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Ecology, the Great Integrator

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Ecology, the Great Integrator

Fundamentals of Ecology. 5th ed. Eugene P. Odum and Gary W. Barrett. Brooks Cole, Belmont, CA, 2004. 624 pp., illus. $104.95 (ISBN 0534420664 cloth).

The fifth edition of *Fundamentals of Ecology* records, sadly, the demise of its first author, Eugene P. Odum, who served at the University of Georgia's Institute of Ecology for more than six decades. Gene Odum's long and productive career as an ecologist was replete with honors. It appropriately ends with the reappearance of his paradigmatic textbook (Bergandi 2000).

The first edition in 1953 was notable for being organized around the then new and little-known concept of the *ecosystem,* a term coined by A. G. Tansley in 1935. The ecosystem concept was initially developed in 1942 by Raymond Lindeman in an article on "trophic-dynamic aspects of ecology" (published with much difficulty), but was brought forcefully to the forefront of ecology in Odum's revolutionary textbook by his emphasis on the structure and function of ecosystems. The current edition maintains the holistic emphasis of the earlier ones and emphasizes the complex problems of hierarchy, emergence, and human components of (and influences on) ecosystems in current ecology.

In the fifth edition, Gary W. Barrett, a long-time ecologist who is the director of the Ecology Institute and holder of the Odum Professorship in Ecology at the University of Georgia, joins Odum in coauthorship. Among numerous distinctions, Barrett served as president of the American Institute of Biological Sciences in 1998.

Writing a textbook on the fundamentals of ecology is a daunting task in an era when ecology has expanded far beyond its traditional scope. Its current breadth, not to say depth, is evident in a quotation from the afterword in a volume on philosophy of ecology coedited by Frank Golley, a University of Georgia colleague of Odum and Barrett: "Thinking ecologically means *synthesizing* the many fields of human knowledge into a coherent world view. Ultimately, the scientific ecologist includes in his or her purview ethics, values, and politics. As a consequence, there will never be overall consensus on the form and objectives of ecological science" (Keller and Golley 2000).



So sweeping a view of ecology makes writing a text on its fundamentals a fitting task for these two distinguished ecologists. Odum and Barrett note the common etymological derivations of *ecology* and *economics* from the Greek word *oikos* and call attention to the recent rapprochement of these traditionally antithetical disciplines in the interface discipline of ecological economics. Indeed, the inside back cover shows a cycle of "natural capital" (ecological resources) and "economic capital" (human production).

One problem the authors note is that the enormous contribution of natural capital, supplied free to human societies by natural ecosystems, is commonly ignored, in part because of the difficulty of evaluating it in conventional economic terms. Money flows out of urban areas to pay for energy, goods, and human services, but natural ecosystem services are not accounted for.

The authors intend the volume to serve as an introduction to a new ecological discipline, involving interdisciplinary approaches at the higher levels of ecological organization, and leading to transdisciplinary means of solving environmental problems and managing resources. They see ecology evolving "into that much needed integrative science of the future." E. O. Wilson notes in the foreword that the book is needed to "learn the boundaries and principal features of ecology," which are increasingly difficult to delineate.

The volume is well organized and clearly written, and addresses the increasing scope and complexity of ecology. It considers seven ecological levels—organism, population, community, ecosystem, landscape, biome, and ecosphere—in terms of seven transcending functions—energetics, evolution, development, regulation, behavior, diversity, and integration. The early editions' emphasis on the ecosystem concept is continued, with 40 percent of the pages being on ecosystems. An innovation is a chapter on statistical thinking for students of ecology, by R. Cary Tuckfield of the Savannah River National Laboratory (which Odum was instrumental in founding). This is followed by an extensive glossary, references, and an index.

The format of the book is uniform throughout. Each subdivision of a chapter, after the first chapter describing the scope of ecology, is introduced by a statement followed by explanations and examples. The statement is a concise comment on the concept or phenomenon considered. The explanation provides three historical references and elaborates the ideas introduced earlier, and the examples offer specific cases and studies thereof. In all chapters, keywords are given in boldface for emphasis. The text is liberally supplied with clear figures and tables from diverse sources. Special attention is given to models, some developed by Howard T. Odum, Gene Odum's brother; the work of son William E. Odum is also cited.

