# Coffee and Conservation

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There is a growing campaign involving both conservation and scientific organizations to convince major retailers and the coffee-drinking public to purchase "shade coffee" (grown under a canopy) as opposed to "sun coffee" (grown without an overstory) as a means for preserving biodiversity in the tropics (Conservation International 2000; National Audubon Society 2000; Rainforest Alliance 2000; Sherry 2000). This campaign is based on studies showing that more structurally complex habitats generally support more diverse faunas (MacArthur & MacArthur 1961). At 10 billion dollars annually in revenues, coffee is second only to oil in value as a legal export commodity in many parts of Latin America, and in some countries it is the most important source of foreign capital (Rice & Ward 1997). These statistics mean that large numbers of consumers are involved, who can bring enormous pressure on growers. If significant numbers of people demand shade coffee and are willing to pay for it, then they are going to get it. Nevertheless, we believe there are reasons for caution in employing such a blunt instrument as global market forces on such a complex conservation issue.

Traditional methods for the establishment and maintenance of coffee plantations involve placement of young coffee plants under a canopy provided by one or more tree species. For instance, we have observed in rainforest regions of southern Veracruz that Mexican government extension agents encourage subsistence farmers to plant coffee as a cash crop, providing them with the seedlings and advising them to plant them in sites cleared of understory but where the native tree overstory remains. These kinds of primitive coffee plantations are found throughout tropical regions of the world. They are relatively inefficient in terms of bean production and harvest, however, because of lower yield per plant, fewer plants per unit area, and greater susceptibility to damage from insects and disease.

Efforts to improve coffee production and to recover from the actual and anticipated damage from the devastating coffee leaf rust (*Hemileia vastatrix*) have led to development of new varieties (e.g., *caturra*) that are tolerant of direct sunlight. These "sun-grown" varieties can be grown in the absence of a forest canopy, making them amenable to mechanized agricultural practices, and they produce significantly higher yields than traditional shade-grown coffee while demonstrating seemingly greater resistance to disease. For these reasons, sun coffee has become extremely popular with international aid organizations, national agricultural agencies, and large-scale producers, and vast areas of the tropics have been planted with them. At present, sun coffee makes up about 40% of coffee production in Colombia, Middle America, and the Caribbean (Rice & Ward 1997).

Sun coffee is not a diverse ecosystem, and its byproducts—forest reduction, increased erosion, chemical runoff (from requisite high levels of pesticide treatments), and consolidation of plantations under large landowners—are not positive environmental developments. If the sole result of the promotion of shade coffee were to encourage growers to convert sites that are currently in sun coffee to shade coffee, then there could be few qualms from a conservation perspective about the campaign so wholeheartedly endorsed not only in lay publications but scientific journals as well (Tangley 1996; Sherry 2000).

The goal of the shade-coffee campaign is to encourage consumers to pay more for shade coffee to provide economic incentives to growers (Rainforest Alliance 2000). Ideally, the incentives would be so attractive that growers would convert their sun coffee to traditional shade coffee. But because the financial returns per hectare are

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significantly greater for sun than shade coffee, it seems likely that there will always be a place for sun coffee at the low end of the market for those consumers who want to pay less regardless of the conservation costs.

A more probable outcome of a successful shade-coffee promotion would be to close the profitability gap between sun and shade coffee so that growers considering conversion of existing plantations would leave them in shade coffee. This potential benefit to conservation from a shade-coffee campaign could have some high costs. The first of these is the creation of an incentive to convert existing areas of primary forest to shade coffee that are too remote or steep to be converted profitably to other forms of cultivation. Although shade coffee may represent a relatively benign type of agriculture, it is not equivalent to native forest. Second, the widespread endorsement of shade coffee represents a dramatic "lowering of the bar" in terms of conservation goals. Shade coffee, even "traditional" shade coffee, cannot provide ecosystem services comparable to the native forest it replaces. Indeed, there are several studies that document significant ecological differences between forests and shade coffee. For instance, the mammalian, avian, and herpetofauna of Middle American shade-coffee sites are depauperate when compared with those of native forest (Rendon-Rojas 1994; Gallina et al. 1996; Martinez & Peters 1996; Roberts et al. 2000). Even when forest species occur in shade-coffee plantations, they are seldom found far from forest edges (Martinez & Peters 1996; Roberts et al. 2000).

