comparisons that I feel spoil, for example, some of Leigh's arguments? Restricting his data to large mammals, seven examples, Leigh shows that the amplitudes of population fluctuations in tropical situations are not less than those in temperate species. However, as J. W. MacArthur points out in this volume, environments are best considered in relation to the extent of the variation in their environmental conditions. The semiarid tropical areas, from which Leigh's two wild, tropical examples are drawn, should not simply be grouped with tropical rain forest in a contrast with temperate regions.

The last section of Hutchinson's chapter, entitled "coda," resolved my uncertainty. In a lucid and powerful argument Hutchinson warns of the danger of excessive generalization and points out the need for "a wide and quite deep understanding of organisms, past and present." He reminds his fellow ecologists of Robert MacArthur's own strictures against an obsession with an intellectual approach to ecology. Yes, this was the difference. Here and there in some of the earlier chapters with their apparently limited knowledge of the literature, as evidenced by the restricted list of references, and their arguments based on a single restricted taxon of animals, I felt a vague unease. There are very real difficulties in quantifying bionomic observations (on habitats, feeding habits, and other such parameters); the more the investigator knows of the biology of the organisms in the trophic levels above and below, the sounder will be his judgment in this process. Studies of predators' fluctuations may be misleading without a knowledge of the fluctuations of their prey, whether these be plants or other animals. But how many students of bird ecology measure changes in available prey or game biologists available forage? Certainly some, but are they becoming proportionally rarer or more abundant?

This handsomely produced volume is an outstanding collection of papers on the species composition of communities by the "MacArthur school." So long as the warning of the Hutchinson coda is obeyed we may expect continued and substantial progress to arise from the approach of this school, so that we may better understand our environment and, as Wilson and Willis prophesy in the final words of the volume, engage in "creative work that is orders of magnitude even more extensive."

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Fish in the Inland Tropics

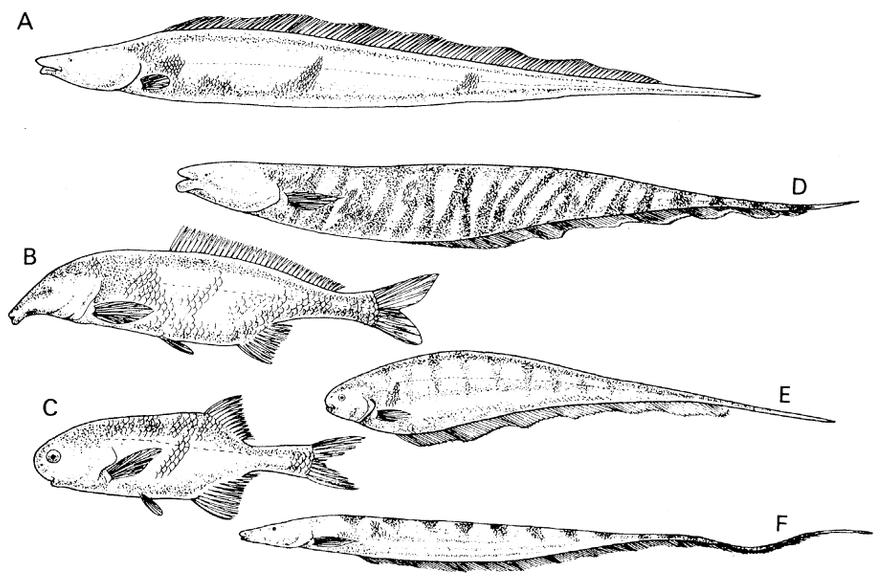
Fish Communities in Tropical Freshwaters. Their Distribution, Ecology and Evolution. R. H. LOWE-MCCONNELL. Longman, New York, 1975. xviii, 338 pp., illus. $26.50.

From the dead-leaf-mimicking South American anabantid *Monocirrhus*, which gently drifts down to the stream bottom to devour an unsuspecting fish, to the overwhelming variety of cichlid species of the Great Lakes of Africa, the diversity of tropical freshwater fishes provides an infinite number of stimulating biological questions. As scientific knowledge of these fishes has proliferated, major contributions have been (dare we say) spawned by four important Old World investigators. A monograph by P. H. Greenwood (*Bull. Br. Mus.* [*Nat. Hist.*] *Zool.* Suppl. 6 [1974]) examined in detail the cichlid species flock associated with Lake Victoria. G. Fryer and T. D. Iles's highly enjoyable book *The Cichlid Fishes of the Great Lakes of Africa* (Oliver and Boyd, 1972) focused on the over 500 cichlid species from the lakes of Africa and the great wealth of literature concerning them. Now R. H. Lowe-McConnell provides a broad review of tropical fishes from Africa, South America, and Asia.

The title may be misleading if one is expecting that all tropical areas will be covered equally. In fact, the book relies heavily on the African literature (about 65 percent), with some treatment of South America (27 percent) and little (less than 8 percent) on Asia. (Central America is entirely omitted for some reason.) This imbalance basically reflects the state of knowledge about these different faunas. The book provides a complete inventory of what is known about tropical fish populations from these regions.

Also included in the book are a bibliography of more than 500 listings and a useful index of fish names along with their synonyms. The latter is most helpful, since many fish species have had their names changed at an even faster rate (and perhaps with less justification) than that at which new African nations have been rechristening lakes and rivers named by their colonial predecessors.

One can appreciate the information available on tropical fishes by considering three types of questions that characterize, in a simple way, the development of biological knowledge: what? how? and why? In Africa, answers to most of the what questions are known from studies of fish taxonomy (what species are present) and zoogeography (what are their distributions). Many how questions have been answered, including ones concerning the behavior of many species (how fishes communicate and reproduce), trophic relationships (how fishes feed), and growth rates. The most basic questions, the ecological and evolutionary why's, have also been considered, including ones concerning competition and predation selective pressures, the food resource spectrum, community organization, the maintenance of



Convergent evolution in two unrelated groups of electric fishes: the mormyroids of Africa (A to C) and the gymnotoids of South America (D to F). "Convergence occurs in types of electric discharge, ecology and body form; propulsion is by undulations of a long unpaired fin in many cases." (A) *Gymnarchus niloticus* (100 cm); (B) *Mormyrus kannume* (60 cm); (C) *Petrocephalus catostoma* (9 cm); (D) *Gymnotus carapo* (30 cm); (E) *Eigenmannia virescens* (25 cm); (F) *Gymnorhamphichthys hypostomus* (15 cm). [From *Fish Communities in Tropical Freshwaters*]

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-