

## A Compendium of Corals

**World Atlas of Coral Reefs.** Spalding, M. D., C. Ravilious, and E. P. Green. 2001. The University of California Press, Berkeley, California. 424 pp. \$45.00. ISBN 0-520-23255-0.

Coral reefs are among the most biologically diverse regions of the world. Along with rainforests, coral reefs represent some of the most readily identifiable ecosystems on the planet. As we are awed by the spectacular diversity of the shapes and colors of rainforest avifauna, so too are we inspired by the myriad of colors and often bizarre forms of tropical reef denizens. Rainforests and coral reefs inspire us not only because of their beauty but also because until relatively recently they have been inaccessible to only the most hardy adventurers. With the development of self-contained underwater breathing apparatus (SCUBA) and the jet engine, however, coral reefs are no longer inaccessible; today's most popular holiday destinations often lie on the fringes of coral reefs.

Coral reefs span all the worlds' oceans 30° north and south of the equator. These communities form massive structures easily visible from space. The Great Barrier Reef of Australia, is the largest continuous reef system in the world, stretching for 2000 km from north to south. It is perhaps the most well known of all coral reef ecosystems. Elsewhere, coral reefs have formed massive rings known as atolls that rise out of the oceans depths. Atolls protect and nurture the organisms that live within their turquoise lagoons.

The diversity of marine life that inhabits coral reef ecosystems is mind-boggling. To date, approximately 90,000 coral-reef organisms have been

identified, ranging from delicate soft corals (Alcyonacea) to giant double-headed parrotfish (*Bolbometopon muricatum*). However, recent estimates put the total number of organisms associated with coral reefs at somewhere between 1 and 3 million species!

Sadly, all does not bode well for the worlds' coral reefs. I recently heard distinguished coral taxonomist Dr. John Veron on national radio describing some of the environmental and human effects on coral reefs today. Runoff from forest clearing, land erosion, explosive fish bombing, pollution, and overfishing are a few of the major human-caused threats to coral reef biodiversity. Perhaps more important, Veron discussed the dramatic effect of the 1997-1998 El Niño-Southern Oscillation event. Veron reported how, during 1998, mass coral bleaching occurred. In some areas up to 90% of all corals died, which has been attributed to a rise in water temperature of as little as 1-2° C. Although Veron continued to say this was indeed an unusual warm-water event, predictions suggest that the extreme conditions in 1998 will likely be the average conditions in 20 years time, and within 50 years they will represent "good" years.

*World Atlas of Coral Reefs* provides us with a timely reminder of the fragility of coral reefs, and it is packed with information. Yet there is no pretense of providing readers with an authoritative identification guide to organisms of the worlds' coral reefs. This simply is not possible in 400 some pages. The authors also do not intend to bedazzle the reader with excessive scientific jargon. This book is instead an excellent introduction to the world of

coral reefs. There are three introductory chapters summarizing what coral reefs are, their diversity, their importance, and the threats they face. Within these pages is an overview of the plants and animals that make up coral reef ecosystems and an informative section on human impacts and how they affect coral reefs. Ultimately, the authors' purposes are to provide the reader with the location and description of coral reefs throughout the world and to review the coral reefs of each country, describing for each ecological features, human uses, and impacts, and conservation status.

The remainder of the book is presented as an atlas, broken down into three sections: Atlantic and Eastern Pacific oceans, Indian Ocean and Southeast Asia, and Pacific Ocean. Within each section are chapters dealing with the details of specific regions, complete with accurate maps illustrating in detail the locations of coral reefs, conservation areas within these reefs, and dive centers. This last inclusion is useful, particularly because this book is designed to be a practical guide for those wishing to visit coral reef regions as either tourists or researchers. Dive centers are often the only point of access for many remote regions. Brief summaries of the socioeconomic status of each country also are included, as are its percentage of reefs at risk, coral diseases, and an overview of the sizes of coral reefs and the species diversity of those reefs.

Having lived in Indonesia and traveled extensively throughout Southeast Asia and Papua New Guinea, and being of Antipodean extraction, I found this book well researched. I enjoyed perusing the index, won-

dering if Madang on Papua New Guinea's north coast or Gunung Api in Banda, Indonesia, two places I have visited to dive on the reefs, were worthy of a mention. Similarly, I wondered if the Houtman Abrolhos, a small archipelago in Western Australia where I spent 10 years studying sea bird ecology, would also be included. Not only was I pleasantly surprised, but the information on each of these small areas was accurate and well researched.

I do have one criticism, however. Perhaps I have a hemispherical insecurity complex, but I thought the southern hemisphere was poorly represented in terms of its contribution to coral reefs. The authors clearly state that, after Indonesia, there are more coral reefs by area in Australia—50,000 km<sup>2</sup>, or 17% of the total—than anywhere else in the world. Yet only 5% of this book is devoted to this massive region. This trend is evident in other books chiefly researched by northern-hemisphere-based authors and tends to reflect population bases rather than the significance of each area. For example, the entire Atlantic including the Caribbean takes up 20% of this edition, yet its coral reefs cover only 8% of the global total. True, the Caribbean is close to North America, and its proximity makes this book a must for the many North Americans who visit this area each year.

