great interest to students of population ecology, wildlife behavior, and disease relationships. It contains a fairly good summary of fox ecology, but, more important, it presents an excellent approach to the study of population regulation and illustrates the importance of behavior for understanding the ecology of a species.

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Echolocation

Animal Sonar Systems. Papers from a symposium, Jersey, Channel Islands, April 1979. RÉNÉ-GUY BUSNEL and JAMES F. FISH, Eds. Plenum, New York, 1980. xxiv, 1136 pp., illus. $75. NATO Advanced Study Institutes Series A, vol. 28.

This volume is the result of a meeting whose participants all work on animal echolocation systems. The papers are much better focused on the subject indicated by the title than is the case with most such volumes, and the overall quality is excellent.

The book is fittingly dedicated to Donald R. Griffin, who, working with bats, pioneered echolocation studies some 45 years ago. Griffin has written the first chapter in the book. It is a revealing and amusing early history of research on an unknown frontier by two students (Griffin and Robert Galambos). Historical reviews such as this and that by Wood and Evans on echolocation in dolphins serve to remind us that good ideas, persistence, and ingenuity were at one time good substitutes for federal dollars. They also give insight into how discoveries are actually made.

Advances made since a similar group convened in 1966 are summarized, and the literature is brought up to date in a masterly fashion. The Russians are doing a great deal of work in this area, and, though the Russian researchers were unable to attend the conference, one of the major deficiencies in the United States in this field, the lack of examination of the Russian literature, is corrected.

The reports deal primarily with the airborne sonar sounds of bats and the underwater sonar sounds of toothed whales. Other animals that are known to echolocate, such as oil birds and shrews, are dealt with to the extent that they have been studied in this regard. Work on echolocation aids for blind humans is also explored.

One of the more startling chapters is that by Watkins indicating the importance of sperm whale clicks in communication, although clicks are not ruled out as echolocation devices. Recent neurophysiological studies in both bat and cetacean echolocation systems are also of considerable interest. Chapters by McCormick, Wever, Ridgway, and Palin, by Ridgway, by Norris, and by Bullock bring us up to date on auditory processing in toothed whales and indicate kinds of research needed on cetacean brains. Such studies are highly desirable for this group of animals, concerning which myth and fact have become confusingly intermixed. Similar excellent studies of echo-processing in bats are presented by Neuweiler, by Pollack, and by Suga and O'Neill. Sound production mechanisms in odontocete cetaceans have been the subject of much debate and are also handled well.

Throughout the book the reader is confronted with reminders that research on echolocation is much further along with bats than with toothed whales. This is indicative of the higher cost and difficulty of work with marine mammals. For instance, the excellent chapter on ontogeny of echolocation in bats by Brown and Grinnell would probably be impossible to duplicate today for dolphins.

We note that one of the most useful contributions in the book, a bibliography of recent papers in the field, is complicated by the inclusion of some references to work on other marine mammals in a section whose heading indicates it is restricted to odontocetes.

The book is large and heavy, and our copy was already coming apart when it arrived. In addition, though it is quite legible, its style and lack of justified margins result in less than excellent visual appeal.

But these are personal preferences, and the book is a necessity to anyone working in the field. Separate indexes by author, species, and subject add much to its usefulness. The editors have done a good job of organizing the papers and getting them into print quickly.

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Books Received

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The Aging Nervous System. Gabe J. Maletta and Francis J. Pirozzolo, Eds. Praeger, New York, 1980. vi, 338 pp. $27.95. Advances in Neurogerontology, vol. 1.

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