

ENVIRONMENT

Cliff Ecology: Pattern and Process in Cliff Ecosystems

By Doug Larson, Uta Matthes, and Peter Kelly. Cambridge University Press, Cambridge, UK. 340 pages. \$105.

Larson, Matthes and Kelly set themselves a formidable task in writing *Cliff Ecology*. Most similar books focusing on other habitats draw on an extensive literature, which is shaped by the authors' experience into a (hopefully) unified and illuminating whole. However, as Larson et al. are quick to point out, cliffs are one of our most ubiquitous and least studied landscape features. Compared to habitats on level ground, cliffs have received almost no scientific attention. In reviewing this almost non-existent literature, the authors have shown that while we do not know much about cliffs, what little we do know is so intriguing that we ought to be paying a lot more attention to these places.

The study of cliffs is limited as much by the preconceptions of the scientists involved as by the inherent difficulties in sampling this environment. Larson et al. cite cases where researchers concluded that cliffs do not represent biological communities, despite having documented the unique biota of the cliffs in question. Similarly, the authors identify problems in studies linking plant distribution to substrate chemistry. In these cases the investigators' expectations lead them to misinterpret their own empirical data. Larson et al. argue persuasively that we know so little about cliffs in large part because of how much we thought we knew – an important reminder to scientists in any discipline.

In the face of our self-inflicted ignorance or "cliff-blindness", *Cliff Ecology* presents a very thorough refutation of the most egregious misconceptions. These aren't extreme, inhospitable places – chapters on geology and the physical environment show how the structure of cliffs moderates moisture, temperature and sunlight. Cliffs aren't lifeless – nearly 100 pages are devoted to reviewing the flora and fauna documented on cliffs around the world. They provide refuge for species otherwise extirpated from a region by competition, predation, human development or changing climate. Cliffs are not homogenous – from microscopic communities growing in the matrix of the rock itself to old growth forests rooting in cracks and fis-

tures along the face, cliffs provide a surprising variety of habitats.

The authors have not limited themselves to the pure ecology of cliffs. They also venture into anthropological and sociological territory. They present a survey of the appearance of cliffs in magazine advertisements over a two year period as evidence of the cultural importance of cliffs as icons. I'm not entirely convinced by these data, but they do establish cliffs as a full-time passion for the authors themselves! More compelling arguments are presented in the chapter devoted to the relationship between humans and cliffs, with discussion that ranges from prehistoric cave paintings, bonsai collecting, and seabird harvesting, to rock climbing, real-estate development and quarrying. Underlying this discussion is the authors' "urban cliff hypothesis", in which they propose that early human cultures developed in caves along cliff faces, and that modern cities and agricultural systems are the result of our exporting the biota and physical characteristics of cliffs to the broader landscape. It's an intriguing idea that will be further explored in an upcoming book from the same authors.

This is not intended to be the definitive work on cliffs. Rather, Larson et al. have prepared a strong case encouraging more concerted work examining cliffs as biologically meaningful places. That the treatment is uneven in places reflects real gaps in knowledge more than any deficiency on the part of the authors – many of the sources, particularly relating to flora and fauna, are not studies of cliffs *per se*, but are gleaned from more general work that included cliffs only incidentally. I expect the book as a whole will provide a major point of departure for future research on cliffs. Far more detail is presented than will be of interest to general audiences, but there are more than enough revelations about the nature of cliffs to reward the interested reader.

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Lessons from Amazonia: The Ecology and Conservation of a Fragmented Forest

Edited by Richard O. Bierregaard, Jr, Claude Gascon, Thomas E. Lovejoy, and Rita Mesquita. 2001. Yale University Press, New Haven, Connecticut. 478 pages. U.S. \$65.