*World Atlas of Coral Reefs* is beautifully presented. High-quality photographs of coral reefs and their residents are generously scattered throughout. In addition there are many excellent images of coral reefs taken from space, which provide a wonderful representation of the diversity of coral-reef shapes and patterns, from the ribbon-like fringing reefs of Australia to the pothole formations of the Maldives. The book is well organized and easy to read. Although it is an unlikely cover-to-cover read, it certainly admirably meets its aim to be a guide to the coral reefs of the world. With visitors to coral reefs

likely to increase dramatically in this age of globalization, this book provides for the discerning traveler, conservationist, or researcher a useful, informative guide to coral reefs, their inhabitants, and the threats they face.

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### Half a Millennium of Bad Habits

#### **Insatiable Appetite: The United States and the Ecological Degradation of the Tropical World.**

Tucker, Richard P. 2000. The University of California Press, Berkeley, California. 564 pp. \$45.00 (hardcover). ISBN 0-520-22087-0.

As investigators of conservation biology, we study myriad cases of northerners blundering greedily into tropical ecosystems seeking a particular resource. Rarely, however, are we informed enough about the history and culture of a place to understand the local context in which such activities are allowed, even encouraged. Rarer yet is background explicitly available on the financial and political will that has built empires on just such exploits. The full story, with its subtleties, good guys and bad guys, purportedly noble goals, and evil means, might be called the stuff of conspiracy theorists. Yet the intent of *Insatiable Appetite* is to tell just this story. Richard Tucker describes himself as an environmental historian, enjoined with the duty of both describing change brought about by history and evaluating it. In particular, Tucker seeks "to understand how American history came to be inseparably linked to the worldwide degradation of the biosphere in our fateful century."

To produce this book, Tucker has compiled a vast amount of historical information from government, corporate, and international trade docu-

ments, as well as scholarly books and papers. The book, with 424 pages of text and 60 pages of maps and notes, thoroughly documents the various entities involved in the systematic increase in exploitation of tropical resources throughout the last half millennium. The book's main focus is the role that the United States has played in the multifactorial efforts to maximize profits and control in the tropics. However, to fully understand the complexities of the political situations contemporary to each stage of advance into tropical extraction and production, Tucker necessarily tells the stories of the many players, American, non-American, governmental, and private.

The book is divided into three parts, entitled "Croplands," "Pasturelands," and "Forestlands," in an effort to organize the massive amount of historical information into categories that make it easier to follow. "Croplands" is the largest section, covering more than 500 years of history and filling more than 200 pages of text. The latter two sections fill approximately 60 pages each. Maps and detailed footnotes are provided for readers who want detailed citations or additional information to supplement the text.

The story told is both familiar and somewhat shocking. The saga of the growing addiction of Europeans, and then Americans, to sugar and of its pursuit literally around the equator, begins with the slave trade in the fifteenth century and proceeds through modern times. This commodity alone is story enough to fill fully one-quarter of the book. Fittingly, the book is comprehensive in its inclusion of every tropical continent and global market, every kind of corporate manipulation and economic brilliance, and every kind of social disruption, oppression, and obliteration. Cheap labor provided by the importation of slaves from Africa permitted an entirely new facility to experiment with and expand rapidly into multiple bases where the sugar monocrop could be developed. Doubtless, the increasing mar-

kets for and dependency on processed sugar created the first true global economy.

Sugar growing required immense clearings of sparsely inhabited lowland ecosystems, and eventually it required irrigation that spanned extremely large areas. Sugar marketing required shipbuilding, which required timber. Shipping often occurred among several continents, requiring development of multiple ports. Higher profits drove technological advances in sugar refining and establishment of refineries in multiple places. Dense labor forces required food and dwellings where few settlements had previously existed. With the settlements came clearing of land for cattle and housing, and trade with other countries for foodstuffs unavailable locally. These pressures amounted over time to massive migrations and congregations of humans in areas that previously had not been densely populated. In this early global economy, the immense hegemony of the wealthy also was apparent. Corporate power to influence, or buy, laws, tariffs, quotas, prohibitions, and politicians was no less insidious than it is today. For example, sugar interests attempted multiple times to purchase the island of Cuba with U.S. government dollars. Interestingly, as with most tropical resources marketed in the United States, Tucker repeatedly reminds the reader how distant the consumers were from the sources of the commodity and the atrocities that produced it. Finally, the sugar story also illustrates the biggest false tenet of the quest for the next big global product, that resources are unlimited. It took more than 300 years for sugar barons to begin to realize that soil quality, cane variety, erosion control, and destruction of uphill watersheds were related to crop viability. They had always been able to move on, clearing more land with more free labor.

Similar tales are enumerated with regard to tropical fruit crops, most significantly bananas, and the pur-

suit of monocropping in the lowlands around the equator. Coffee is the next big crop described. Coffee production moved agricultural efforts upslope into areas that had been more densely populated historically, thus displacing many more indigenous peoples. The last cropland section focuses on rubber plantations. Tucker focuses heavily on global, multinational efforts to successfully cultivate profitable species of rubber-producing plants. Yet, he devoted only a two-sentence allusion to the history of five decades of enslavement and genocide for rubber extraction from latex-producing forest trees in equatorial Africa. This was accompanied by destruction of natural resources and social systems that linked to secondary environmental degradation. All this was led by the Belgians, but first officially endorsed by the United States (Hochschild 1998). Nonetheless, the story of the rubber market, driven by a disproportionate desire by Americans for automobiles and enhanced by the World Wars, is another remarkable example of the destruction of the tropics by American greed.

