Impact of tourism on bird diversity, abundance, and community composition

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ABSTRACT

In recent years the ecotourism industry has been touted as offering incentives for protecting biodiversity while promoting economic growth for the surrounding communities. This paper examines the impact that ecotourism has on bird communities in the Monteverde Cloud Forest Preserve. Abundance and species richness for birds were compared on tourist trails and trails closed to tourist. The results indicated no significant difference in H' values between trail types. The average species richness between trail types was not significantly different, but tourist trails significantly increased in average abundance. Increases may be a result of food resources provided by the Preserve on tourist trails or to a decrease in predation on such trails. Sustainable tourism requires an awareness of the pitfalls of tourism and requires efforts to minimize the impact visitors have on the environment.

RESUMEN

En los últimos años la industria del turismo se ha presentado como una solución potencial para los problemas de conservación, porque ofrece el estímulo para proteger la biodiversidad al promover crecimiento económico para las comunidades circundantes. Este estudio examinó el impacto que ese turismo tiene en comunidades de aves en la Reserva de Bosque Nuboso de Monteverde. La abundancia y la riqueza de especies para aves se compararon en senderos turistas y en senderos cerrados al público. Los resultados no indicaron diferencias significativas en H' entre los diferentes tipos de sendero. La riqueza de especies promedio entre los tipos de sendero no fue significativamente diferente, pero la abundancia promedio entre los tipos de sendero fue significativamente diferente. Los aumentos pueden ser el resultado de recursos alimentarios más abundantes de alimento proporcionados por la Reserva, o ser debidos a una disminución en la depredación en los senderos. El turismo sostenible requiere el conocimiento de las posibles trampas del turismo y requiere esfuerzos para aminorar el impacto que los visitants puedan tener en el ambiente.

INTRODUCTION

Ecotourism provides benefits for local communities by creating jobs, supporting biodiversity conservation, and raising public awareness of environmental issues by exposing people to nature (Blamey 2001). The ecotourism industry in Costa Rica has grown immensely in the past decades and currently one of the largest grossing economic industry in Costa Rica (Rojas 2004). Between 2003 and 2004 the number of foreign tourists visiting Costa Rica increased 27%, totaling in excess of 3.2 million (Loloaiza 2004). Following this trend, the well-known Monteverde Cloud Forest Preserve has seen a dramatic increase from 25 thousand visitors in 1990 to over 73 thousand tourists in 2004 (Rodriguez pers. comm., Fig 1).

However, ecotourism can negatively impact natural communities. Stresses induced by ecotourism can cause changes in population densities, community

composition, and the behavior of animals (Hindinger 1999). Beale and Monaghan (2004) demonstrated that bird communities in southeast Scotland perceive humans as potential predators. Their studies revealed that the hatching and fledging success of Kittiwakes, *Rissa tridactyla,* were significantly reduced when colonies were located in close proximity to tourist destinations. A study conducted in Tikal National Park, Guatemala, showed that animal populations responded differently following a sharp increase in ecotourism. Three mammal species experienced increases in their populations while three species of birds decreased in abundance (Hindinger 1999). Case studies conducted in Milford Sound, showed dolphin behaved differently when confronted with tourists. Populations were shown to both actively avoid boat interactions where as other species were more likely to travel after an interaction with a vessel (Leusea 2004).

The avifauna of Monteverde has been widely studied, yet little quantitative data exists on the effects of human activity on bird populations (Young and McDonald 2000). Specifically, widening trails and creating new paths for ecotourism may encourage colonization birds that prefer disturbed habitats (Wheelwright 2000). Birds, such as the Ochraceous Wren, *Troglodytes ochraceus,* Slate-throated Redstart, *Myioborus miniatus,* and Golden-browed Chlorophonia, *Chlorophonia callophrys,* readily colonize these disturbed habitats (Stiles and Skutch 1989). Additionally, the expanding ranges and increasing densities of birds that respond positively to disturbed areas can potentially cause increased competition with other species for food (Wheelwright 2000).

This study seeks to quantify changes in Monteverde Cloud Forest Preserve avifauna subjected to varying levels of ecotourism visitation by comparing bird diversity, abundance, and composition on trails frequented by tourists versus trails closed to the public. This research will provide an important case study on the effects of ecotourism and human activity on tropical avian communities.

METHODS

Data collection took place in the MVCFP between the dates of April 20th and May 7th using trails restricted to lower montane wet forest. An altimeter was used to insure that all data points fell within the range of 1500-1600m. Trail types were classified as tourist trails (South El Camino and Sendero Bosque Nuboso) and those with restricted access (Closed Trail). Tourist trails were open to the public while closed trails were accessible by only a few researchers. There was no noticeable difference in the age, species, or structural complexity of tourist versus closed trails. Six sample sites were located on each trail type approximately 200m apart. Sites one through six were located on tourist trails while sites seven through 12 were located on trails closed to the public. Sites seven and eight on the closed trails were within 100m of the tourist trails.