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The authors devote considerable attention to concerns about biodiversity and the problems of human effects on the earth and sustainability. They note, in passing, those who would resolve such problems by establishing enormous space colonies (without direct mention of President Bush's plan for Mars). Their conclusion: don't count on it.

Ecologists linked humans and ecology even in the early years of the discipline, but this volume brings human influences and concerns to the forefront of the discussion of Earth's sustainability and poses the problems of postmaturity old age. It is of interest, in the context of modern high-tech agriculture, to note the recent emphasis on traditional practices of indigenous peoples and what may be learned from them about sustainability (Ford and Martinez 2000).

Odum and Barrett consider the elusive problem of ecological theory, which has long frustrated ecologists. They review the grand old climax theory of Frederic Clements and the attendant dispute about its merits, and declare that it remains "one of the most important unifying theories in ecology." Indeed, it has several descendants in the concepts of self-organization, synergetics, and ascendancy, which in more modern jargon see ecosystems as developing into self-organizing systems, similar to Clements's concept.

Notably, Odum and Barrett do not consider two individuals, Robert May and Jared Diamond, who flashed across the ecological sky in the 1970s and 1980s and then went on to other conquests. May, an Australian physicist, wrote several articles on theoretical ecology and wrote or edited books on model ecosystems and theoretical ecology, then served in England as science advisor to the prime minister and received a knighthood. Diamond, a well-known physiologist, wondered why ecologists had overlooked competition—which, J. B. Jackson pointed out, they had not. His principal contribution to ecological theory was his use of the terms "assembly," "assembly rule," and "assemblage," predicated on the primacy of interspecific competition. These gave rise to extended debate and to the proliferation of an extensive set of some 60 terms based on "assembly" and 47 on "assemblage" in the literature between 1970 and 1999. Diamond moved on to books about human societies, one of which was awarded a Pulitzer Prize.

The concluding chapter by R. Cary Tuckfield, on statistical thinking, is not a primer on elementary statistics; rather, it considers the intrinsic difficulties of applying conventional statistics in ecology because of problems of scale. Oddly, Tuckfield asserts that "statistical methods may not always apply, but statistical thinking will." He equates Plato's famous shadows with samples, and calls for a different perspective on data analysis in ecological studies, particularly at larger scales. According to this perspective, the emphasis is on data display rather than statistical computing software, in what he terms the "weight of evidence" paradigm. This is a refreshing departure from the common emphasis on statistical techniques per se as the resolution of ecological problems.

This fifth edition of *Fundamentals of Ecology* can stand as a memorial to Gene Odum's contributions to ecology and, with Gary Barrett's collaboration, it will serve as an introduction to the long history of traditional ecology and a balanced consideration of the recent emergence of ecology as an integrative science.

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WILDLIFE WORLDWIDE

Nature's Strongholds: The World's Great Wildlife Reserves. Laura and William Riley. Princeton University Press, Princeton, NJ, 2005. 672 pp., illus. $49.50 (ISBN 0691122199 cloth).

Laura and William Riley wrote *Guide to the National Wildlife Refuges* in 1979 and updated it in 1992 and 1993. Laura Riley's natural history photographs and writing have appeared in *Natural History, National/International Wildlife, American Birds, Smithsonian,* and many other magazines. Now the Rileys have provided us with another impressive volume, one of global scope, in *Nature's Strongholds: The World's Great Wildlife Reserves.*

Descriptions of about 600 sanctuaries in some 80 countries on every continent constitute the bulk of this hefty book. The authors' introduction provides historical background on the reserves, describes the challenges facing them, and supplies information on permits, immunizations, and other nitty-gritty matters of travel.

Reserves are grouped alphabetically by country and nested in nine large chapters: "Africa," "Antarctica," "Asia," "Caribbean and Central America," "Europe," "North America," "Offshore Islands," "South America," and "South Pacific Islands." The entry for each country opens with a country map showing the locations of its preserves and a size scale. A second map places the country on its continent. Graphs of average monthly temperature and rainfall accompany a brief introduction to wild places in each country. Descriptions of specific sanctuaries follow: area encompassed by the preserve, charismatic and rare species, biome, times to visit, what to see, background, facilities, and contact information (telephone, fax, e-mail, and postal address).