The last two sections of the book, "The Crop on Hooves" and "Unsustainable Yield," cover cattle ranching and the growth of American dependence on fast food and logging of tropical forests for all manner of hard- and softwoods, respectively. These sections are understandably shorter because much of the geographical and ecological progression of Yankee businesses around the equator and across all possible tropical ecosystems has already been described in preceding sections. Many of the players, including the global markets, multinational corporate interests, political interests of various governments, and colonized tropical entities, have already been fairly well fleshed out. In many ways, the stories of greed, political, economic and social manipulation, and lack of foresight are already "old news," and one can easily predict the patterns.

In large part, this book contains sufficient detail and adequate references to permit further detailed study of any aspect of tropical exploitation, should a reader choose to pursue one. In many sections, the events unfold like a well-told story, with all the necessary drama to keep the reader interested. I recommend the book for readers interested in learning about how markets, governments, and social systems work together. These dynamics are as relevant today as they were over 400 years ago, and many lessons could be learned by politicians and policymakers today. In addition, the book would make a good background text for a graduate seminar on the topic, supplemented by additional readings and research.

I regret that in some large ways, the book is not as well edited as it could have been. The decision to proceed essentially geographically with respect to a resource type—sugar, bananas, rubber—means that the chronological events that occur in each location are repeated as the reader moves from island to island to continent. In addition, the style of the writing shifts dramatically a little more than a third of the way through the book, from methodical and detailed to fairly general and often nonsystematic. The section that follows the switch includes some geomorphological and ecological information that would have been useful 150 pages prior. Finally, while the author's interpretations of events, conclusions, and opinions are welcome throughout the text, many of these editorial comments seem to contradict one another and some of the information provided in the text. This distracts the reader and undermines the authority of the writer.

Overall, Tucker achieves his goals, to both chronicle a massive body of history and to provide context and criteria (mainly, the viewpoint of a modern environmentalist) with which to judge it. I recommend this book and its subject matter to all

who seek to understand the effect on the global economy of driving to get a hamburger and a cup of coffee with sugar.

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### Details of a Desert Carnivore

**Desert Puma: Evolutionary Ecology and Conservation of an Enduring Carnivore.** Logan, K. A., and L. L. Sweanor. 2001. Island Press, Washington, D.C. 463 pp. \$70.00 (hardcover). ISBN 1-55963-866-4. \$45.00 (paperback) ISBN 1-55963-867-2.

From 1985 through 1995, Ken Logan and Linda Sweanor studied puma (*Puma concolor*) in the San Andres Mountains of New Mexico. Their objectives were to describe and quantify puma population dynamics, social organization, and relationships with their principal prey, desert mule deer (*Odocoileus hemionus crooki*) and desert bighorn sheep (*Ovis canadensis mexicana*). To this end, they radiotagged most of the puma population and large numbers of their ungulate prey. In early 1991, Logan and Sweanor experimentally removed half of the pumas from the southern half of the mountain range. The resulting 10-year, whole-population study—summarized in *Desert Puma*—provides a richly detailed picture of the puma's natural history and ecology, with important lessons for conservation and management.

Organized into five parts, 21 chapters, and four appendices, the book is truly comprehensive. Major topics are population structure, reproduc-

tion, survival, philopatry, emigration, immigration, population growth, metapopulation structure, behavior and social organization, dispersal, interactions between pumas, prey relationships, and conservation and management.

Logan and Sweanor do an admirable job of summarizing their own work and putting it in the context of previous work on large carnivores. Many of the citations are from the year 2000, and in all cases the authors interpret previous work accurately and respectfully. Because their study was unreplicated and only partly controlled—for instance, there were no radiotagged mule deer or bighorn in the control area—the study qualifies more as a natural history than as an experimental test of scientific hypotheses. Consistent with their descriptive objectives, the authors' basic strategy was to look for patterns and, "once a [pattern] was detected, [to] look. . .for possible explanations." Although advocates of strict hypothetico-deductive science may find this disappointing, *Desert Puma* strikingly illustrates the value of applying excellent natural history to important ecological questions. At worst, natural history is merely an attempt to marshal evidence for a pet hypothesis. In contrast, Logan and Sweanor embody the best of natural history. They carefully scoured the literature for possible explanations for each observed pattern and structured their discussion sections as honest attempts to determine which hypotheses are most consistent with their observations.

This study produces several important insights, perhaps chief among them how puma dispersal structures metapopulations, including the observation that 100% of male cubs that survived to independence dispersed to other mountain ranges. Previously, most puma researchers (myself included), although aware that male pumas are superb dispersers, assumed that a young male would occupy a local vacancy if he found one. But in the San

Andres, male immigrants regularly moved in and were accommodated by resident adult males at the same time that locally born juvenile males left the mountain range. Obligatory male dispersal should be an important feature of any future individual-based simulation metapopulation model for this species. The conservation import of dispersal is the only major conservation finding in the book that has been published elsewhere (Sweanor et al. 2000).

In *Desert Puma*, Logan and Sweanor present strong evidence against two popular notions about pumas. The first shibboleth is that puma social structure limits puma density at a level so low that puma cannot affect prey abundance. Whenever management agencies propose to reduce puma numbers to benefit teetering populations of deer, bighorn, or pronghorn, opponents cite this "fact" to argue that the management proposal is fundamentally misguided. Although Logan and Sweanor give other reasons to be cautious about such management actions, the scientific debate will be more productive now that they have slain the ill-supported social-limitation hypothesis. They similarly found no support, and anecdotal refutation, for the idea that after a puma kills an ungulate the surviving deer and elk move far away from the kill site for days. In most versions of this myth, pumas are portrayed as range managers, forcing ungulates to distribute themselves evenly on the landscape rather than concentrating in sensitive areas. Although the idea is attractive, I have long been uncomfortable with repeating unsupported ideas as scientific fact. I thank Logan and Sweanor for putting this old saw to rest.

