Book Reviews

Mathematics of Social Dynamics

Casual Groups of Monkeys and Men. Stochastic Models of Elemental Social Systems. JOEL E. COHEN. Harvard University Press, Cambridge, Mass., 1971. xiv, 176 pp., illus. $8.

Ethological approaches to the understanding of animal and human behavior characteristically adopt a broad perspective, in which phenomena are considered in relation to their full ecological and sociodynamic contexts. Implicitly or explicitly, current ethological thinking adopts a systems viewpoint and aspires to complex analyses of a multivariate type in which data of very varied kinds can be utilized. As yet the socioecological ethologist is hampered by the paucity of quantitative models for particular processes within the behavioral system he may be investigating, and of analytic tools with which to evaluate or relate these. Few ethologists possess the mathematical expertise to develop the tools and models themselves, so it is reassuring to find mathematicians like Joel Cohen willing to apply their special skills to this end.

Cohen's monograph focuses on only one basic aspect of social grouping, albeit one with many important ramifications—the determination of the sizes of freely forming primate groups and their fluctuations through time. He sets out to evaluate several mathematical models which might describe typical observed distributions of sizes of groups forming within open or closed populations. Comparison of models and distributions in turn suggests possible means of quantitatively assessing actual determinants of social grouping. While the scope of this book is thus more restricted than its title might suggest, it is clear that applying such analyses to a sufficient variety of behavioral phenomena will contribute greatly to the future power of systematic ethology; so in its way it represents a minor milestone.

Previous observations of grouping patterns adopted by adult humans have been analyzed by several authors, and have been found in most cases to be consistent with models predicting that the frequency distribution of group size can, if a system of groups is in equilibrium, be represented by some Poisson function truncated below unity. Cohen has investigated the utility of these models in accounting for data collected by Thomas Struhsaker on the nightly subdivision of a troop of wild vervet monkeys into sleeping groups. He finds that whereas the best fit to a Poisson function is poor in this case, a similarly truncated negative binomial describes the data well. However, an evaluation of several models in which this binomial can be derived from assuming the operation of compound Poisson processes indicates that group size cannot be accounted for by the attraction of individuals to either dominant animals or young infants, nor by the operation of time-dependent joining or leaving processes. Combinatorial models assuming the equiprobable distribution of indistinguishable individuals into either distinguishable or indistinguishable groups also fail.

Cohen proposes a family of four-parameter linear one-step transition (LOST) models to describe the equilibrial frequency distribution of alternative group sizes in a closed system. The basic postulate of LOST models is that the number of individuals leaving or joining groups of a given size in a given short time interval is a linear function of the size times its frequency at the start of the interval. With appropriate parameter values LOST models can yield either truncated Poisson or truncated negative binomial functions. If individuals are assumed to enter or leave the system as a whole on the same basis on which they join or leave a group, the LOST models can also apply to open systems. Furthermore, by computer simulation Cohen has been able to show that systems can reach equilibrium conditions rapidly if the intervals between successive samplings correspond well to the parameter values.

Applying the LOST models to new grouping data on an open system of children in a nursery school playroom reveals that derived Poisson or binomial functions fit well for five out of six sets of observations for which their assumptions seem plausible. With this and other sets of grouping data Cohen shows further that where assumptions are obviously violated the LOST models do not predict well. As he points out, these failures actually strengthen the likelihood that the models' parameters can be empirically interpreted—thus rebutting the possible charge that he is engaged in mere curve fitting. Cohen in fact readily admits the present limitations of the LOST models—they are based on assumptions which are not all easily evaluated in practice, and comparison of them with alternative models has depended as yet on a small quantity of data and somewhat problematic statistical procedures. Furthermore, it is not even possible at present to predict whether the size frequency distribution in a given case will be Poisson or binomial, although Cohen does suggest that prior acquaintance or attraction between individuals could be investigated here.

What LOST models do not do is permit identification of the finer structure of social dynamics which would underlie grouping processes which the models should in principle be able to specify. Different models would be required for this finer level, and as an example Cohen suggests an ecological model to account for the finding of a maximum group size of six persons in data collected by John James on outdoor conversational groups. He shows that attenuation of speech intelligibility by background noise as distance from a speaker increases, together with a reluctance to come closer to another person than about 1.5 or 2 feet, predicts the limit well for casual groupings. Although this model has not been tested independently, it shows quite convincingly how one probable influencing factor underlying such distributions may operate. Cohen goes still further in suggesting the utility of LOST models in cross-species comparisons which might indicate evolutionary as well as ecological advantages of particular grouping processes.

For what it sets out to do and partially achieves, this monograph should prove attractive to those concerned with the analysis of social systems and processes, but one note of regret needs to be sounded. Unfortunately the many pages of formulas and statistical analysis will prove daunting to many who, like this reviewer, lack the mathemati-

cal facility to follow the detail of Cohen's specialist treatment. Despite his extensive use of appendices one has to search hard to find the not always quite explicit discussions of what the mathematics is actually addressed to. Since procedures are not in any case presented in all the step-by-step detail necessary for the relatively innumerate majority to apply them to data of their own, the influence of the book would surely be greater if Cohen had presented his models and their evaluation in a more intuitively comprehensible fashion and left almost all the quantitative treatment for appendices. At the very least a glossary of the terms and symbols used should have been provided, especially as their definitions are not always apparent in the text.