In Africa's Côte d'Ivoire, dazzling Diana monkeys swing through the forest canopy of Tai National Park. In Malawi,

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which has parks that are among the finest-run in Africa, orchids flourish in Nyika National Park. Springs and waterholes dot the grasslands of Etosha National Park in Namibia, drawing enormous numbers of wildlife to this less-visited equivalent of the Serengeti. The Parc National de Ranomafana, Madagascar, is one of the best examples of ecotourism making a park work (Wright and Andriamihaja 2002). With wildlife riches from the rare red owl to the tomato frog, Madagascar is a world-class destination for conservation-oriented visitors.

Those hoping to observe Antarctica's fauna might do well to advance this ice-bound continent to the top of their travel list: the habitat for much wildlife is threatened, as Antarctic ice shelves hundreds of square miles in area are floating off to sea. What Antarctica and subantarctic islands lack in numbers of species, they make up for in sheer masses of penguins—millions of Adélie, chinstrap, emperor, gentoo, king, macaroni, and rockhopper species. Antarctica supports large populations of leopard, crabeater, and Weddell seals, along with petrels (named for St. Peter because petrels appear to walk on the water, as that man is said to have done). South Georgia Island, the goal of Shackleton's perilous voyage from Elephant Island, is home to southern fur seals, elephant seals, wandering albatrosses, and Antarctic prions. On Macquarie Island, the Tasmanian Parks and Wildlife Service oversees the world's sole breeding colony of royal penguins.

The superb Web site of the Center for Russian Nature Conservation (*www.wild-russia.org*) will inspire scientists to dig out their field gear. A festival in spring at Khingansky Zapovednik, one of more than 100 reserves in the Russian Federation, celebrates the mating dances of red-crowned cranes. Less familiar Asian destinations are also described: Jigme Dorji National Park (Bhutan) with its blue sheep, Mount Hkakabo-Razi (Myanmar) with its red pandas, the Arabian Oryx Sanctuary (Oman), and other refuges in Bangladesh, China, India, Korea, Laos, Sri Lanka, Thailand, and Vietnam.

Europe has a surprising number of lesser-known wildlife reserves. Shaggy musk ox graze in Dovrefjell National Park (Norway). A variety of eagles soar over Bulgaria's Rhodopes Mountains: imperial, golden, booted, short-toed, lesser spotted, and white-tailed species (the last is Poland's national symbol). Birdlife abounds in the Danube marshes and on Bulgaria's Black Sea coast. The Carpathian Mountains are a 1500-kilometer (km) (930-mile) corridor rich in biodiversity, curving through eastern Europe. Chamois, gray wolves, lynx, brown bears, and one-third of Europe's plant species lure visitors to Romania's Carpathian reserves. The Carpathian Large Carnivore Project conducts field studies of big predators in Romania. Farther north, on the vast Hungarian plains, up to 72,000 cranes and the largest birds that can take to the air—the great bustards—are found. Shorebirds probing mudflats in Hungary's Hortobagy National Park can be observed from 30 towers. Poland's Bialowieza National Park and the contiguous Belovezhskaya Pushcha National Park in Belarus are prime habitat for European bison and more than 60 other mammals. These parks offer guided walks, bilingual booklets, foot and horseback trails, boat tours, natural history museums, guesthouses, and camping.

Caribbean reefs off Belize and Dominica are treasure troves of biodiversity. The misty Monte Verde Cloud Forest of Costa Rica protects resplendent quetzals, bellbirds, and the semiaquatic Baird's tapir. Southward, reserves of South America beckon. Vicuñas graze Bolivian, Peruvian, and Chilean highlands. Rheas race across Argentina's grassland. The Amazon is named for the mythical fierce female warriors, but visitors are more likely to spot blue morpho butterflies, blond-crested woodpeckers, ocelots, and giant river otters.

Canada has the oldest continuous national park service on the planet. Parks of the Canadian Rockies are best known: Banff, Jasper, Kootenay, and Yoho. Glacier-cut fjords indent the 138 islands of Gwaii Haanas National Park in British Columbia, guaranteeing undisturbed nest sites to rhinoceros auklets, tufted puffins, Cassin's auklets, and storm petrels. One of the last free-ranging herds of wood bison roams the remote Wood Buffalo National Park in the Northwest Territories, where a flock of more than 400 spectacular whooping cranes nests in grass and sedge meadows. The same flock winters 4300 km (2600 miles) south in Aransas National Wildlife Refuge, Texas.