They also debunk the reasoning, popular among many managers, that observations of combat among adult male pumas, and of juvenile males showing up in marginal habitat, indicate that puma habitat is saturated and there are "too many puma." By demonstrating that male dispersal is

obligatory and inter-male combat for access to females is unrelated to puma density, this book will help keep bad science out of management decisions.

*Desert Puma* also paints a new and compelling picture of how drought and predation interact to regulate deer populations in arid systems. When deer thrive in wet years, pumas rely heavily on ungulates of less than a year old and have relatively little effect on adults, which have the highest reproductive value. This allows the deer population to at least hold its own in the face of predation, even when the puma population is also increasing. With the onset of drought, deer fecundity declines, and with fewer fawns available, pumas shift to taking adults, further exacerbating next year's fawn shortage and predation pressure on adults. In a prolonged drought, perennial water sources dry up, ungulates are forced to leave their home range to search for water, and then often concentrate near the few remaining water sources. Both responses increase the vulnerability of deer to puma predation. Thus pumas—at least for 2–3 years—increase in numbers as their main prey decline. It would have been difficult to document this important role for top-down processes in less than 10 years of study of radiotagged predators and prey. This complex story piqued my curiosity about interactions that remain undiscovered, such as those involving species that compete with deer, mesopredators, and lower trophic levels. (Do browse plants need predator-mediated deer declines for establishment?) How will all of this change when puma once again interact with the now-missing grizzly and soon-to-be-recovered Mexican wolf?

The book contains many other new and interesting findings, although with less conservation import than those already mentioned. For instance, the large home ranges of adult male pumas reported in all

previous studies suggest that most females have no opportunity for mate choice. But in this study, only 5 of 19 adult females during a typical year had home ranges entirely encompassed within the home range of a single adult male. The other 14 females were accessible to, and perhaps could choose among, two or more adult males. This study is also the first to document geographic clusters of matrilineal female groups whereby young females establish home ranges in areas already occupied by their mother or siblings. The documentation of high overlap among home ranges of neighboring adult males makes me suspect that previous observations (including my own) of low overlap among home ranges of neighboring adult males may have been artifacts of under-sampling.

The book provides great gobs of raw data that future models, meta-analyses, and cross-species comparisons in ecology and biology will re-mine for decades to come. For instance, I was able to use the nearly raw data to compute the maximum instantaneous rate of increase ( $r_{\max}$ ) for the treatment area in the year immediately following the experimental removal (a statistic the authors did not provide) on the basis of January counts ( $r_{\max} = 0.73$ ), calendar year (0.33), and biological year (0.46). If you want a more traditional  $r_{\max}$  measure (i.e., ignoring immigration), all the data you need are in the book. This same level of detail, and the book's sheer length, may put off nonscientists who are not carnivore enthusiasts. This would be unfortunate, because Logan and Sweanor took pains to make the book accessible to a nonscientific audience—for example, by defining each new concept in clear, nontechnical terms at first introduction.

I was not persuaded, however, by all of Logan and Sweanor's interpretations. For instance, they argue that "the best explanation" for male dispersal is "avoidance of inbreeding." Their own observation that resident

males bred with their daughters suggests that natural selection can overlook inbreeding. More important, natural selection on inbreeding defects (which may not become manifest for several generations) seems a tenuous mechanism to compel obligatory dispersal. It seems more likely, as implied in several parts of the book, that a young male cannot challenge resident males for breeding space until he spends a year away from home gaining size, strength, fighting experience, and perhaps increased exposure to sex hormones.

Rigorous peer review would have sharpened some of the interpretations (such as that just mentioned) as well as several descriptions of the methods. For instance, the procedure for estimating error in radio locations was described simply as follows: "all radiotelemetry locations had estimated error radii of 500 m or less." It is not clear if or how this error relates to the "overlapping error polygons" used to infer that two pumas were associating with each other. Although most (perhaps all) of these problems are minor, they make it hard for readers to interpret results on their own.

This leads to my only serious complaint about the book: I wish Logan and Sweanor had first published a series of tightly focused peer-reviewed papers and then written a shorter book for a broad audience. I believe this would have increased the impact of their main new findings. For instance, the paper by Sweanor et al. (2000) provides conservation biologists with a concise, defensible argument for incorporating puma dispersal in conservation efforts. Similarly, we need companion papers with titles such as "Puma Social Structure Does Not Prevent Overexploitation of Prey" and "Puma Predation Does Not Redistribute Ungulates on the Landscape." And wildlife managers need papers titled "Bogus Indicators of Puma Habitat Saturation" and "Interaction of Drought and Predation Regulates

Deer Populations.” I can’t help but fear that some important ideas will be buried in this massive volume and that lack of peer review may impede broad acceptance of ideas that are almost certainly correct or allow incorrect ideas to prosper too long. With several peer-reviewed publications in the literature, a shorter book could then bring natural history and a conservation message to readers in a more lively format, lavishly illustrated with anecdotes about individual pumas.

The penultimate chapter of *Desert Puma* is a well-reasoned call for specific conservation actions. As a supporter of The Wildlands Project vision, which uses carnivores as umbrellas for planning of large interconnected reserves, I applaud Logan and Sweanor for stating that the top conservation need is to “immediately identify, map, and conserve puma habitat and landscape linkages.” They cogently argue against complacency by pointing out the dramatic impact of a single highway project in their study area. I have often presented my studies of pumas in southern California as indicating the sort of future that the rest of the West must work to avoid. For pumas, the remote landscape of central New Mexico is as good as it gets. Learning that even this landscape is under assault has heightened my sense of urgency and commitment to conservation action.

