species diversity, and the relationships of biotic and physical factors to species life history patterns.

In South America a majority of the what questions have been answered but, in stark contrast to the situation with Africa, very few of the how and virtually none of the why questions have even been considered. (The pattern for Asia is similar, but with even less known.) There are good biological, historical, and cultural reasons for the considerable development of the African literature relative to that on other parts of the tropics, but the lack of information about South American (not to mention Asian) fishes, which becomes painfully obvious from this book, is appalling. This is especially unfortunate, since the Amazon basin alone has close to 8 percent of the world's approximately 20,000 species of marine and freshwater fishes.

Chapters 1 through 6 of Lowe-McConnell's book consider basically the what questions (that is, faunal distributions of the continents, rivers, and African lakes). Chapters 7 and 8 discuss man-made lakes (the author has a book on this subject) and fish production in the tropics. Chapter 9 describes what is known about growth, trophic relationships, reproductive histories, and communication among these fishes (the how questions). Finally, the last full chapter comes alive with why questions. One gem is the simple yet profound generalization, which only someone with the author's broad experience could make, that many of the nocturnal species are larger than the diurnal ones. Is this because of non-visual communication systems, protection from predators, or more efficient food-capturing ability? Both the New World and the Old World have fishes who make their living as scale-, fin-, or even eye-eating specialists. Why, then, are there no cases of flesh-eaters in Africa comparable to the ubiquitous piranhas of the genus *Serrasalmus* of South America? Many questions are exposed the investigation of which could open up wide areas of biological interest.

Predation and competition among fish communities are also considered. The author presents a compromise answer to the hotly debated question whether predation enhances or restricts prey speciation. She suggests that in limnetic (open-water) lake regions predation selects for uniformity among prey (conspicuous individuals are more easily located and removed from schools), which results in a decreased likelihood of speciation, but that in littoral (nearshore) environments, areas with substrate and cover, predation leads to physical separation of populations and increased speciation potential.

The effect of predation in population control is best illustrated by an example from Lake Tanganyika. In this lake when fisheries first removed significant numbers of the major predator, the centropomid genus *Lates*, catches of these predators decreased from 1963 to 1966 and remained low. In contrast, catches of their prey, the clupeids *Stolothrissa* and *Limnothrissa*, rose from 1964 to 1967 and remained high in 1968. This suggests that predation pressure formerly kept the clupeid populations at a low level.

In contrast, many authors seem to concur that competition for food is not a major controller of numbers of species and their distributions in tropical freshwater communities. (One wonders what would be the present state of theoretical ecology if scientists such as MacArthur, Cody, or May had considered fish populations instead of birds.) Competition for space, however, can be critical, as in marine intertidal or coral reef habitats.

Another highlight relates to the four major habitats of tropical waters distinguished by the author. These are: littoral and benthic areas of the great lakes; limnetic areas of the same; equatorial forest rivers; and savanna river floodplains. The argument is made that the first habitat is the most stable in terms of various physical criteria. In such habitats competition for food is negligible and competition for space keen, and in general the populations are *K*-selected. At the other extreme the savanna floodplains are physically unstable, with competition for food and space severe only in season, and the populations are *r*-selected. The fact that the floodplain habitat is considerably older than the great lakes just makes the classification more intriguing. It suggests that the presence of lakes may be critical for a high fish species diversity, and both Africa and South America have had great lakes in the recent or ancient past. This idea is further supported by the recent find of Lake Nabugabo. This small lake, separated from Lake Victoria by a sandbar dated at 4000 years old, has five endemic species of *Haplochromis*, suggesting an extremely rapid rate of speciation.

Overall the book is well written and thorough. As more and more ecologists discover the versatility of fishes, especially for testing and developing theory, this book will provide a key reference for what I foresee as a new wave of ecological thought emerging on the wet horizon.

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A Last Chance in the Amazon

Amazon Jungle: Green Hell to Red Desert? An Ecological Discussion of the Environmental Impact of the Highway Construction Program in the Amazon Basin. R. J. A. GOODLAND and H. S. IRWIN. Elsevier, New York, 1975. x, 156 pp., illus. $13.75. Developments in Landscape Management and Urban Planning, 1. Reprinted from *Landscape Planning*, vol. 1, No. 2/3.

The shortsightedness of 20th-century man in his frenetic rush to squander the nonrenewable resources of the earth will provide a stark object lesson for future historians. A prime example may well be the destruction of the mighty forests of the Amazon basin. Or, more optimistically, it could be that the story of Amazonian development will be cited as the turning point at which modern society began to heed its responsibility to the future by weighing long-range costs against short-term benefits. With regard to the unperturbed natural world, the Amazon is practically our last chance.

In spite of the sensational nature of its title, this is a serious book. The authors are a tropical ecologist and botanist, respectively, with more than half a decade of experience in the Neotropics, including Brazil, between them. Their reaction to the current road-building program in Amazonia is the familiar one of helpless frustration that any teacher experiences when he watches a student make the wrong inference at every juncture in attempting to solve a complex problem.

The Transamazônica is a much more ambitious project than most of us realize. It is not just a road; it is a vast network comprising some 40,000 kilometers of paved and secondary highways designed to provide accessibility to all quarters of the hitherto remote and mysterious Brazilian Amazon. What is more, the construction has proceeded at an extraordinary pace; thousands of kilometers are already in service, and by 1978 the system will be essentially complete.