A further example of the potential unintended consequences of shade-coffee promotion is its possible effects on the highland pine-oak (*Pinus-Quercus*) ecosystem, recognized as one of the most endangered habitats of Middle America (Dinerstein et al. 1995). Over 150 species of birds are found in this community (King & Rappole 2000), including the Golden-cheeked Warbler (*Dendroica chrysoparia*), an endangered migratory species and pine-oak obligate (Rappole et al. 1999, 2000). Based on our observations, the principal threat to pine-oak is conversion to agriculture, and coffee is one of the few types of agriculture suited to the high elevations and steep slopes where most of the remaining habitat is found. Removal of the native oak midstory, which presumably would accompany the most benign conversion of pine-oak to coffee, would render the habitat unsuitable for Golden-cheeked Warblers, which forage nearly exclusively on oak (Rappole et al. 1999), and for many other members of the avian community. Thus, although some types of shade coffee may have a legitimate role as a buffer for forest reserves (Moguel & Toledo 1999), shade coffee is not sufficient to preserve the biota of the native forest. Perhaps the strongest claim for the ecological equivalency of shade coffee and forest is that some types of plantations can provide "biodiversity" similar to that of forest. However, diversity indices tell little about the equivalency of ecological communities (Rappole & Morton 1985). An agricultural site in which 30 forest bird species have been replaced by 30 open-country bird species can have the same avian diversity as a forest site.

A third problem is that, in the apparent interests of sending a clear message to the coffee-drinking public, promotions often blur the distinction between the different types of shade coffee. Methods of shade-coffee cultivation vary widely. At one end of the spectrum is the type used by subsistence farmers that hardly differs from native forest; at the other end is a two- or three-crop system with coffee plants as the understory and low-pruned trees (e.g., cacao [*Theobroma cacao*] or citrus [*Citrus*]) as an overstory. Economic forces tend to push growers away from plantations that mimic forest and toward those that mimic a citrus grove. Both extremes qualify as "shade coffee," but their contributions to biodiversity are significantly different. For instance, coffee plantations with tall, multilayered overstories of native trees can have avian diversity comparable to that of native forest, whereas other types of shade coffee, dominated by single tree species pruned to 5–6 m, are little different from sun coffee in terms of avian diversity and species richness (Greenberg et al. 1997). The issue of accuracy is critically important because promotions often make no distinction between different types of shade coffee, or they make a distinction in one part of their materials but make no distinction in another (Conservation International 2000; Rainforest Alliance 2000). As Rice and Ward (1997) note, "Consumers are now faced with a growing array of coffees produced beneath a variety of systems, but seldom realize the distinction being made." These distinctions can be quite fine. For instance, the Organic Crop Improvement Association has the oldest and most successful process for certifying environmentally friendly coffee farms, accounting for as much as 2% of the world market (Rice & Ward 1997), but they include no explicit requirements for shade cover (Organic Crop Improvement Association International 1999). Yet their producers, or indeed anyone marketing coffee as "shade-grown," are likely to reap some benefit from an increased market for the product whether or not they meet the rigorous certification requirements for the diversity of plantation tree species prescribed by some certifying conservation organizations.

Given these considerations, there are obviously important issues yet to be addressed regarding the conservation value of shade coffee. With 700,000 coffee growers in northern Latin America alone (Rice & Ward 1997), what sort of certification process will assure that the funds generated to support shade coffee actually go toward tropical habitat conservation? What is the total acreage of shade coffee of different levels of overstory diversity, and what are the differences in terms of community structure and ecosystem services provided by these

different shade-coffee types compared with the forests they have replaced? What are the likely and actual outcomes in terms of coffee-plantation management of an infusion of funds promoting shade versus sun coffee? Most important, what are the effects of a shade-coffee campaign on efforts to promote the preservation of native forest? These and many other critical ecological, economic, and sociological questions should be answered before the conservation and scientific communities provide their unqualified endorsement of shade coffee.

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