With only about 32,000 pumas in the United States, these animals clearly have an influence larger than their numbers or biomass in the ecosystems they inhabit. Logan and Sweanor have considerably advanced our appreciation of those influences. They debunk some old myths and provide many new insights and hypotheses. They present evidence for both top-down and bottom-up regulation (predation will not be pigeonholed). They are conservationists at heart, but avoid letting their values cloud their interpretation. I highly recommend *Desert Puma* as a must-read for any student of large carni-

vores or their prey and for citizen activists in regions that are—or ought to be—inhabited by puma. Any conservation biologist would find it useful and thought-provoking.

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Sweanor, L. L., K. A. Logan, and M. G. Hor-nocker. 2000. Cougar dispersal patterns, metapopulation dynamics, and conservation. *Conservation Biology* 14:798–808.

#### Lessons for Large-Mammal Conservationists

**Large Mammal Restoration: Ecological and Sociological Challenges in the 21st Century.** Maehr, D. S., R. F. Noss, and J. L. Larkin, editors. 2001. Island Press, Washington, D.C. 375 pp. \$65.00 (hardcover). ISBN 1-55963-816-8. \$30.00 (paperback). ISBN 1-55963-817-6.

Perhaps no conservation task is more daunting, both politically and scientifically, than the reintroduction of large mammals to areas from which they have been eliminated or reduced in abundance. Large mammals have been lost from many areas of North America because of overexploitation (e.g., American bison, *Bos bison*) or conflicts with humans and human enterprise (e.g. wolf, *Canis lupus*). Restoring the former distributions or abundances of such species requires overcoming biological, logistical, sociological, economic, and legal hurdles. In some cases, carrying out reintroductions reminds us of the conflicts that led to the extirpation of the taxon in the first place. In other cases, modern environments may not be as suitable as those in which Europeans found the species of concern. However, the public’s interest and support for such reintroductions, and the willingness of agencies and pri-

vate entities to fund and undertake these projects, have increased in the last two decades, and it is likely that many more such efforts will be made in coming decades. Thus, a comprehensive description and appraisal of past experiences is a welcome addition to the literature.

*Large Mammal Restoration* treats a number of conceptual and practical issues related to restoring large mammals, and it documents the experiences of various organizations that have tried to do so. This is a tremendously valuable resource for anyone considering restoring large (or small) mammals (or other vertebrates). It would be impossible to place a dollar value on the lessons learned and related by the authors, but the overall combined cost of the programs described runs well into eight digits. For this reason alone, this book was worth publishing. The multiauthored book is the outcome of the 1999 symposium held at the annual meeting of The Wildlife Society. It comprises 16 chapters in four sections: feasibility, practice, human dimensions, and abetting natural colonization. The chapters take three basic forms: conceptual issues (2 chapters), feasibility studies (3 chapters), and accounts of restoration efforts or technical aspects of them (11 chapters). Thirteen of the chapters describe restoration efforts, all of them in North America. Interspersed among all are four briefer case histories or essays, which draw upon geographically varied experiences. One of the cases describes the near eradication of white-tailed deer (*Odocoileus virginianus*) from Kentucky ( $N < 1000$  in 1927, with deer present in four of 120 counties), followed by prohibitions of hunting, translocations within the state, introductions from distant sites, and regulated hunting (Gassett, case 1). Today, Kentucky has an estimated 690,000 deer—a phenomenal success of restoration to some, a problem of another sort to others.

An introductory chapter by Noss outlines the broad justification for

restoring large mammals, and a concluding piece by Maehr explores the place of large-mammal restoration in evolution and wildlife management. In his introduction, Noss argues, with his accustomed passion, for the restoration of large mammals, particularly carnivores, to their former ranges and the preservation of wildlands to support them. Noss repeats a set of arguments that have become nearly a mantra for some conservation biologists: large mammals, particularly carnivores, exert top-down trophic and competitive influences on communities and ecosystems that shape the most basic features of plant and vertebrate communities. This, then, becomes the justification for the protection of huge land areas required by large carnivores and their prey. The same sentiment is echoed by various authors throughout the book, showing how firmly these beliefs have become imbedded in the minds of conservation biologists, in spite of their very tentative support by empirical data.

In a conceptual chapter, Gaydos and Corn (chapter 7) describe animal health issues at individual and population levels. One of the most important topics receives relatively weak treatment here. Their review of the problems associated with capturing, immobilizing, screening, and transporting animals is so brief and general that it is not of much use. Perhaps an account with sufficient detail to be useful would have been excessively long. Among feasibility studies, the clearest and most quantitative approach is that provided by McClafferty and Parkhurst (chapter 4), who describe the two-pronged strategy of habitat identification and socioeconomic assessment used by workers in Virginia in considering whether to restore elk (*Cervus elaphus*). Agencies contemplating such a feasibility study would do well to consider this chapter as a model. The accounts of restoration efforts per se, including those to put free-ranging elk into Kentucky (chapter 5) and wolves into the northern

Rockies (chapter 6) and desert Southwest (chapter 8) are rich with tough lessons learned about biology and sociology. Perhaps the most important of these lessons is articulated in a new criterion proposed by Maehr (final chapter) to indicate whether a reintroduction attempt should be considered seriously: the public (and, I suspect, key stakeholders) must be sufficiently supportive of the project to avoid conflicts with reintroduced animals.

