

# The role of cacao plantations in maintaining avian diversity in Southeastern Costa Rica

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## Introduction

### *Agroforestry Systems in a Conservation Perspective*

Loss of tropical forest has been targeted as a major contributor to the worldwide loss of biodiversity (Nations, 1993). Northern Latin America, in particular, continues to lose its few remaining forested lands to agricultural clearing at a rate of over 1-4% per year with native forest having long since been cleared in many regions (Greenberg and Reaser, 1995). Costa Rica, which boasts of protecting 11% of the country through managed parks, refuges and reserves, has one of the highest deforestation rates in Latin America (Vandermeer and Perfecto, 1996).

The magnitude and rate of tropical forest clearing in Latin America have challenged conservationists to quickly establish large reserves in the last few frontiers of the region not open for development. Often overlooked, however, is that the conversion of tropical forests to agricultural lands is rarely complete, and often not permanent. Within the expanding agricultural landscape, one can find a significant amount of forested area in the form of managed agroforestry systems, or agroecosystems, whose features of structural complexity, microclimate buffering, and the diversity of canopy food plants contribute to the protection of forest biota (Perfecto *et al.*, 1996; Young, 1994; Whitmore and Sayer, 1992; Alcorn, 1990; Beer, 1987). These economically important anthropogenic habitats will have increasing conservation value as large tracts of tropical forest continue to be reduced or eliminated (Sherry and Holmes, 1996, 1994; Schelhaus and Greenberg, 1993; Pimentel *et al.*, 1992, Gomez-Pampa *et al.*, 1990).

### *Birds and Biodiversity in Agroforestry Systems*

There have been relatively few studies focusing on biodiversity in agroforestry systems. Most of the work done in this area has been conducted in the last decade (Greenberg *et al.*, 1997a, 1997b; Wunderle and Latta, 1996; Estrada, 1993; Hagan and Johnston, 1992; Heinen, 1992; Room, 1971; Leston, 1970). Of the studies using birds as indicators of biodiversity and habitat quality, not many have focused on year-round resident birds, nor have they included measures of habitat or landscape features attributed to high levels of biodiversity.

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Particularly noteworthy, however, have been the recent studies on birds in coffee (*Coffea sp.*) plantations of the neotropics. When compared to a variety of agricultural habitats and natural forest, shade coffee plantations in the state of Chiapas, Mexico, were found to harbor a total bird species diversity second only to moist tropical forest and also support a relatively high number of forest migratory species (Greenberg, 1997b). In the Dominican Republic, shade coffee plantations compared favorably with other natural forest habitats in terms of overall bird diversity (Wunderle and Latta, 1996). Similar results were obtained from studies in western Panama (Parrish and Petit, 1996).

Less attention has been given to the potential cacao (*Theobroma cacao*) plantations have as refuges for biodiversity. One study using mist-netting surveys throughout Northern Latin America found that shaded cacao plantations support high numbers and high diversity of neotropical migratory birds (Robbins *et al.*, 1992). By contrast, results from a study in the extensive, heavily-managed cacao plantations of the southern Bahia region of Brazil indicate that large frugivorous and insectivorous resident bird species, as well as forest understory specialists, are uncommon or absent. However, wide-ranging birds and mammals are present and those plantations near forest patches have greater bird and mammal diversity than isolated plantations (Alves, 1990). Finally, cacao plantations of Tabasco, Mexico were relatively depauperate in forest bird species, possibly due to a high degree of isolation from forested habitat (Greenberg *et al.*, in prep).

## Study Site

### *Location*

This study was administered by The Nature Conservancy's Wings of the Americas program with support from several in-country organizations (see below). It took place in the Caribbean lowlands of the canton of Talamanca, Costa Rica, near the Panamanian border (9° 30' N, 22° 40' W). The majority of study sites were located within the Talamanca - Caribbean Biological Corridor, a two to ten mile-wide band with varied protection status extending from the continental divide to the Atlantic coast. It is a culturally and biotically rich region of Costa Rica, yet has been the site of relatively little biological research. (The Nature Conservancy, *in review*).

