ECOSCIENCE 7 (4) : 516-522 (2000)

Revue des livres

Book Review

SCHMID-HEMPEL, Paul, 1998. Parasites in Social Insects, Princeton University Press, Princeton, New Jersey, *xi* + 410 p. 16 × 24 cm., soft cover, US$35.00, ISBN 0-691-05923-3.

There are approximately 20,000 species of social insects, most of which are in the orders Hymenoptera (ants, bees, and wasps) and Isoptera (termites). Much of the research on social insects has been focussed on the evolution of social behaviour, with far less attention being directed at their population ecologies and determing how and why the numbers of colonies making up populations vary. This contrasts to the situation for nonsocial insects for which the impacts of parasites on population dynamics have been well studied. The evolution and dynamics of parasites and social insects sitoids, but also increases the opportunity for horizontal transmission of parasites and diseases. In addition, the breeding structure of colonies of many social species with one reproductive queen and many closely related workers, will influence the evolution of these hosts to their parasites. Therefore, social species provide new opportunities for looking at parasite-host interactions. In *Parasites in Social Insects*, Schmid-Hempel summarizes and synthesizes information from a vast and diffuse literature, and describes and applies the theory of host-parasite interactions to social insects. This book is more than about social insects and is an excellent overview of interactions between hosts and their parasites and diseases. Following a short chapter introducing social insects, Schmid-Hempel describes the biologies of the many types of parasites which attack insects. This chapter is useful for all readers interested in insect parasites and covers disease causing microorganisms, viruses, bacteria, fungi, and protozoans; parasites such as nematodes, helminths and mites; and parasitic insects, primarily flies and wasps. Parasites of social insects are faced with a formidable barrier in gaining access to a colony, but once inside the opportunities for transmission abound. Brood, larvae and pupae, are prime hosts for parasites, while those of sexuals are less common. Social insects also have social parasites, species which share their nest or resources. The organization of colonies will influence the interactions between social insect hosts and their parasites and the pathways of parasite transmission depend on the caste structure and how work is organized within the colony. Schmid-Hempel develops a basic model of host-parasite dynamics within a social insect colony and uses this to predict how weak or strong division of labour in the colony might influence parasite transmission. There is a need for more empirical studies to determine how the rate of nest movement, food transfer, nest construction and spatial distribution of colony members influence parasitism. The breeding systems of social insects also differ from those of nonsocial insects and this potentially influences the levels of genetic variation within and between colonies, and therefore the potential for selection for resistance to parasites. The causes of observed relationships between colony size, genetic variability and levels of parasitism require clarification by future studies. While the theory of host-parasite dynamics has received much attention for nonsocial insects, little work has considered disease epidemiology of social species. Basic epidemiological models, age-structured models, and models with discrete generations and seasonal dynamics are reviewed. As with nonsocial insects, host-disease dynamics are strongly influenced by transmission rates, a parameter which is difficult to quantify in the field. Some of the outcomes of theoretical analyses are that long-term oscillations, spontaneous and local outbreaks of diseases, and persistent infection in growing populations are all possible with social insects. How virulent should a disease be? How rapidly should hosts evolve resistance? These questions of coevolution have received more speculation than investigation. Theories suggest that parasite virulence should be affected by rates of horizontal and vertical transmission, by population structure, and by the presence of multiple infections. Predictions for social insects are that virulence should be low in hosts with large colonies and common horizontal transmission, and virulence should be high where multiple infections are common. A survey of what is known for social insects in some cases confirms these predictions, but many exceptions also occur. Again more empirical data and experimental manipulations are required. Schmid-Hempel has done a brilliant job of bringing together a diverse literature on the parasites of social insects and of outlining or developing models that are relevant to exploring the dynamics of host-parasite interactions. He is broad in his approach and in some cases compares social insects to other groups of social organisms such as birds and mammals. Considerable information is summarized in tables and an appendix which lists reported associations between social insects and parasites. There are enough questions identified in the chapters of this book to provide ideas for theses and research proposals for generations to come. On the other hand one gets the feeling that general patterns may be difficult to detect because the details of the lives of social insects are very diverse. I found this a very valuable overview and think it will stimulate future research in the much needed area of the impacts of parasites on the population dynamics of social insects. It is excellent value for money.

Judith H. Myers
Department of Zoology and Faculty of Agricultural Sciences
University of British Columbia
6270 University Blvd.
Vancouver, B.C. V6T 1Z4
myers@zoology.ubc.ca

ISENBERG, Andrew C., 2000. The Destruction of the Bison, Cambridge University Press, *xii* + 206 p., 15.5 × 23 cm, soft cover, US$24.95, ISBN 0-521-77172-2.

