Book Reviews

Birds Living Together: Actually and in Theory

Competition and the Structure of Bird Communities. MARTIN L. CODY. Princeton University Press, Princeton, N.J., 1974. x, 318 pp., illus. Cloth, $12.50; paper, $6.95. Monographs in Population Biology, vol. 7.

"The goal of ecology is to provide explanations that account for the occurrence of natural patterns as products of natural selection." With these unequivocal words Martin Cody begins his book, a synthesis primarily of his own field studies of bird communities. The framework for the book is provided by recent developments in the theory of competition, character displacement, character divergence, and the evolution of niche breadths, together with some interesting models developed specifically by Cody for use of a two-patch environment, character convergence, and flocking as a means of assessing resource depression. The goals of the monograph are, more precisely, to "present the patterns of organization of bird communities such that the selective basis of such patterns is elaborated" (p. 48).

Most of Cody's efforts were devoted to measurement of patterns of bird community structure and the behavior of individual species in grassland and scrub habitats in North and South America, supplemented with data from Europe, island communities, and relevant studies from the literature. The patterns revealed by the field studies are then analyzed in relation to probable "coexistence mechanisms," the evolution of niche breadths and niche overlaps, situations of competitive release (especially on islands), and the evolution of ecological counterparts between taxonomically unrelated species in habitats that have similar structures and climates but are located on different continents. The final chapter of the book deals with a number of cases of apparent failure of birds to evolve the predicted ecological differences. These cases are judged to be caused by unusual abundance or scarcity of food. Cody presents capsule versions of the relevant theory, but, except for the models developed specifically for the book, the reader will have to consult the original references to understand the assumptions inherent in the theories and the necessary limitations in their applicability.

Cody concludes that competition is the most important factor molding the structure of breeding bird communities. It is important to recognize the indirect manner in which the conclusion is reached. The theory Cody uses is based on the Lotka-Volterra equations of population growth and competition. The weaknesses in these equations as descriptions of reality have been debated many times and need not be repeated here, as they are probably not the most serious source of uncertainty in Cody's analyses. The equations require an estimate of α, the competition coefficient, which is the effect of adding another individual of the competing species compared to the effect of adding another conspecific individual. Nobody has ever measured this for wild birds, and we rely instead on indirect measures. The indirect technique used by Cody is to estimate overlaps in resource usage and to use these estimates as measures of α. Overlaps are, in turn, estimated by similarities in where individuals of different species forage, how they forage, and their foraging equipment—that is, from behavioral and morphological data and not from knowledge of the food actually taken. The rationale for using these measures is discussed in some detail by Cody in what is probably the most explicit treatment available of the problems and prospects of this type of approach.

It is easy to criticize these compoundings of estimates of estimates, but anyone who has attempted to work on these matters knows how difficult it is to obtain more direct measures. Moreover, direct measures of food taken are also open to serious problems of interpretation which are especially critical in featured environments where prey microhabitat is a major determinant of which individuals will be encountered. The weaknesses in Cody's data thus represent shortcomings in the state of the art of gathering extensive data for comparative analysis.

The interpretation of these estimates of competition coefficients and niche breadths raises other problems. Any test of the significance of an observed distribution of values requires determination of some expected distribution generated by the hypothesis under investigation. The observed distributions are then compared with the expected and differences interpreted. Unfortunately, ecological theory is not sufficiently well developed to enable us to generate reliable expected distributions. For example, Cody generates theoretical distributions of competition coefficients, for the presumed assumption that the species do not mutually influence their resource utilization, by taking the sums (or products) of three numbers drawn from a table of random numbers with values ranging from 0 to 1. This is the range of competition coefficients possible with the equations on which the analysis is based. The selection of three numbers from the table, however, appears to be based on Cody's evidence that three parameters are sufficient to separate his bird species evenly. Thus the choice of the expected distribution is derived in part from the results it is being used to test. The reasons for regarding it as an expected distribution if there were no competition may be very tenuous.

In addition, it is difficult to detect and interpret differences between the expected and the real distributions. Cody claims that the observed distributions show a tendency for a secondary hump at high (0.65 to 0.8) overlap values of his "summation alpha." My eye detects possible secondary humps in only three of eight such curves shown by Cody and I don't know if they are real or meaningful. This uncertainty is not resolvable by appeal to statistical tests—and none are offered in this case—because our biological intuition is not sufficiently developed to be able to give biological, as opposed to statistical, significance to differences of 0.1

as opposed to 0.2 between α's. Not surprisingly, Cody's interpretations at this juncture become highly intuitive, reinforcing my impression that his intuition, derived from his extensive field experience, is actually much better than the theory he is able to employ. This is probably a general state of affairs in contemporary ecology. The intuition of capable field ecologists exceeds their abilities to express the often subtle notions in analytical form, and the higher-order interactions that most of us believe are central to competition among species in nature are exasperatingly difficult to treat formally and are almost universally ignored in theory. Nevertheless, the role of theory in the development of Cody's book has clearly been substantial. It was the source of most of the questions Cody asked, and it guided the selection of things to measure in the field. Without the theory many of the questions that now occupy the attention of field ecologists would not be asked, and this is probably the greatest value of contemporary theory. The proper attitude, paradoxically, is to know and to use theory whenever possible but not to take it too seriously.

