An Ecosystem Surveyed

Serengeti. Dynamics of an Ecosystem. A. R. E. SINCLAIR and M. NORTON-GRIFFITHS, Eds. University of Chicago Press, Chicago, 1980. xii, 390 pp., illus. + plates. $28.50.

The vast rolling grasslands and woodlands of the Serengeti plains cover an area of 25,000 square kilometers in northern Tanzania between 1° and 3°S and lie at a mean altitude of 1500 meters. Hominoids and the local wildlife have interacted in this region for over 3½ million years, yet it is only now that we are beginning to understand how the relative equilibrium of the large-mammal community is maintained.

Following on the pioneering surveys of W. H. Pearsall and Bernhard and Michael Grzimek, the foundation of the Serengeti Research Institute in the early 1960's has led to detailed studies of the ecology of this unique region. Annually within this huge natural laboratory vast herds of over 1 million white-bearded wildebeest migrate across the plains in search of grazing, followed by their ever-ready predators.

Much of the research on large mammals that has been carried out in Africa over the last 20 years has consisted of single-species studies of the large herbivores and their predators, and it is largely at institutes like the Serengeti Research Institute that coordinated programs of ecological monitoring of whole communities and their abiotic environments have been conducted over a long period. Such long-term surveys are at last making it possible to analyze temporal variations of the environment and their influence on the local biota.

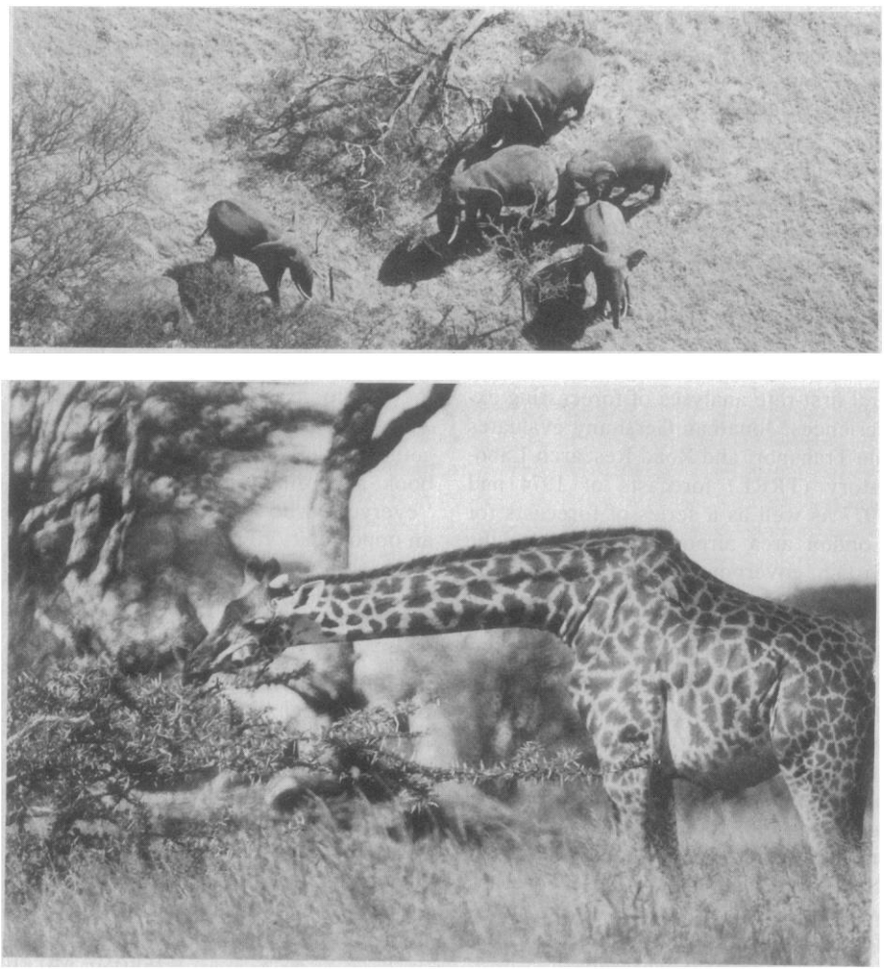
It is sometimes difficult for the ecologist whose work is centered in the temperate zone to appreciate the complexity of a tropical semiarid ecosystem such as the Serengeti, where one is dealing with one of the highest standing-crop biomasses of large mammals to be found in the world today. Faced with the difficulties encountered in censusing such large numbers of mammals, which exist in a variable and extreme climate, it is not difficult to appreciate why it has taken so long for ecologists to have the courage to attempt a synthesis.

