# THE MAINTENANCE OF AVIAN MORPHOSPECIES RICHNESS IN HUMAN MANAGED MICROHABITATS

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*Abstract:* Conservation often focuses on the restoration or protection of pristine environments. In the Monteverde cloud forests, actively managed and urbanized areas have been integrated into these pristine environments. The aim of this study was to better understand the differences in avian species richness between tropical forest and nearby managed areas. We predicted that a human altered site would contain similar morphospecies richness to a forested area (alpha diversity), possibly because both habitat types would provide unique structures, habitats, and resources. After comparing bird diversity between human managed and forested sites, we found that actively managed sites had significantly more bird morphospecies. Our results indicate that actively managed areas of a tropical cloud forest provide habitats for many bird species and will be important in future conservation strategies.

*Key Words: active management, conservation, species richness*

## INTRODUCTION

The traditional view of conservation is based on the desire to preserve natural environments without human influence or interference, and to restore damaged habitats to their original state (MacMahon and Holl 2000). However, because there is very little undisturbed land left in the world (Vitousek *et al.* 1997), conservation of biodiversity must also incorporate sustainable development.

In the cloud forests of Monteverde, land use and alteration have increased with a booming ecotourism industry (Scrimshaw *et al.* 2000). Although many conservationists believe that the forest should be preserved (Schwartzman *et al.* 2000), the town of Monteverde has also displayed environmentally conscious development by maintaining gardens, trees, and meadows (Scrimshaw *et al.* 2000). Because the managed areas of Monteverde contain diverse habitats, cosmopolitan species may not be able to achieve the dominance seen in more urban environments (e.g., San Jose) (Shochat *et al.* 2006 b).

Our study explored the idea that human-managed land does not necessarily diminish species diversity compared to intact cloud forest because human-managed land may offer a unique environment in which species can colonize. We hypothesized that human-managed land in Monteverde would support

avian species diversity, and we predicted that managed sites and forest would contain comparable avian morphospecies richness.

## METHODS

Our study took place on 20-22 January, 2007 near the Estación Biológica Monteverde, Costa Rica. We conducted our study in two habitat classifications: undisturbed forest and human-managed land. Forest locations were near trails to the East and West of the Estación Biológica in areas of primary and secondary forests, respectively. We formulated our definition of human-managed sites based on a compilation of descriptions given by Shochat *et al.* (2006 a). They categorized human land use into three classes: urban, suburban, and rural. Urban areas were either dominated by built structures or were populated by more than 620 persons per $km^2$. Suburban areas had less land coverage and were on the edge of urban areas, and rural areas were other residential lands. Our managed sites included all three of these classes, including a banana plantation and cleared plots along the access road to the Estación Biológica, the Monteverde town center, and the Hotel Belmar grounds.

With an observation team in each site-type, we simultaneously observed and documented all birds in one-hour time intervals, totaling eight hours per site-type over three days. We recorded as much detail as possible for each bird sighting, ranging from morphotypes to families to species. If we heard bird calls, we used the sound to help locate the bird and, if possible, make an identification. We calculated the total number of different bird morphospecies per observation period for each site. In total, we observed eight separate forest sites and eight separate areas of managed land.

We matched the observations by time and used a paired two-sample t-test to compare bird morphospecies richness in forested and managed lands. We also compiled a Venn diagram of the birds we were able to identify to species-level for both forested and human-managed sites. This allowed us to compare unique morphospecies and overlapping morphospecies between the two site-types.

## RESULTS

There were 49.2% more bird morphospecies in the managed sites than in the forested sites ($t_7$=2.26, P=0.03; Fig. 1). There were three known bird species found in both of the sites, as well as fourteen that were unique to the different habitat types (Fig. 2).