Cody has amassed a large body of information on the behavior and morphology of birds living together and shows that these patterns for the most part can be explained on the basis of long-term competition for resources during the breeding season. Other interpretations are not necessarily precluded by the data, but Cody has developed a number of ingenious ideas about patterns of divergence and overlap. These patterns and the interpretations offered for them should be challenging to all ecologists, even those who dislike "natural experiments" of the kind employed by Cody. One can quibble with some analytical techniques and be frustrated by the illustrations whose captions are not complete enough or are too small to be read easily, but in general the book is free of errors (though the author has committed the unpardonable sin of misspelling the scientific name of the yellowheaded blackbird). This important book, standing as the most complete attempt to date to integrate several aspects of recent theory with field data, can be a valuable source of stimulation to ecologists of many persuasions and deserves to be widely read and digested.

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How Pictures Work

A Psychology of Picture Perception. JOHN M. KENNEDY. Jossey-Bass, San Francisco, 1974. xvi, 174 pp., illus. $10.75. Jossey-Bass Behavioral Science Series.

Whether or not one agrees with the old adage that a picture is worth a thousand words, it can hardly be disputed that pictures can provide rich and generally veridical representations of visual objects and events. Moreover, various forms of pictorial representation—from high-fidelity photographs to unembellished line drawings—are all successful in conveying information concerning actual or potential scenes and activities. In this short, provocative book Kennedy explores the fundamental issue of how it is that pictures can be so informative. He discusses pictorial representation from the point of view of a perceptual psychologist. Esthetic considerations, though acknowledged, are intentionally ignored.

Kennedy's basic thesis is that pictures are informative because they present to the viewer the same elements of optical information that are available in the ordinary visible environment. In his words, "pictures work because light is informative, [and] pictures make use of the laws of naturalistic light" (p. 159). Kennedy begins by analyzing the operation of light in the natural environment and establishes that the structure of the optic array (the pattern of illumination available at a point of observation or station point) can provide unambiguous information concerning its real-world origins. Before extending this analysis to pictorial representations, Kennedy evaluates four "theories" (the basis for the selection of which he does not make clear) of the nature of pictures, this evaluation constituting nearly one-third of the book.

The first theory Kennedy discusses, which views pictorial representations as successful communication devices because they somehow "resemble" the scenes they depict, is swiftly and rightly rejected as being circular and, at best, vague. A second definition of depiction, according to which pictures are artificially treated surfaces providing light to a particular station point which is isomorphic to light provided by the appropriate real-world scene, is found incapable of explaining such representations as line drawings and caricatures. The third position views pictures as arbitrary learned symbols, much like words, which bear no significant structural relation to the objects and scenes they represent. By this "arbitrary convention" account, picture perception should depend strongly upon developmental and cultural factors, and Kennedy marshals considerable experimental evidence against this claim. By reinterpreting cross-cultural, developmental, and infrahuman perceptual research, he successfully argues that the ability to perceive pictorial representations is present at a very early age, is common to Western and non-Western culture, and is evident in a variety of nonhuman organisms, from chimps to pigeons.

The position Kennedy finally adopts holds that pictures provide the same basic features of optic structure as the aspects of the visible environment they represent. (This is to be distinguished from the view that pictures yield the same point-by-point elements of light as the objects and scenes they depict.) The remainder of the book is devoted to gathering support for this position. The role of figure and ground in picture perception is examined, some basic elements of optic information that must be provided by pictures are enumerated, and an argument that these fundamental features of optic structure are available in relatively impoverished line drawings is advanced. Unfortunately, Kennedy's own experimental work provides only weak support for his major conclusions.

Throughout, Kennedy's analysis of picture perception is limited by his adherence to a particular theory of ordinary visual perception, the "passive registration" theory. Stated simply, this position views perception of the visible environment as direct and unmediated. In the opening chapter, Kennedy contrasts the "registration" theory of perception, an approach originally advanced by James Gibson, with the "constructive" theory of perception, a position often identified with information-processing approaches and modern cognitive psychology. His presentation of the constructive theory and his arguments against this position are surprisingly naive. To Kennedy, the constructive theory holds that information impinging on the sensory receptors is generally incomplete and ambiguous and that, therefore, "the observer is forced, willy-nilly, to guess and deduce" (p. 8). His dissatisfaction with this position is twofold. (i) Our everyday perceptual experience of the world seems effortless and direct. Rarely, if ever, do we need to guess or deduce. (It is strange that such an objection should be made,