After the rinderpest epizootic in 1890, when cattle and wild ungulates were decimated over much of East Africa, the numbers of wildebeest remained comparatively low until veterinary immunization programs in areas surrounding the Serengeti allowed them to increase their numbers dramatically. Between 1961 and 1967 the wildebeest population increased from 250,000 to 500,000 and the buffalo from 30,000 to 50,000. These rapid changes in numbers have been accompanied by changes in grass species composition in the grasslands and regeneration of trees in the woodlands. Thus, although the numbers of wildebeest that compete with buffalo in the woodlands is quite low, local competition for grazing and the effects of trampling have resulted in a leveling off of buffalo numbers after 1970, whereas the wildebeest have continued to increase.

In addition to dramatic and essentially extraneous perturbations like rinderpest, climatic trends affecting available primary production have had a profound short-term influence on the large-mammal population of the Serengeti. This effect is particularly interesting, for although the amount of annual rainfall has remained the same its distribution through the year has changed, with more rain falling in the dry season and less in the wet season. Thus the increased availability of food in what is normally a period of shortage has greatly reduced juvenile mortality among the wildebeest, and as a direct result the population had by 1977 reached a staggering 1.3 million. The association of this upward trend in numbers with rainfall and grass production would lead one to predict that a considerable crash in numbers will accompany any reversion to the former seasonal pattern of precipitation.

These climatic effects on the vegetation and the wildebeest population have also been accompanied by increases in other plains ungulates and their predators, while a reduction in the incidence of fire has resulted in an increase in tree numbers and a decrease in their stature due to browsing by giraffe.

The National Parks of Africa and their wildlife represent a world asset which it is the responsibility of the developed world to support with funds. Yet at a time when the developed world is faced with a severe economic recession, there is a danger of complete withdrawal of funds for wildlife research in developing countries. The reduction of such research in the Serengeti would have severe consequences, not only from the



(Top) "Elephant feeding on an adult [*Acacia*] *clavigera* tree they have pulled over." (Bottom) "Female giraffe prefer to browse immature *Acacia* trees." Browsing by giraffe "shapes trees into pyramid and hourglass shapes. Only the center of the tree is out of reach, so that it grows up and spreads out." [From *Serengeti*]

point of view of pure research or conservation but because it is only by the study of areas subject to little direct influence by humans that the nations of semiarid Africa will be able to establish land use planning criteria that will enable them to raise the standard of living of their rapidly expanding populations. In much of Africa meat from wild animals still provides up to 60 percent of the protein needs, yet understanding of the potential for harvesting the large herbivore communities on a sustained yield basis is still in its infancy. Financial support of the sort of research that was carried out on the Serengeti over the last two decades has now virtually ceased in spite of the fact that the research is still some way from producing predictive models that will be of general value.

The editors of this volume have drawn together a number of experienced ecologists who have attempted to view their research within the broad framework of the Serengeti ecosystem. The book represents one of the most complete and thought-provoking attempts to analyze an African grassland ecosystem to date and will be a valuable source for all students and researchers engaged in the study of ecology in the tropics. Above all, perhaps, we may hope that as a result of the appearance of this valuable volume the work of the Serengeti Research Institute will not die.