The project was launched with a sense of urgency in 1970 by President Medici after he had witnessed the demoralization and misery of the northeast in the throes of a devastating drought. Advance planning consisted of hardly more than drawing lines across a blank map, with little apparent regard for the loca-

tion of tribal homelands, topography, soil, or the suitability of regions for colonization and agriculture. No environmental appraisal was commissioned before the construction began, and none has been officially published since.

This book makes a valiant attempt to fill the void. The scope of the subject matter is enormous. There are chapters on deforestation and agriculture, epidemiology, Amerindians, fauna, vegetation, and industrial development. While reviewing nearly 400 references the authors are unavoidably drawn into some superficial, though nonetheless largely accurate, accounts of topics that are far removed from their own professional experience. I was especially aware of weaknesses in the chapter on fauna, the one I am best qualified to judge. No doubt experts on, say, tropical agriculture or public health would make similar remarks about the treatment afforded their fields.

Though the book is pervasively critical and negative, it does make an effort to point out viable long-range alternatives to the government's strong-arm development tactics; for example, selecting locations for colonization on the basis of soil quality, planting mixed gardens instead of monocultures, managing game and timber resources for sustained yield, "refining" forests instead of clear-cutting them, using trunks for timber, pulp, or methanol production instead of burning them, concentrating on pisciculture rather than cattle growing, avoiding regions of disease endemism, and honoring the constitutional rights of the Amerindians.

To live at equilibrium with nature and its cycles one has to think small, and that, regrettably, is anathema to most politicians. Although little time remains before we have done irreversible environmental damage to much of the planet, it is still a lamentable fact of life that the go-slow-and-be-careful advice of prudent scientists is more than likely to be scoffed at by ambitious and impatient public works administrators. The ultimate irony of the Transamazonian Highway is that even if it fulfills its planned purpose of providing for the accommodation of one million settlers, it will succeed in stalling the clock on Brazil's population bomb by just four months.

As with most environmental impact statements, the book is not to be recommended for light reading. For the environmentally conscious person with masochistic tendencies, it is guaranteed to provide a few nights of insomnia.

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Hutchinson's Botany Volume

A Treatise on Limnology. Vol. 3, Limnological Botany. G. EVELYN HUTCHINSON. Wiley-Interscience, New York, 1975. xii, 660 pp., illus. $30.

In this third volume of Hutchinson's masterly treatise, "botany" embraces all those plants which are not planktonic; the plankton were included in the previous volume ("Introduction to Lake Biology and the Limnoplankton," Wiley-Interscience, 1967). Primary production is also largely excluded since it is to form part of a volume on production by all freshwater organisms. (May one hope that that and the others of the "several volumes" referred to in the preface will not appear, like the first two, at ten-year intervals?) Obviously, production cannot be wholly excluded in an account that includes some 200 pages of the chemical factors affecting it. What is excluded is most of the comparative data about rates of production and sizes of crops.

Much of the book is concerned with classical, descriptive ecology or the natural history of flowering plants and other tracheophytes (ferns, fern allies, bryophytes), though there is much of interest on charophytes and algae. This is no bad thing in these days when interest is concentrated on other aspects, such as modeling, a powerful interpretative tool the enthusiasts for which occasionally seem to be somewhat unfamiliar with the natural world. The subject of limnological botany includes matters that some, like myself, may find boring. An example is phytosociology. One feels sympathy with the qualification appended to Hutchinson's statement, prefacing his treatment of the continental European approach, that "the following presentation is intended merely to show how the system works, or as some may say, is supposed to work." Nevertheless, it is right that phytosociology is included. One wonders whether even so broadminded an author as Hutchinson shares prejudices held by the reviewer, for the Saprobian system, so popular in some parts of Europe, is not mentioned.

"Wooden boss in the roof of Selby Abbey, Yorkshire, England, presumably from the first half of the fourteenth century, depicting a heterophyllous aquatic species of *Ranunculus* with laminar floating leaves and very finely divided submersed leaves." [From a photograph by C. J. P. Cave, reproduced in *A Treatise on Limnology*, vol. 3, by permission of the Cambridge University Press and the National Monuments Record (England)]

There are valuable reviews and discussions on plant distribution with, as usual, the author throwing new light on the subject matter or offering informed speculation, notably in relation to chemical factors. Here too the information in some large works (Swedish ones, for example) is integrated into a clear account. The book is far from being devoted purely to descriptive matter. It deals, for example, with passive and active uptake of dissolved materials, the physical factors controlling the distribution of plants in depth, and the old and much-debated question concerning to what extent the roots of aquatic plants function purely as anchors and to what extent they are important for nutrient uptake and translocation. Frequently Hutchinson mentions unsolved problems, and the book should inspire younger workers to begin the large amount of experimental work that is crying out to be done, even in regard to microscopic plants, which can be relatively easy to handle. To take one example, anyone who has observed, even casually, the changes in an underwater aquatic weed bed over several years is likely to have seen marked changes unrelated to seral transformations from water to land. The information available, judging by this book, offers little explanation for such changes, and, in the main, experimental work is lacking.

Hutchinson takes certain important papers and discusses them in considerable detail to illustrate a given theme. This avoids the indigestible information mass found in many reviews. Any impression that the author is being too selective will be dispelled by a glance at the bibliography, over 700 titles, ranging in date from 1673 to 1973.

A word of praise should be given for the general, lake, and species and genera indexes, some 46 pages in all. I made no attempt to check them in detail, but often something on a page led me to look up an allied matter or name, and the indexes never failed me.