The third section of the book, "Abetting Natural Colonization," was the least fulfilling for me, inasmuch as it deals with a wide range of mammal conservation issues with varying relationships to restoration or natural colonization. These chapters do include some interesting reading but do not strengthen the conceptual focus of the book.

One important topic not addressed in any chapter is that of taxonomic and ecological equivalency. When translocation is contemplated, geographic ranges have been vacated and animals genetically and ecotypically identical to the original occupants are presumably not available. What do biologists, agency decision-makers, and the public consider aesthetically, taxonomically, genetically, and ecologically acceptable substitutes for the original forms—another ecotype, subspecies, or even species? The chapter on translocation of plains bison to Wood Buffalo National Park, guaranteeing hybridization with wood buffalo, hints at the biological sensitivities, but the subject deserves its own treatment. North American wildlife conservation is replete with examples of how systematists, ecologists, wildlife managers, and stakeholder groups view this issue, and a fascinating tale could have been told about our diverse collective tastes.

The editing of this volume is very good, the production values are mostly good (several figures are coarsely reproduced or are difficult to fully decipher), and the index is comprehensive and useful. *Large*

*Mammal Restoration* should find ready acceptance among agency biologists and university libraries. It also contains examples that will be useful to teachers of conservation biology and wildlife biology. For agencies and private entities contemplating restoration of large mammals to their former ranges in complex biological and socioeconomic settings, this is a must-read book. Careful consideration of *Large Mammal Restoration: Ecological and Sociological Challenges in the 21st Century*, preferably early in the planning process, may remove or anticipate barriers in what will nonetheless likely be a process fraught with challenges.

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### **Transforming Forests with Good Intentions**

**Forests under Fire: a Century of Ecosystem Mismanagement in the Southwest.** Huggard, C. J., and A. R. Gómez, editors. 2001. The University of Arizona Press, Tucson, AZ. 307 pp. \$40.00. ISBN 0-8185-1775-4.

When I first agreed to review this book, from the title I expected to read about fire-management policies, the pros and cons of prescribed burning, and how historical fire-suppression management has created a management nightmare. What I discovered instead was a more comprehensive approach to the history of management of national forests in the Southwest United States. This book contains nine chapters, which take a variety of approaches to describing how the people of the Southwest have interacted with wild forests in their mountainous areas above the drier lowlands. The history of these forests over the last century is traced through examination of the social interactions, changes in attitudes, and strengths,

weaknesses, and evolution of multiple users, all in a context of changes within society as a whole. From the preface, one perspective for this collection is the “inherent conflict between people and their environment” and the attempts to find “equitable balance between multiple use and conservation.” Overall, the book seems clearly intended to document the historical transformations of our national forests that have occurred over the last century and to leave us with a picture of how current policies are struggling against multiple interests to preserve forests from complete degradation.

During the time covered, the U.S. Forest Service was established within the U.S. Department of Agriculture. To some extent, *Forests Under Fire* is about the evolution of this federal agency. Overall, I ended up with a much greater appreciation for this holistic assessment of national forest management than I would have predicted. From this perspective, I give the book a strong recommendation.

At the same time, the book does not fit neatly into any other category. Ecologists, environmental policymakers, conservationists, ranchers, and forest users of all types will find the book useful for its comprehensive approach and historical context. Even though well documented, the book is not aimed at any one group in particular, but instead takes a relatively balanced historical approach through all the chapters, even though this is an edited book representing the ideas of nine different people and backgrounds. That does not mean that criminal exploitation is not laid bare. The University of Arizona suffers in a chapter documenting its political bullying to bypass the U.S. Endangered Species Act of 1973 to obtain sites for observatories in endangered animal habitat. But the only advocacy in this book is in the background. It focuses on the forests themselves and on how we have interacted with them, and it illustrates the ways in

which they have been exploited. In the end, an ecosystem-management approach is advanced that will preserve forests under new types of use that will affect the systems in different ways.

The first three chapters provide case studies of the social history of local peoples, their interaction with forests as a source of income, and the role of government. Arthur R. Gómez focuses on the history of Apache logging in northern Arizona. Gómez describes the development of local Apache-owned companies, their interaction with Anglos with money and expertise, and conflicts between the U.S. Bureau of Indian Affairs and the Forest Service. Duane A. Smith recounts the history of McPhee, a planned lumber town in the southwest portion of Colorado that has now disappeared beneath a reservoir. Finally, Suzanne S. Forrest's chapter considers the development of the Vallecito Federal Sustained-Yield Unit, a post-World War II designation intended to help local people simultaneously earn a living while tying their success to the forest's resilience to exploitation. Together, these chapters illustrate competing management strategies coming from the Forest Service, along with the perspectives of the people living with or in the forests. Often, good approaches simply died because of events not under local control, such as a series of bad weather years, the crash of the economy in the 1930s, or war. I found these chapters interesting, but less so than the remainder of the book.

The next two chapters provide a history of management approaches in the context of grazing and the development of the first wilderness area in the United States. A discussion of the evolution of management policy is continued by Diana Hadley in a chapter about grazing in the forest lands near the Mexican border in what is now the Coronado National Forest. Allotments for grazing are well illustrated, as are changes in Forest Service management philoso-

phy as different scientific concepts became incorporated. Droughts and the depression of the 1930s provided historical contingencies to management, as did slowly shifting policies. Christopher J. Huggard provides a profile of Aldo Leopold in his early years as he worked in the forests of the Southwest. I found this chapter particularly interesting because of my own inclinations, and Huggard does a good job showing the evolution of Leopold's conservation thinking, his efforts toward establishing the first wilderness area (Gila Wilderness Area), some spectacular errors, and the complexities of balancing multiple interests and philosophies.