### *Character of the Landscape*

The landscape of this region is a product of the boom and bust cycles of banana and cacao cultivation of the last century, and more recently, of increased deforestation. Interspersed within the dominant land uses of cacao and banana cultivation are small patches of pasture, open agricultural fields, and larger patches of forest, most of which have been selectively logged between one and 40 years ago.

In response to the introduction of monilia pod rot disease (*Moniliophthora roreri*) in the late 1970's, many farmers cut down their cacao plantations for pasture or the cultivation of subsistence crops. However, cacao plantations still comprise a large area within the region in either an abandoned, yet biotically rich state, or in a reclaimed state in 2 ha to 10 ha patches. Fifty-six percent of all farms in the lower Talamanca region (below 300 m) produce some cacao. Approximately 69 percent of these farms have some natural forest trees present on their land (Hernández-Auerbach, 1995), creating a complex of land uses which, if appropriately managed, could effectively enhance the size and quality of the biological corridor. Cacao is regaining its former level of economic prominence in the area as a result of an organic cacao project initiated in 1994 by Asociación ANAI and APPTA (Talamancan Small Producers Cooperative), two members of the Talamancan Biological Corridor Commission which have longstanding relationships with Talamancan farmers.

## **Purpose and Methods**

The purposes of the study were 1) to assess the relative ability of the cacao habitats to provide surrogate forest habitat through bird community structure comparisons; 2) to determine which combination of habitat and landscape variables were most conducive to forest-like bird species composition; and 3) to make management recommendations to cacao farmers that will enhance higher levels of biodiversity.

Between 11 November, 1997 and 17 March, 1998, birds were systematically censused using the point-count visual/aural surveying technique (Petit *et al.*, 1994). Forest, abandoned cacao, and managed cacao were surveyed using a total of 100, ten-minute 25m radius point counts in each of these habitats. All points were surveyed twice, once during a wetter part of the year (November/December) and again during a drier part of the year (February/March). At each point count circle, various bird variables were recorded for community structure comparisons. In addition, vegetation variables characterizing habitat structure were recorded and linked to bird variables. Also linked to bird variables were distance measures to adjacent habitats in order to characterize the landscape within which a given point count site was situated.

## **Results and Discussion**

### *Bird community comparisons*

A total of 1464, 1713, and 1708 individual birds and 130, 131, and 144 total species were detected in forest, abandoned cacao, and managed cacao respectively. Abandoned and managed cacao had significantly more individual birds per point compared to forest ( $p < 0.05$ ), and managed cacao significantly more species per point than the other two habitats ( $p < 0.01$ ). This result is not surprising, since shaded cacao agroecosystems can contain structural characteristics of both forest and early successional habitats, allowing many more avian species to find suitable refuge. None of the three habitats differed significantly with respect to the presence of forest generalists - those forest species which wander into adjacent disturbed habitats - hinting that cacao may serve as an adequate forest buffer.

In other comparisons, forest specialists – species requiring intact forest all of their lives - were significantly less represented in the cacao habitats ( $p \ll 0.001$ ) with managed cacao having significantly more non-forest individuals ( $p \ll 0.001$ ). Furthermore, similarity analyses based on a combined total of 35 guild and microhabitat descriptors revealed that forest and abandoned cacao bird communities were highly similar in species composition (Pearson's  $r = 0.91$ ), and forest and managed cacao less similar in composition ( $r = 0.75$ ). All habitat comparisons, however, were highly significant in their degree of similarity (Bonferroni adjusted  $p \ll 0.001$ ). Additionally, the similarity coefficient for forest and managed cacao was even higher than that recorded for a comparison between forest and shaded coffee plantations of highland Mexico (Greenberg *et al.*, 1997b).

### *Vegetation and Landscape Influences*

At the time of writing, stepwise multiple regression analyses linking vegetation and landscape variables was yet to be completed. However, differences with respect to these variables are thought to be the sources of significant variability at the site level, mostly with respect to managed cacao. Upon completion of these analyses, the implications of these variables will be discussed, particularly in regards to biodiversity enhancement through cacao management.

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