Personal insights into history, if my experience is any indication, are uncommon. One small revelation came to a fellow graduate student and me, several years ago, while preparing for fieldwork in the arctic community of Cambridge Bay: beneath our feet was, until very recently, wild muskox range. Curiously, we had scarcely considered that our campus at the University of Saskatchewan had been, just as assuredly, wild bison range, even though that monumental upheaval took place in the time of our great-grandfathers. As anthropologist Wade Davis has remarked (*Saturday Night*, Dec 1999/Jan 2000), for most of the current inhabitants of the North American plains, "the time of the buffalo is as distant from their lives as the fall of Rome." Understanding past extinctions may be key to stemming the rate of current and future extinctions. Hence, as Davis observed, "this capacity to forget is a frightening trait."

In *Destruction of the Bison*, Isenberg offers an antidote to the impermanence of the human memory. At its core, the book is a chronology of the consequences and causes of the collapse and recovery of bison on the North American plains. The story centres on the Euroamerican invasion, a "maelstrom of cultural, ecological, and economic change", which precipitated the transformation of sedentary aboriginal societies into nomadic equestrian hunters in the 18th century, shattered their communities and the bison in the 19th century, and served as precursor to the preservationist movement of the 20th century. The author does more than chronicle these changes. He

assembles an impressive set of observations to postulate that both ecological and economic changes were intimately interwined in the collapse of the bison.

In stressing interconnectedness, the author occasionally becomes mired in the ecological truth that everything-is-connected-to-everything-else. Discerning the contribution of population limiting factors is difficult in living systems, so it is not surprising that while identifying putative agents of demise, drought, exotic bovine diseases, wolf predation, competition with livestock, and hunting, their relative contributions are not as clearly identified. Nevertheless, the author notes that the basis of the failure to restrict commercial bison hunting in the 19th century was the " belief in economic competition. Everyone... was engaged in a race to exploit resources for individual gain." To apply this comment to circumstances in the early 21st century is easily (unfortunately, too easily) done.

Much of the intrigue of the book stems from its rich detail of the complex interplay between human societies and environment. En route, the author manages to challenge the western tradition of the dualism between humanity and nature, to stress that history is embedded in ecology, and to proffer common human traits: wastefulness, the conflict between individual and common good, and destruction of biological resources as our "ecological Achilles' heel." Of course, some of our fascination with the story of the bison stems from its scale and rapidity. Isenberg provides, but doesn't dwell on, the details. The collapse transformed a landscape dominated by perhaps 30 million beasts in the mid-18th century to a few hundred by the early twentieth century, a brush with extinction largely effected in only 1 decades. The author quotes a rancher who, in the 1880s, was "never out of sight of a dead buffalo and never in sight of a live one".

The author demonstrates clearly that the near-extermination of the species was not unforeseen; indeed it was predicted and largely welcomed by non-native Americans. Bison, and the Natives who relied on them, were viewed as impediments to western Euroamerican expansion. Destruction was policy of the government of the United States, who, as the author notes, commended but did not command the commercial hide hunters. A weakness of the book is its strict geographic focus, largely south of the 49th parallel. While the Canadian government did not openly wage war on the bison, the policy of aboriginal assimilation was similar, and the collapse of the bison was similarly effective. The decimation of bison in Canada may have been more economic than political (Valerius Geist, *Buffalo Nation*, 1996).

In *Destruction of the Bison*, we find that the history of recent extinctions, like its geography (R. Channell & M. V. Lomolino, 2000, *Nature* 403:84), parallels the history of humanity. The book is a memorable and provocative read.

Reference

Channell, R., & M. V. Lomolino. 2000. Dynamic biogeography and conservation of endangered species. Nature, 403:84-86.

James A. Schaefer
BIOLOGY DEPARTMENT
TRENT UNIVERSITY
1600 WEST BANK DRIVE
PETERBOROUGH, ONTARIO
K9J 7B8 CANADA
E-MAIL JSCHAEFER@TRENTU.CA

LARSON, Douglas W., Uta MATTHES & Peter E. KELLY, 2000. Cliff Ecology: Patterns and Process in Cliff Ecosystems. Cambridge Studies in Ecology. Cambridge University Press, Cambridge, *xviii* + 340 p., 16 × 23.5 cm, hard cover, US$69.95, ISBN 0-521-55489-6.

The main objective of this book is to present cliffs as peculiar ecosystems, comprising some of the less disturbed habitats on earth and presenting great values in terms of biodiversity. To do so, the authors present the first summary and review of the available information on cliff ecology. A significant part of the work surveyed comes from the authors' own research, at the Cliff Ecology Research Group of the University of Guelph, during the last fifteen years at the Niagara Escarpment. The authors had to cope with the paradox that "cliffs are places that are of interest to everyone and no-one at the same time". That is, cliffs have attracted people attention for a long time for religious, cultural or aesthetic values, but due to the methodological difficulties imposed by gravity, they have encouraged little scrutiny from scientists compared to other, even adjacent, ecosystems. Moreover, previous cliff research almost always focussed on specific organisms or aspects of the ecosystem, without considering cliffs in the same way as, for example, a lake is considered by limnologists. Despite these constraints, the authors are not discouraged to look for general patterns and controlling processes, in order to interpret cliffs from a somehow holistic viewpoint.

