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KAYAPÓ INDIAN
 NATURAL-RESOURCE
 MANAGEMENT
 DARRELL POSEY

South of the Amazon's main stream in the basin of the Xingu River, the rain forest intergrades with drier savanna. In this diverse environment the Kayapó, a traditionally seminomadic Amerindian group, survives the encroachment of the developed world. A quick look at the Kayapó would identify them as typical shifting cultivators like most of their Amazonian neighbors. In the course of several years of research, however, a multidisciplinary team of researchers have found that their resource-use practices are far more diverse and complex than had first been assumed.

Kayapó Indians do not separate management strategies into the neat categories of agronomy, forestry, agroforestry, wildlife management, and forestation as Western thinkers try to do; instead, they have a unified view of plant-animal management and conservation. Even traditional scientific concepts of agriculture and domestication are challenged by the complexities of Kayapó plant manipulation. For example, agricultural plots are simply the beginning of a long-term process of planting and sequential management that ends with a mature forest filled with medicinal and edible plants, as well as plants used in building and crafts and useful animals. Many crops are planted and survive only due to the care of their cultivators, but the majority are transplanted from the wild to make a concentrated resource bank in the modified microenvironments created by the Indians. Other useful species are simply allowed to grow in these gardens. Plants known to be favorite foods of wildlife are likewise introduced into fields and these old fields are thought of as hunting reserves for future generations. As gardens grow into forests, they are dominated by fruit and nut trees that bear as long as thirty to fifty years after they were planted.

Crop management is the result of carefully integrated strategies of soil management, ground cover preservation, temperature and humidity control, natural pest management, and well-timed intercropping. The process begins with selection of good agricultural land, which depends on the Kayapó farmer's knowledge of the soils, based on their color, texture, organic matter, drainage, and temperatures. Ground cover is also indicative of surface and subsoil types. Underbrush is cleared and some planting of tubers (sweet potatoes, yam, taro, manioc) and bananas occurs be-

fore the trees are felled to dry and be burned. When burning does occur some two to three months later, the preburn plantings have already developed a healthy root system. A controlled, "cool" burn kills the above-ground vegetation and sterilizes the soil surface; it does not, however, adversely affect the tubers and bananas, which can then take up the nutrients released from the ash during the first rains. Planting time is based on lunar phases; the Indians say destructive mammal and insect pests are least active during moonlit evenings, thus planting is preferred at the onset of a new moon to protect new shoots.

Planting is anything but random. Distinct concentric circles or zones can be observed in Kayapó plots; each zone is managed differently and has a different complement of crops. For example, the center zone is reserved for sweet potatoes and taro, where the soil is frequently aerated by hand and enriched constantly by the addition of ash and organic matter. A second circle is reserved for such nutrient-demanding crops as beans, papaya, melons, pumpkins, yams, cotton, and tobacco.

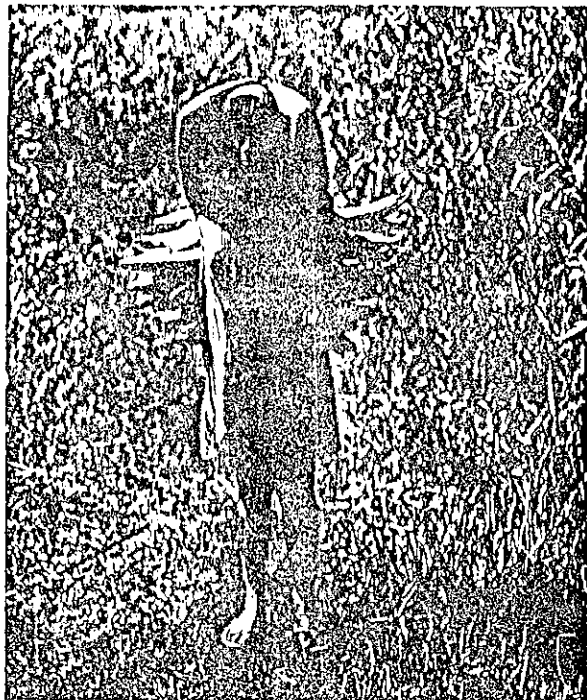
One of the most interesting zones of a Kayapó field is the surrounding *atykma*, a buffer zone between the plot and the surrounding forest. It is full of useful medicinal plants, some of which may lure would-be pests from the more valuable cultigens. A high proportion of these *atykma* plants have nectar-producing glands on their foliage. These nectaries attract aggressive ants, which also deter leaf-cutting ants and termites. Several species of parasitic wasps nest in bananas that ring the fields; these wasps feed on herbivorous caterpillars, thereby also contributing to the natural protection of the Kayapó plots.

An important key to the successful ecological management system of the Kayapó is their preservation of natural corridors of old forests between field plots. These corridors serve as biological reserves that can also facilitate the reforestation of the old fields.

The Kayapó do not limit their resource management to forest areas; savannas are also modified by fire and by the creation of "islands" of forest (*apíté* in Kayapó). Fires may be set fifteen to twenty times a year in savannas near village sites to keep them open and reduce snake and scorpion populations. Fires also alter the flowering and fruiting times of savanna plants.

Kayapó, like many other Amazonian groups, use a variety of plant and animal materials to adorn themselves for festivals.

A woman brings home a load of bananas. The Kayapó cultivate fourteen varieties of bananas.



based upon their plant knowledge; it is never just haphazard. Some plants are fire-tolerant and even stimulated by burning; others are damaged by fire and need protection. The Kayapó may stand guard in their *apêtê* to beat out any flames that threaten fire-sensitive species.

The *apêtê* themselves are some of the most ingenious aspects of Kayapó resource management. These forest islands are actually created by the Indians in piles of a planting medium prepared from termite and ant nests mixed with compost. Into this rich earth are planted hundreds of useful plants. Small *apêtê* are expanded to many hectares over the decades. A complete survey of sample *apêtê* revealed that 98 percent of the plants found in them had at least one use; well over two-thirds had multiple uses. Equally amazing is that these forest islands are composed of botanical resources taken from an area the size of western Europe. Many of the species are used to attract wildlife and are included in the forestation process so that older *apêtê* will abound in useful birds, reptiles, rodents, and other mammals.

The thread of uniformity to these strategies—and the great lesson that can be learned from the Kayapó—

is that biological diversity is fundamental to sustained management of the humid tropics. In sharp contrast to the dominant modern pattern of forest destruction for the establishment of single-species plantations, the Kayapó actually increase biological diversity through their concentration of useful resources.

Native peoples have had much time to discover uses for the natural resources around them and to develop strategies to exploit and manage them. If those who plan the future of tropical areas would follow some of the fundamentals of the Kayapó system, we would be well on a path to a socially and ecologically viable alternative for the humid tropics. The world is threatened not just with the loss of tropical ecosystems but with the loss of the peoples who know how to use them, whose ideas and knowledge may be the richest of all tropical resources.

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