In these earlier chapters, conflicts between various interests are well described. Interactions with Washington, D.C. and differences in world views all are clear influences as the histories become increasingly recent. The next three chapters, a history of wildfire policy by John Herron, a recent history of ecosystem management in the forests of southern Utah by Thomas G. Alexander, and a history by Paul W. Hirt of the University of Arizona's exploitation of the Mount Graham, all bring the conflicts center stage. Management of national forests always has been subject to strong politics, but the number of groups and the furor of their advocacy have increased greatly in the past 30–40 years, and these chapters each explain them effectively. Herron recounts the history of fire policy, from the early fire-suppression advocates and some notable detractors, through federal expansion with the Conservation Corps program and post-World War II aggressive fire-fighting techniques, to the final realization in the last two decades that fire has to be a part of forest management. Alexander's chapter, in particular, demonstrates the shifting emphases of forest supervisors and the public as well as the conflicts involved in managing these systems. Alexander documents how, like ex-

tractive groups in the past, current advocacy groups for off-road recreation or environmental protection, among others, can pressure, delay, and interfere with ecosystem-management decisions. Hirt's chapter about the Mount Graham red squirrel and the conflict between the U.S. Forest Service and politicians pulls together a condensed but uncomfortable story. This chapter reveals the realities of the difficulties of conservation when any group with political muscle—in this case the University of Arizona, a supposed enlightened institution, acts in its own best interest to get what it wants regardless of who loses.

The final chapter by Hal K. Rothman is an overview. Although a little too short, it does provide an effective framework from which to view the history provided and discusses directions for the future. The role of the Southwest forests as experimental areas (and ironically as leaders in management policies and “dead-end” places for “career-ending positions”) gives the history a special perspective. While lumber and other extractive companies have receded in importance, off-road vehicle use, expansion of ski resorts, and other recreational uses represent the current cultural exploitation of our national forests.

The individual chapters will vary in their appeal depending on the reader's own background and interests. But overall this book provides a better stimulus than many others I have read for a reassessment of national policies governing management of natural resources. Too often calls for reassessment come from groups with narrow self-interests and are thus easily overlooked. This collection of historical case studies is convincing because of the multiple perspectives and the general balance provided. The transformation of our forests during the last century is clear. The policies governing those transformations were well meaning at the time. Together, this collection advocates a more comprehensive ecosystem-management ap-

proach. We can only hope that results match intention in this round.

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### A Biologist's Guide to Fragmenting the Amazon (Including Why That's a Bad Idea)

**Lessons from Amazonia: the Ecology and Conservation of a Fragmented Forest.** Bierregaard, R. O., T. E. Lovejoy, C. Gascon, and R. Mesquita, editors. 2002. Yale University Press, New Haven, Connecticut. 544 pp. \$65.00 (hardcover). ISBN 0-300-08483-8.

Unraveling the effects of habitat fragmentation has become one of the primary subdisciplines in conservation biology, and several excellent books on the topic have been published in recent years (Laurance & Bierregaard 1997; Young & Clark 2000). Have we come so far conceptually that a new one is needed? Probably not. *Lessons from Amazonia* is an important work, however, because it does what no other book has done to date: synthesized over 20 years of research on the effects of forest fragmentation in the Amazon, all of which was conducted at Brazil's Biological Dynamics of Forest Fragments Project (BDFFP). The BDFFP remains the world's largest-scale and longest-running experiment on the effects of fragmentation. As such, *Lessons from Amazonia* is both a biography of the BDFFP and a comprehensive catalog of the consequences of fragmentation.

Putting this catalog together was clearly no easy task. The book is divided into five major sections, and its 29 chapters are written by authors from nine different countries. To these authors the editors gave the daunting assignment of writing with two very different target audiences

in mind. The first is “field biologists,” whose research programs it was hoped the authors would inspire with their results. The second audience is “wildlife managers and conservation planners,” at whom the distilled “Conservation Lessons” at the end of each chapter are specifically aimed. This attempt to directly link the results of each study with the management of tropical forests is an important part of what sets this book apart from others on the subject.

*Lessons from Amazonia* begins with the section “Theory and Overview,” which chronicles the BDFFP's evolution from a team of five (a field director, cook, and three trail cutters) to its present status as a partnership between Brazil's National Institute for Amazonian Research and the Smithsonian Tropical Research Institute. It includes a cogent introduction to deforestation patterns in the Brazilian Amazon (Gascon et al.) and a review of the BDFFP's experimental design, which also details the isolation history of each fragment and the major faunal and botanical inventories carried out before and after isolation (Gascon & Bierregaard). This chapter also describes—in gory detail—the process by which thousands of hectares of tropical forest were leveled to create the BDFFP reserves.

The second section, “Forest Ecology and Genetics,” begins with a review of the central Amazon's surprisingly diverse and unique tree flora (Laurance). It will come as no surprise that the conservation of the more than 1300 tree species in the BDFFP reserves may require protected areas that are tens of thousands of hectares in size either to maintain viable populations of all species in a given family (Mori et al.) or because most species are locally rare and may have limited local genetic diversity (Lepsch-Cunha et al.). A further complicating factor, particularly in light of the short-term nature of most studies of forest ecology, is that trees in the tropics may be considerably older than previously imag-

ined. In one of the more simple yet thought-provoking chapters in the book, Chambers et al. used Carbon-14 dating to estimate the ages of trees from 15 commercially valuable timber species. They found that the average tree  $\geq 10$  cm diameter at breast height was at least 150 years old, and the oldest tree in their study was an astounding 1400 years old. Despite a sample size of only 44 individuals, Chambers et al. managed to more than double previous estimates of the maximum age of tropical trees.