This is a well written and richly illustrated book. Its purpose is adequately explained and it is oriented to a wide public, from researchers and educators to students and professional land managers. The book is organized in a very logical structure, permitting the reader to arrive to ecological patterns and processes having in mind clear descriptions of the physical environment and the cliff biota.

The Introduction offers a clear definition of what is a cliff, mostly based on physical characteristics, but strongly influenced by human perception. The different parts of a cliff, and a classification of inland, maritime and man-made cliffs are also presented. In addition, taking the Niagara Escarpment as an example, the authors emphasize the utility of "the ecology of place", an approach which aims to study all taxa and processes in a small ecological context to produce a picture as complete as possible of the structure and function of a relatively discrete ecosystem.

The authors start the book with a description of the geology and geomorphology of cliffs (Chapter 2), very useful to evidence the persistence of the contact between the biota and the rocks on cliffs. Different aspects of bedrock composition, mechanical heterogeneities, weathering processes, erosion and bedrock hydrology are discussed with an array of helpful figures. These explanations are also important to understand the role of the physical factors influencing the distribution and abundance of the organisms on the different parts of the cliff. In Chapter 3, the components of the physical environment that are affected by the vertical orientation of the substrate and their complex interactions are presented. This is followed by comprehensive descriptions of incident radiation, moisture, wind, temperature and topographic heterogeneity. The figures accompanying the text are adequately chosen and make it easier to understand the conditions resulting from complex interactions among the factors (for example, the interaction among sun position, aspect and slope of the surface determining the angle of incidence of light on cliff surface, Figures 3.2 to 3.4). Many important patterns (radiation penetration for endolitic communities, water storage on the rock, temperature regimes) and concepts (open-shade, matric potential) make this chapter one of the most interesting.

Chapters 4 and 5 are reviews of the literature studying flora and fauna inhabiting cliffs. Nowhere more than here is it evident that most of studies on cliffs have been lacking an ecological perspective relating the organisms to their habitat. Because of that, at times, the reader might feel saturated with a vast list of specific examples from which it is difficult to generalize patterns. Flora description is organized by cliff types (inland, marine and man-made) and, for inland cliffs, geographical regions (tropical and subtropical, and temperate and subartic locations) are distinguished. The available information is, however, strongly biassed towards inland temperate cliffs. Despite these limitations, the authors provide evidence for interesting

results such as the similarity between cliffs of different types and locations in the structure of life-forms and the characteristics of the plant species. Also remarkable, they give numerous examples and explain the causes of cliff richness in rare, endemic and relict plant species as well as in old-growth communities all over the world. The chapter on cliff animals follows a taxonomic structure. Then, different subsections are devoted to birds (raptors and seabirds are the center of interest in the literature), mammals (differenciating small and large mammals, with a small subsection on past use of cliffs by mammals), amphibians and reptiles, and invertebrates. The attractive, but controversial, "urban-cliff" hypothesis is also here introduced to explain the origin of many species, currently commensal with humans (*i.e.*, inhabiting artificial cliffs of human buildings) which would have originated from taxa once endemic to natural cliffs.

Once the abiotic and biological patterns of cliffs have been described, ecological processes are discussed in Chapter 6. The authors first try to answer how physical factors influence the cliff biota, with specific sections on the effect of bedrock composition, heterogeneities, erosion, the interaction of light-temperature-water, wind, nutrient availability and food supply, aspect, gravity, fire and sea influence on maritime cliffs. Some findings are specially outstanding as, for example, the interaction between heterogeneity and nutrient-microsite availability; and the effect of gravity and rock fall on plant architecture. A second part of the chapter deals with the effect of interactions between organisms on community structure, developing subsections on biotic interactions *sensu stricto* (competition, predation and mutualism), community biological origins, biogeography of cliffs, and succession. Interesting examples on habitat segregation for trees (seedling establishment) and sea birds (nesting sites) are here presented. The concept of cliffs as "evolutionary traps" for non-aggressive, low competitive species is also well developed. This chapter finishes by presenting eleven predictable assembly rules as restrictions which woul apply to the cliff biota as a whole and which are different to other types of communities.