Many endemic species have evolved on isolated offshore islands such as the 155 Seychelles Islands. The carrycot frog lugs tadpoles on its back, one of a dozen Seychelles species that amphibian aficionados seek. Aldabra atoll, one of the Seychelles, is a United Nations World Heritage site and the largest coral atoll in the world. Here the Aldabra lily is one of about 40 endemic plants. Flightless rails, rare Aldabra sacred ibises, and 150,000 Aldabra giant land tortoises, coco de mer palms, sea turtles, and fabulous reef fishes attract visitors to the Seychelles.

The flora and fauna of Southwest Pacific islands may be the most diverse in the world. Two distinct groups are physically separated by Wallace's line: oriental species inhabit the region from Bali (Indonesia) westward, while Australasian species live from Lombok eastward. Spectacular species include Indonesia's Queen Alexandra's birdwing butterflies, with a wingspan up to one foot wide, and the "flying" frogs and snakes of Gunung Leuser National Park (Sumatra). High walkways afford visitors a canopy perspective at Kinabalu Park on Sabah (Malaysia) and at Taman Negara National Park (peninsular Malaysia).

Laura Riley's photographs depict wildlife elegantly. In one image an African



An anhinga, photographed by Laura Riley.

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paradise flycatcher binds its delicate nest with spiderwebs; in another, a sambar deer feeds shoulder deep, a cattle egret hitchhiking on its spine. The writing style is colorful and crisp: for example, pangolins resemble "animated artichokes." References are grouped for each continent and alphabetized by title, a handy arrangement. General references are tucked at the end of the bibliography. References to backpack guides are included for any reader desiring more detail about a sanctuary's geology, plants, animals, history, and recreation. One of the best is Gadd's *Handbook of the Canadian Rockies* (1995). The index and text use only vernacular names for wildlife, though many readers would find genus and species helpful. Glitches are few: the lack of park locations on a few Caribbean maps and a mention of salamanders as reptiles. Also, almiquis (the Cuban solenodon, *Solenodon cubanus*) are mistakenly described as the world's smallest mammals (they actually weigh about 1 kilogram). Current contenders for the smallest mammal, weighing in at about 2 grams, are Thailand's bumblebee bat, *Craseonycteris thonglongyai,* and the Etruscan shrew, *Suncus etruscus* (Brown 2001).

As the authors intend, this book describes particular sanctuaries with specific wildlife for scientists and similarly interested travelers. Examples of reserves with specialties include Koros-Maros National Park (Hungary), with 12 snail species; Ojcowski (Poland) and Gran Paradiso (Italy), with butterflies; the kelp forest of St. Kilda; twilight flights of swifts over the sapphire lagoons of St. Paul's Subterranean River National Park (Palawan, Philippines); and the southern beech–podocarp forest of Te Wahipounamu World Heritage Site (New Zealand).

The mission of reserves is to protect natural communities that represent the diversity of life on Earth by preserving the lands and water they need to survive. "The most significant bioregional gaps in protected area coverage (less than 2%) are in the tropical dry forests of Mexico, the mediterranean habitats of Chile, and the temperate grasslands of southern Africa," according to Brooks and colleagues (2004). The Rileys' book has the potential to close such gaps in protection. It will inspire more people to visit reserves than the 40 million people who already do so each year. The authors recognize ecotourism as "potentially the most powerful single force for preservation of wild creatures and places" (p. 18). From aardwolf to zubr (European bison), this volume fills an information gap for scientists, environmental organizations, and anyone interested in the best wild places.

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REDEFINING THE ROLE OF NATURAL RESOURCE EXTRACTION IN FOREST CONSERVATION

Working Forests in the Neotropics: Conservation through Sustainable Management? Daniel J. Zarin, Janaki R. R. Alavalapati, Francis E. Putz, and Marianne Schmink, eds. Columbia University Press, New York, 2004. 437 pp., illus. $42.50 (ISBN 0231129076 paper).

