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Book Review

Acoustic Communication in Insects and Anurans: Common Problems and Diverse Solutions. By H. Carl Gerhard and Franz Huber. University of Chicago Press, Chicago, 2002, 531 pp. $100 hardcover, $35 paperback.

This book is ambitious. It attempts to treat all aspects of acoustic communication as it occurs in insects that use sounds to signal at long range and in anurans. These groups—namely, crickets, katydids, grasshoppers, cicadas, and frogs and toads—have features that make them unusually attractive to researchers. Hence there is a large and rapidly growing literature to be covered. Prime reasons for interest in these groups are that they are common and diverse and their principal method of forming sexual pairs is by producing advertisement calls that are easily heard and can be recorded, analyzed, reproduced, and synthesized with relative ease. These calls, produced by males, develop normally in the absence of the opportunity to learn from other members of the same species and have features that are as invariant and characteristic of the species as are the morphological features. At the same time the calls of individuals in a species population have features that vary in ways that affect the responses of rivals and potential mates. The effects of both variant and invariant features can be investigated by playbacks of natural or synthetic calls in the field and in controlled laboratory situations. This facilitates the study of the mechanisms for sound localization and recognition and the features responsible for reproductive isolation between species and sexual selection within species.

The authors start their treatise by listing common attributes that lead to common problems. For example, small size leads to the production of high-frequency signals that have a limited range and are energetically inefficient. It also results in closely spaced ears that limit the binaural cues available for sound localization. Ectothermy leads to temporal changes in signals, which may not be coupled to corresponding changes in the signal receiver. Short life cycles and brief episodes of breeding limit the opportunities

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for learning signals and for signal assessment. Acoustically orienting predators and parasites reduce the survivorship of males that call loudly and persistently, features that otherwise increase mating opportunities. Some problems are especially severe or usual in insects (e.g., those related to small size) and others in anurans (e.g., signaling in aggregations leading to masking interference and competition for resources). In keeping with these differences and with the state of knowledge, discussions on some topics must deal largely with one group to the near-exclusion of the other.

More than half of the main text is devoted to the nature and variety of acoustic signals and how these signals are produced, recognized, and localized. These six chapters include discussions of the neuromuscular mechanisms, neural processing of signals, and peripheral sound producing and receiving structures. The final four chapters are on chorusing, acoustic competition, female choice, and the evolutionary history of signal diversification and recognition mechanisms.

Despite its ambitious scope, this book is noteworthy in the effectiveness of the treatments of its topics. One reason for this is that nearly every concept is illustrated with one or more figures that are clear and concise. Few two-page spreads are devoid of figures. Numerous boxed presentations more fully explain or illustrate points mentioned in the main text. For example, an early box deals with the terminology for describing acoustic signals. In it the authors conclude, "Whatever the rationale for identifying acoustic elements, attempts to establish a universal terminology are almost certainly doomed by traditional usage and the sheer diversity of signal structures." (In keeping with this, the authors sometimes use the same term for different acoustic elements and different terms for the same elements but usually avoid creating confusion by doing so.) Three appendices are similar to the boxes in function but more lengthy. These give succinct accounts of communication theory and analysis, the analysis and description of acoustic signals, and signal attenuation and degradation.

For each topic they discuss, the authors attempt to describe and synthesize (for anurans and insects) what is known and to identify aspects that have not been studied or need to be investigated further. To further these objectives they end each chapter with a one- to two-page section entitled "Summary and Suggestions for Future Studies." I found it helpful to read these before starting a chapter as well as at the end.

As mentioned earlier, the literature on the subjects covered by this work is enormous. The Literature Cited section has more than 1300 references and accounts for about one eighth of the book. Particularly impressive is that the literature through 2000 seems to be thoroughly covered and there are a surprising number of 2001 references.

With a scope so broad and a literature so vast, phenomena that some consider significant are sure to be omitted. One that I looked for and failed to find is the occurrence, in a single species, of two advertisement calls with discrete pair-forming functions (e.g., Spooner, 1968, *Anim. Behav.* **16:** 197–212). Another is the occurrence of four-part advertisement calls (e.g., Walker and Dew, 1972, *Science* **178:** 174–176), although two-part calls are discussed.

If you are at all interested in anurans or in insects that use long-range acoustic signals, this book should be in your library. If you are interested in communication by sound or in the techniques for studying it, this book has much to recommend it. The price of the paperback version, combined with the quality of its contents, makes it a real bargain.

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