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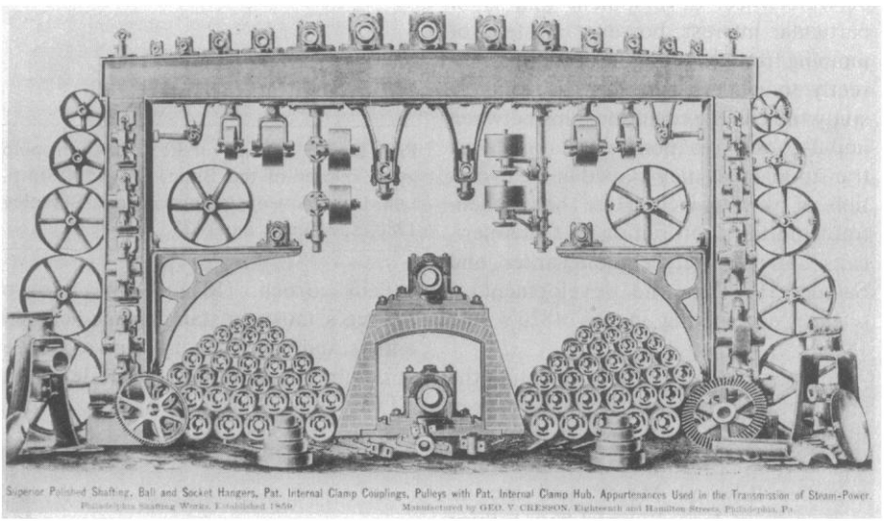
Waterpower

A History of Industrial Power in the United States, 1780–1930. Vol. 1, Waterpower in the Century of the Steam Engine. LOUIS C. HUNTER. Published for the Eleutherian Mills-Hagley Foundation by University Press of Virginia, Charlottesville, 1980. xxviii, 606 pp., illus. $24.95.

Louis C. Hunter's study of waterpower in the century of the steam engine is one of those landmark books that define a subject and in so doing set goals and standards for future work. The author traces the history of direct-drive waterwheels from the scattered rural mills of 200 years ago to the concentrated urban factories of the 20th century.

The strength of the study comes from Hunter's view of waterpower as a system composed of many parts. Unlike previous writers, who usually have limited themselves to description of the wheels, Hunter deals also with the dams and raceways that supplied them with water and the millwork that distributed the power generated to production machinery. Moreover, he weaves the tale of waterpower into the technological, economic, and cultural fabric of 19th-century society. As he grapples with developments of nationwide importance, his pen often dips into the ink of local history to lend his writing an immediacy that is lacking in the publications of the European and American millwrights and engineers that constitute his basic source materials. The book is a pleasing blend of generalization and detail interwoven in the exploration of the problems en-



A millwork manufacturer's advertisement of the 1870's (*The Manufacturer and Builder*, March 1875). Much earlier than in Europe, the traditional massive wheelwork gearing came to be replaced with belting in the United States. "At bottom the acceptance of this innovation . . . simply reflected the steady rise in machine speeds dictated by the drive for increased productivity and lower unit costs. . . . The success of belt drives and the ever rising speed of shafting that it made possible were owing in large part . . . to the redesign and systematic production not only of the shafting itself but of the auxiliary equipment ranging from hangers, couplings, and bearings to the pulleys and belts forming the first and final link between the motor and the machine." [From *A History of Industrial Power in the United States, 1780–1930*, vol. 1]

Piney Branch Mill near Fairfax, Virginia. "With the accelerating advance of industrialization from the 1840s and the progressive though gradual penetration of rural life by the market economy, water mills steadily declined in usefulness and importance. With the farm population more than doubling from 1840 to 1880, the number of gristmills and sawmills in this country decreased by about 10 percent, from some 55,000 to 50,000. Except for the relatively small proportion of these mills driven by draft animals . . . or by wind . . . , the country mills were driven by the energy of falling water." [From *A History of Industrial Power in the United States, 1780–1930*, vol. 1. Photograph by John O. Brostrup, Historic American Buildings Survey Collection, Library of Congress]