In the recent past, one of the weaknesses of the international conservation movement in many forested regions of the world was the failure to recognize the widespread extraction of forest products by local communities. In addition, foresters, biologists, and social scientists rarely seemed to communicate and cooperate with one another or with the communities that occupied the forest of interest. Compounding the problem was the lack of local participation in research that was designed to understand or improve the management of these same forests.

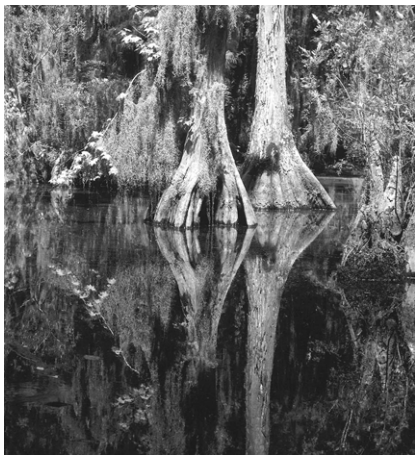
Fortunately, the stakeholders involved in the management and conservation of forests around the world have begun to recognize the necessity of interdisciplinary and participatory research to address the complex issues behind forest use and misuse. An example of this positive change is reflected in a new book titled *Working Forests in the Neotropics: Conservation through Sustainable Management?* This volume, edited by a forest ecologist (Dan Zarin), a natural resource economist (Janaki Alavalapati), a botanist (Jack Putz), and an anthropologist (Marianne Schmink), was the product of an international conference held at the University of Florida in 2002, and the contents explore current ideas related to the efficacy of using forest management as a conservation tool in the diverse forests of Latin America.

As a practicing temperate forest manager with research experience in tropical and boreal biomes, I am happy to see this type of work emerge from our research community, because it is full of case studies from various locations in Central and South America. Although the focus is on lands distant from my home in rural Tennessee, the problems and challenges outlined in many of the chapters strike a chord for me and for other forest managers outside the tropics. Who has not wrestled with the regeneration of the principal commercial species, as described for La Chonta, Bolivia? Or the need for public subsidies to prop up initial efforts of community forest management, as in Quintana Roo, Mexico? Or the mess created by unregulated and unplanned timber harvests, such as those that occur throughout lowland Amazonia, Brazil?

The editors have organized this book into four sections that represent what

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they view as the key issues in Neotropical working forests, and the first section focuses on the use of timber extraction as a conservation tool. Included in this section are detailed descriptions of the silvicultural and logistical problems associated with planned and unplanned logging in Brazil and Bolivia. In chapter 2, Putz sounds almost confessional when he states that forest management for timber production should be part of a larger strategy for tropical forest conservation, and that wood production and forest protection are not necessarily opposites. The second section of the book consists of numerous case studies that emphasize the importance of understanding land tenure, community decisionmaking, building local markets, and myriad other social factors once typically ignored by development organizations that promote community forestry projects. Section 3 delivers a nice spoonful of reality by examining several working forests and the problems stakeholders have encountered when managing areas for multiple

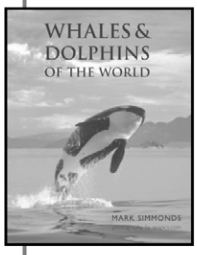


products. Certainly there are no cookbook recipes for the successful management of all forests, and this section draws attention to specific problems encountered when introducing forest management of varying intensities. Section 4 ties in nicely with concepts presented in previous chapters, and the authors address policy modifications that are needed to help sustainable forest management become a reality in the Neotropics.

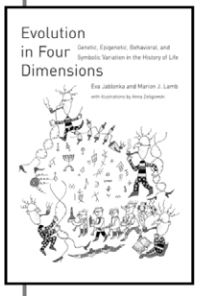
This work should be required reading for foresters, biologists, and social scientists involved in attempts to maintain forest cover around the globe. Most of the writing is clear and concise; I plan to assign several of the chapters in an undergraduate class that examines natural resource issues in the developing world. Whether the pressure to convert comes from cattle ranchers in Brazil or suburban developers in North Carolina, many of the potential solutions to conserving forest cover are the same throughout the world. The importance of maintaining working forests in concert with biological preserves is critical, and as the authors in this volume clearly illustrate, we should all start working with one another before it is too late.

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