Chapter 7 centers on the important topic of the perception and use of cliffs by humans. After some anthropological questions, where the "urban-cliff" hypothesis is discussed again, a section of current use and exploitation is developed. Here, although some figures (Figure 7.7) might be difficult to interpret even with the text, the reader will find good examples of the often detrimental effect of hiking, climbing, bonsai collecting, poaching and hunting, and quarries on cliff communities. After that, conservation examples and management guidelines for the high-diversity, old-growth cliff communities are discussed. A final section emphasizes the high value of cliffs as tools for education, as they are landscape units integrating anthropological, aesthetic and biological richness. The book ends with a summary chapter which definitively offsets any misconception we all may have had about cliffs before reading this book. The five most significant findings are presented here, properly synthesizing information exposed throughout the text. In addition, a section on areas of deficiency and uncertainty is pinpointing the wide research opportunities to be examined in the future.

Overall, this book should prove to be a useful reference tool for a wide range of people interested in cliffs or somehow comparable environments (rock outcrops, urban environments) for research, management or education. Perhaps it does not represent a keystone text on ecological studies, but it provides an excellent example of how to manage with scarce and heterogeneous information to properly highlight findings and uncertainities about peculiar, relatively discrete, ecosystems.

Daniel García
DÉPARTEMENT DE BIOLOGIE
UNIVERSITÉ LAVAL
SAINTE-FOY, QUÉBEC G1K 7P4, CANADA
E-MAIL: DANIEL.GARCIA@BIO.ULAVAL.CA

STRANGEWAYS, Ian, 2000. Measuring the Natural Environment. Cambridge University Press, *viii* + 365 p., 17.5 × 25 cm, hardcover, US$74.95, ISBN 0-521-57310 6.

From microbes and phytoplankton to whales and redwoods, all organisms "measure" and use information about the condition of their environments. Phytoplankton move vertically on diurnal cycles in response to light cycles and predation pressure. Vascular plants orient their leaves, and Neotropical stilt palms creep across the forest floor, to reach the best light. Many plants alter their secondary chemistry in response to herbivores consuming, for example, their leaves. Animals move toward or away from diverse physical, chemical, and biological components of environment. Any organism that does not sense the environment around it likely has but a limited future. Humans also search for information with their eyes, ears, noses, and skin sensors. But since the seventeenth century, when the earliest instruments to measure temperature and barometric pressure were developed, humans have taken environmental measurement to new levels.

Measuring the Natural Environment describes "the methods used to measure all the variables of the natural world" (page i). Strangeways traces the history of measurement of the physical and chemical worlds and reviews instruments used to measure solar radiation, temperature, moisture, and their interactions (*e.g.*, evaporation). But he omits what is certainly a critical and arguably the most important component of the "natural environment", its living systems. *Measuring* claims to be "the first book to make a thorough enquiry into the origins of environmental data, upon which our scientific understanding and economic planning of the environment directly hang" (page i). It baffles me how anyone can claim, let alone believe, that scientific understanding important for economic planning can come in the absence of measurement of the biological components of the natural environment. In many respects, the environmental challenges faced by modern society are a direct result of a long history of ignoring trends in living systems. Because this volume ignores the biological component of environment, it is more likely to continue than to reverse those trends.

Although *Measuring* does not deal with living systems as part of environment, it does provide a rigorous and broad overview of monitoring of the physical environment. A brief introductory chapter documents the need for measurement, the origins of data, and general points concerning all instruments. Use of the first manual and mechanical instruments was limited to inhabited regions of the Earth, for example, because they required operators. Newer recording instruments open many new measurement doors, in part because they do not need to be tended daily by human operators. New generation instruments with remote-sensing capabilities provide massive amounts of data. The entire process (measurement, transmission, reception, processing, and storage) is fully automatic with remote telemetry and solid state memory. The amount of data collected today challenges our ability to store, let alone interpret, it.

In 9 chapters, Strangeways outlines techniques, including pitfalls, in the measurement of radiation, temperature, humidity, wind, evaporation, barometric pressure, precipitation, soil moisture and groundwater, and water. Each chapter first describes variables commonly measured then presents the units and terminology associated with those measurements. Each reviews the history of measurement for the relevant physical variables before discussing state-of-the-art instruments and their use. All chapters are liberally sprinkled with figures and tables illustrating the variables measured and their interactions as well as useful photos of instruments.

Current trends in environmental measurement are covered in chapters on data logging, telemetry, and remote sensing; one chapter explores the problems of measurement in oceans and polar regions (*e.g.*, ships and buoys as measurement platforms, de-icing systems). A final chapter ("Forward Look") notes the growing scientific and political interest in measurement tied to the need to have better environmental data sets to, for example, track climate change.

There is much to learn in this volume about the measurement of Earth's physical environment and Strangeways notes how much more we could learn if more time, energy and money were dedicated to more comprehensive measurement of the features that he discusses. As a biologist, I can only wish that as much historical data existed on the biological parts and