Although the editors have organized the 14 chapters in the “Fragmentation Effects” section by taxonomic group—plant, invertebrate, and vertebrate communities—most of the chapters in this section actually focus on one of two issues that transcend taxonomic boundaries. The first issue is the influence of fragment size on species diversity and abundance. This focus clearly reflects the BDFFP’s initial mission to determine the minimum size of reserves needed to protect tropical biotas. The second topic is the impact of proximity to forest edges, including how the type of matrix habitat in which fragments are embedded modulates edge effects.

Irrespective of whether one is interested in palms (Scariot), bees (de Oliveira), beetles (Didham), or primates (Gilbert & Setz), the message is frequently the same: protecting species diversity will ultimately require large tracts of undisturbed forest because most species are rare and patchily distributed. However, for a broad cross section of taxa ranging from ants (Vasconcelos et al.) to amphibians (Tocher et al.), the diversity found in fragments may depend in large part on the habitat that surrounds them. Even in the advanced stages of forest regeneration, some types of matrix appear to be a major barrier to individual dispersal, including for some presumably more mobile taxa such as understory birds (Stouffer & Borges).

My only regret is that this section did not include more chapters that moved beyond describing patterns of

abundance in fragments to actually testing the mechanisms responsible for these patterns. An excellent example of this limited subset of chapters is the one by Venticinqui and Fowler, which I consider one of book’s highlights. They used survey data to parameterize metapopulation models for the spider *Anelosimus eximius*, a fascinating social species that builds communal webs containing up to 10,000 individuals. Whereas the abundance of colonies was higher in fragments than in continuous forest, the life expectancy of colonies in fragments was considerably lower than in unbroken habitat. Despite this increased mortality, the probability of simultaneous extinction from all fragments was actually minimal, because the dynamics of webs in the different fragments fluctuate asynchronously. This chapter, along with those on seedling recruitment (Benitez-Malvido) and pollination (Dick), is a good example of the mechanistic studies for which the BDFFP historically has been underutilized.

The fourth section, “Management Guidelines,” includes chapters on topics broadly relating to the restoration, conservation, and politics of Amazonian forests. Two of them summarize empirical studies of regeneration in pastures, with one focusing on seedling establishment (Ganade) and the other on fire (Williamson & Mesquita). There are also chapters on selective logging (Higuchi), the use of remote sensing to describe changes in fragment quality (Logsdon et al.), and the application of heat-conductance models to predicting large-scale edge effects (Malcolm). Finally, there is an outstanding primer on the region’s soils (Fearnside & Leal-Filho), one of the book’s most informative and well-written chapters. Many will be surprised to learn that, despite being one of the most luxuriant ecosystems on the planet, much of the Amazon is built on soils that are highly acidic, toxic in levels of aluminum, and extremely poor in nutrients. Fearnside and Leal-Filho do an excellent job of walking the nonspecialist through

classification of soils, the influence of soil texture on properties such as water-retention capacity, and how different chemical elements interact with these properties to influence soil nutrient levels. It is unfortunate this chapter wasn’t placed earlier in the book, because it would have been useful for interpreting patterns described by other authors such as low tree fertility (Laurance) and primate home ranges up to 10 times larger than those in other Neotropical sites (Spironello). The chapter by Fearnside and Leal-Filho should be required reading in all courses in tropical ecology.

The book ends with a one-chapter section listing 13 “principles of forest fragmentation and conservation in the Amazon,” as well as publications and theses resulting from BDFFP research (the list is continuously updated and can be found at [www.inpa.gov.br/pdbff](http://www.inpa.gov.br/pdbff)). Summarizing two decades of complex, frequently contradictory results is far from easy, and I found this chapter to be a surprisingly comprehensive and lucid distillation. Its only weakness was the occasional platitudes, such as “roads are an enemy” and “conservation is best achieved through people,” which I think oversimplify the social and economic complexities of conservation and development in tropical countries.

*Lessons from Amazonia* is not without its shortcomings: a few of the authors have simply summarized their previously published papers, and judicious editing would have eliminated the redundant descriptions of study sites presented in multiple chapters. Also, the two-audience approach, although laudable, is not entirely successful. I was occasionally frustrated by lack of details on experimental design or statistical analysis, and some of the management guidelines presented by authors are either already well known to conservation professionals (e.g., “minimize edge”) or not overly useful (e.g., “reserves should be large”). Despite these criticisms, however, *Lessons from Amazonia* is a solid and wel-

come addition to the fragmentation literature. It is comprehensive and rich in data and provides a good introduction to the ecology of the central Amazon. The clarity of the writing and synthetic nature of most chapters makes it an excellent source of readings for both undergraduate and graduate courses, and students will find it a good place to mine for

thesis topics. This book leaves no doubt as to why in 23 short years the BDFFP has matured into one of the premier sites in Latin America for conservation research and training.

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*Erratum*

In the April 2002 issue (Volume 16) of *Conservation Biology*, there are several errors in the table on page 299. N. Sloan's page-proof corrections to the table were not incorporated by the publisher. A revised version follows.