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A Coastal Tour

Our Changing Coastlines. FRANCIS P. SHEPARD and HAROLD R. WANLESS. McGraw-Hill, New York, 1971. x, 580 pp., illus. $39.50.

Interest in coastlines is at an all-time high, and awareness of the importance of the coastal zone in the overall environment is definitely on the increase. Significant legislation has been introduced in Congress for the management of the coastal zone, and many states have adopted their own plans for the development of this important piece of real estate. The coastline, a significant part of the coastal zone, has received considerable detailed attention in the U.S. Army Corps of Engineers' recently released *National Shoreline Study*. The Corps's study provides a complement to Shepard and Wanless's *Our Changing Coastlines*.

Shepard and Wanless have attempted a comprehensive survey, suitable for the general reader, of the shoreline of the United States, including Alaska and Hawaii, and have documented coastal changes that have occurred during historical times. Information on the shoreline is coordinated so that some general conclusions may be reached about both the natural fate of the coast and its potential use.

As might be expected by students of coastal geomorphology, the authors have followed Shepard's classification according to which shorelines are regarded as

either primary or secondary. Primary shorelines are margins of the land that have scarcely been affected by marine processes; they are essentially in the same condition they were in when the sea came to rest against them. Secondary shorelines are those that have been modified by the action of waves and currents. This classification is based on an interpretation of the dominant process by which the coast has been shaped. Primary coasts include drowned river valleys, coastal areas dominated by glacial erosion and deposition, coasts formed by river deposition such as deltas, volcanic coasts, fault coasts, and drowned karst topography. Secondary coasts include coasts straightened by erosion, coastlines of marine deposition such as barrier islands, and coasts built up by animals and plants (coral reefs, mangrove swamps, and so on).

The authors describe the coast of the United States starting in New England and proceeding clockwise to Washington, Alaska, and finally Hawaii. The division into chapters is based on morphology—for example, "Glaciated coasts: New England and Long Island" and "Deltaic coasts: Louisiana." The discussion is primarily geographic. A great many illustrations, among them pairs showing sections of coast before and after such events as storms and earthslides, give graphic evidence of changes that have occurred; the book is profusely illustrated with vertical aerial photographs, charts, and oblique photographs. The style is informal; anecdotes and miscellaneous items of interest are scattered through the text. These serve to dramatize coastal events or to bring the human factor into coastal studies.

Because it has been impossible for Shepard and Wanless to visit every segment of the coast, they have based some tentative conclusions on aerial photographs and literature. This has resulted in some errors concerning particular sections. The authors readily admit such errors are possible. Each reader will undoubtedly find that his particular segment of the coast is not treated as fully as he would like. Completeness, of course, is impossible in a study of 84,000 miles of coastline in a single volume. The serious student of coastal geomorphology will wish that more geology were included and that literature citations were more numerous. The random, friendly style of writing may bother those who are used to reading of coastlines from more conven-

tional texts; to others it will be refreshing.

The price may keep a great many people who should have the book from buying it. The book will certainly make it to most libraries and to the shelves of those specializing in coastal processes and coastal geomorphology. Because of the beauty of production, it may find its way to the gift tables of bookstores. In one sense the book is a bargain; it presents more than 2000 miles of coastline for each dollar invested.

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Research on the Maya

Monographs and Papers in Maya Archaeology. WILLIAM R. BULLARD, JR., Ed. Peabody Museum of Archaeology and Ethnology, Cambridge, Mass., 1970. x, 502 pp., illus. $13.50. Papers of the Peabody Museum, vol. 61.

Archeologists trace the evolution of cultural systems by analysis of stratified deposits. The volume under review can be viewed as a stratigraphic record of changes in research objectives and associated methods in Maya archeology over three generations. These changes reflect the increasing scope of fieldwork in the Maya area, as well as the correlated shifts in its theoretical and methodological underpinnings. It is impossible to summarize adequately the descriptive richness of this volume spanning over 30 years of survey and excavation by some of the most noted Maya archeologists. Yet one perceives differing ways of collecting, analyzing, and presenting data in the four parts devoted to major archeological programs.

The report of H. E. D. Pollock on a 1936 survey of the Chenes region of Yucatan represents the initial stages of systematic archeological research in a poorly known area. Pollock wishes to determine whether the region contains a distinctive cultural tradition. Is there such a thing as Chenes culture? If so, what is its chronological placement? Its geographical distribution? Its cultural affiliations? Since architectural styles are often used as diagnostic markers in defining regional cultural traditions, Pollock systematically describes attributes of Chenes style architecture from a large number of sites. Yet he reaches no definite conclusions