Beginning as a seemingly basic and simple study on the minimum size of a viable rainforest ecosystem, this over-20-years-and-counting project is the largest and most ambitious investigation into the effects and consequences of habitat fragmentation in the tropics. The key visionaries present an edited volume with some technical contributions by researchers actively building

upon our knowledge of the Amazon but also with a primary intent on getting the broader message of management and conservation of a very complex environment to a wider audience including wildlife managers and government policy makers. After two decades of research, some by trial and error as the practical concept changed from the smallest area to differing fragment sizes, this is a timely summary of progress and conclusions that can now hopefully be translated into effective application throughout the world.

The book is divided into five sections covering an overview of the project and underlying philosophy, general forest ecology of Amazonia, effects of fragmentation on different organisms, guidelines and issues for management, and ending with a synthesis aimed at conservation in Brazil. Part 1 has four chapters starting with an historical perspective on the genesis of what is now known as the Biological Dynamics of Forest Fragments Project. The theoretical underpinnings are based largely on the influential island biogeography developed by MacArthur and Wilson but fragmented habitats require a reinterpretation of ecological processes to account for observed species richness. The book is definitely aimed at the unnatural phenomenon of human induced deforestation and understanding the unique effects produced by forest edge and surrounding modified habitat. The first part finishes with a description of the study site 80 km north of Manaus, methodology of isolating the experimental forest fragments, and brief overview of data accumulated to date.

Part II looks at the ecology of the Amazonian forest concentrating primarily on the tree community. An in-depth study was conducted on the Brazil nut tree family (Lecythidaceae) in a 1000 hectare control site within continuous forest and will serve as baseline data for comparative purposes with fragmented habitats. Carbon dating was done for aging trees because in the tropics annual growth rings are not reliable. This facilitated extrapolation to areas of population dynamics, genetic diversity, and carbon cycling. The last chapter in the section investigates the significance of rarity in trees, their genetic basis, and the ecological and evolutionary implications for tropical forests.

The bulk of the book deals with the effects of fragmentation on plant and animal communities. Some of the studies on plants include the edge effect on population structure and dynamics as related to tree mortality and recruitment; case study using palms to investigate demography and community composition; seedling ecology and forest regeneration; and habitat change on the pollination of the large timber tree *Dinizia excelsa* by bees. There are invertebrate studies of fragmentation effects on fruit flies and changes in their guild structure; metapopulation dynamics of the social spider *Anelosimus eximius*; response of ants in the modified matrix habitat surrounding the forest frag-

ments; species composition of stingless and orchid bees with comparisons to other neotropical localities; and the effects on vertebrate predators of changes in leaf-litter invertebrates. The impacts of forest fragmentation on vertebrate communities are investigated by studies on frog community structure and breeding success; diversity and abundance of understory birds in modified matrix habitat; summary of primate projects conducted in the study area; and a detailed look at home range and diet of the brown capuchin monkey (*Cebus apella*).

The fourth section deals with management related issues pertaining to the Amazon. The first chapter takes a close look at soil quality in the research site and the general inappropriateness of Amazonia for large-scale agricultural or ranching purposes. Pastures are, however, shown to be restorable to regrowth vegetation with potential for reforestation. The role of fire is also explored in the regeneration of rainforest. Selective logging is seen as economically viable if treated as a primary industry as opposed to a by-product of clear cutting for ranching or farming. Different edge effect models were used to test their application across a variety of landscapes for comparative purposes throughout the tropics. Remote sensing facilitates landscape perspectives of fragmented patches, surrounding matrix habitat and continuous forest, and interpretation of change by spatial analysis to characterize and monitor the observed patterns.

The last part and chapter is a synthesis of 20 years of study in a fragmented forest research area and the lessons learnt in the form of principles that can be applied to wisely balance the needs of conservation and sustainable development in the Amazon and beyond. Whether these principles will be adopted and implemented over the long term depends on the will of the government of the day but this book and the research contained within each chapter has laid the groundwork for sound policy decisions. *Lessons from Amazonia* is a must read for tropical biologists, environmental managers, and government policy makers. I hope to see another volume in two-decades time giving an update on the future progress.

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