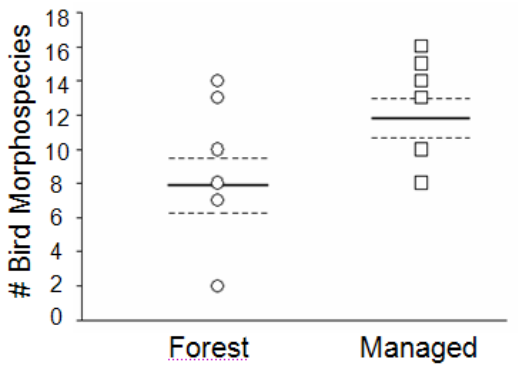


Figure 1. Bird morphospecies richness for both forested and managed sites in Monteverde, Costa Rica. Solid lines represent means, and dotted lines represent ± 1 SE.

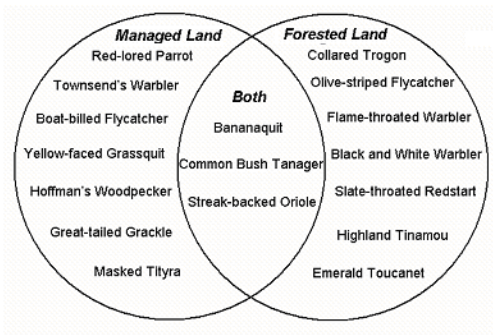


Figure 2. A Venn diagram showing some of the species-identified birds in each of the habitats as well as the species overlap between both.

## DISCUSSION

The results support our hypothesis that cleared and managed land would maintain bird species richness comparable to that of forested areas. Morphospecies richness in managed land was actually higher in seven of eight observation periods. Several mechanisms in managed land could be maintaining and possibly increasing avian morphospecies richness, including increased habitat heterogeneity and resource subsidies (e.g., food items or structural complexity; Roth 1976, Freemark and Merriam 1986).

Rarefaction analysis would be necessary to more accurately compare the avian richness between habitat types by standardizing against the number of birds observed. However, because we only considered morphospecies richness data per observation period and did not record morphospecies density, we could not use rarefaction to compare richness between our habitat sites. The low-light and dense flora of the forest sites made this strategy impossible. From a bird watcher's perspective, the managed areas contain a high, visible avian richness that differs in composition between sites. Further studies could investigate the true avian richness of Monteverde's forest habitats and how this compares to the high visible richness in managed areas.

The city of Monteverde and its human-altered surroundings (managed sites) were highly heterogeneous, containing patches of buildings, trees, low brush, meadows, gardens, and ponds. Birds used these areas to socialize, perch, and forage, taking advantage of resource subsidies such as pond insects or fruiting trees (*personal observations*). The species utilizing managed habitats were numerous but may be specifically adapted to colonize only after human alteration

(Stiles and Skutch 1989). For example, the red-lored parrots, golden-browed chlorophonia, and Hoffman's woodpeckers were only seen in managed sites. The Hoffman's woodpecker (Honduras, Nicaragua, Costa Rica) and golden-browed chlorophonia (Cost Rica, Panama) are only found within Central American countries and require habitat outside primary or secondary cloud forest. Other species including the emerald toucanet and collared trogon were seen only in the forest. Further research is necessary to understand the species composition variation between managed habitats and forest, as well as the distribution of rare or endemic species.

Preserving and restoring pristine habitats in the tropics are often emphasized in conservation efforts; however, these habitats are often a small proportion of total land area (Powell *et al.* 2000, MacMahon and Holl 2000). Our findings suggest that rural urbanization and active land management in a tropical cloud forest can maintain avian morphospecies richness in a manner similar to management in temperate zones (Freemark and Merriam 1986). Our study demonstrates that both the forest and managed areas can be centers of avian diversity and therefore important in ecotourism (e.g. bird watching) and environmental education. If further urbanization occurs in Monteverde, it must continue to incorporate trees, gardens, and other areas useful to birds. Environmentally conscious development would allow the managed areas to continue hosting bird species as part of a dynamic landscape (Andren 1994, Schwartzman *et al.* 2000). Further study could follow the urbanization of Monteverde through time and observe the changes in species composition in both nearby forests and newly managed areas.

Urbanization is often considered an invasion of natural habitats; however, it would benefit biodiversity to consider urbanization a dynamic part of a changing environment. A shift in focus may spark an interest in the creative and effective methods of maintaining species richness and environmental health in a cityscape.

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