Point counts were used to sample birds using a combination of auditory and visual identification. Nesting areas on trails were visually identified between sites. Nests were observed for activity each day to assure they were being used. Stiles and Skutch (1989) was used to aid in visual identification of birds while audio identifications were based on recordings of common Cloud Forest birds of Monteverde (Ross 1997). Birdcalls were only documented from a maximum distance of 50m. Point counts lasted 15 minutes in duration and were taken from 7:00AM to 10:00AM and again from 2:00PM to 5:00PM. The visitation time of site numbers was alternated on a twelve-day cycle to avoid

sampling bias due to the time of day (Table 1). Bird abundance was calculated with and without the presence of hummingbirds. Tourist trails offer a better vantage point for viewing birds. To insure that the number of birds identified on each trail type represents the actual number of birds found there the percent of identifications made by call was calculated for both communities.

RESULTS

Overall a total of 1963 individuals were identified belonging to 47 species. The tourist trails had a higher richness and abundance (S = 43, Smarg = 5.98, N =1119) than the closed trails (S = 36, Smarg = 5.19, N = 844). Chi-squared values indicated no significant difference for richness (x^2 = 0.62, d.f. = 1) but found a significant difference for the abundance between trail types (x^2 = 96.4, d.f. = 1). Bird abundance was not significantly affected by the presence of hummingbirds (x^2 = 0.765, d.f. = 1). The percent of individuals identified by call for the tourist trail was not significantly different from closed trails (68% vs. 72%, x^2 = 0.114, d.f. = 1). The evenness for tourist trails (E = 0.763) was slightly lower than that of the closed trails (E = 0.807). No significant differences in H' values were observed between the two trail types (t = 0.46, P < 0.05).

The 12 sites varied in their average species richness both within and between trails types (Fig 2). The most substantial differences, however, occurred more between different trail types than between trails of a single type (tourist vs. closed, Table 2). Although not significantly different (P = 0.785), the lowest average species rich site for tourist trails (8.000 +/- 1.128) was still greater than the highest average species rich site for closed trails (7.833 +/- 1.642).

Similar trends were found for the average abundance for each site (Fig 3). The most substantial variations were found between, not within, trail type (Table 3). Though not significant (P = 0.0615), the lowest average abundance for tourist sites (14.250 +/- 3.289) was greater than the highest average abundance for closed sites (12.000 +/- 2.174).

Seven active nest sites were found on the tourist trails while no nests were found on the closed trail. The nests belonged to seven different species of birds including: Black-faced Solitaire, Black Guan, Emerald Toucanet, Golden-browed Chlorophonia, Grey-throated Leaftosser, Resplendent Quetzal, and a Slate-throated Redstart. Mating pairs from each of these species were observed tending nests on tourist trails.

The most common birds (Appendix 1) seen in this study were usually observed everyday on four or five of the tourist sites. For example, the Common Bush Tanager was observed on a minimum of four tourist sites, ten out of12 days (n = 153). On the closed trails the Common Bush Tanager was identified on a maximum of four sites for only seven of the 12 days (n = 123). This suggests that tourist sites have a high degree of overlap in their species richness. Therefore, there is a higher likelihood of observing more species of birds in a given observation period on the tourist trails (Fig 2). It was also more likely that more individuals of these species would be seen for a given observation period (Fig 3).

DISCUSSION

Growing ecotourism in Costa Rica is putting increasing pressure on reserve systems to develop ways to accommodate more tourists while minimizing impact on local wildlife (Loloaiza 2004). This study expected to see that bird communities along highly trafficked trails would have a lower diversity and species richness than trails that were closed to the public. However, the results of this study did not support this hypothesis and indicated that the total diversity and species composition for each of these communities was very similar.

One explanation for the increased abundance of bird species found on tourist trails is that food resources are more plentiful. The Monteverde Cloud Forest Preserve has incorporated different species of hummingbird-pollinated and frugivorous bird dispersed plants including: *Columnea lepidocaula, Psychotria elata, Cenropogon solanifolius,* and *Heliconia tortuosa* (Rodriquez pers. comm.). The majority of these plants are located around the reserve buildings and restricted to a single trail know as the "pollination garden," which has over 100 individuals representing hummingbird-pollinated plant species. The pollination garden is in close enough proximity to the observed study site that it may be acting as a species source, increasing the local abundance of birds on the surrounding trails.

In addition, several Lauraceous trees had also been planted near the major trails (Rodriguez pers. comm.). The Preserve hopes to attract more of Costa Rica's biggest tourist attraction, the Resplendent Quetzal. Lauraceaeous fruits are rich in amino acids and lipids, which provide a critical component to the Resplendent Quetzal's diet (Groom 2000). In the next 15 years the MVCFP plans on incorporating 3000 Lauraceous trees, which could increase bird abundance in the future.

Another reason for an increase in species abundance on tourist trails could be a result of fewer predators. Negative impacts on foraging and reproductive rates in Felids have been attributed to tourism (Hindinger 1999). In addition, long-term studies of primates often report increases in population sizes due to decreased predation associated with the presence of researchers (Griffiths and Van Shaik 1993). Where human traffic is common, some animals become habituated to human presence (Griffiths and Van Shaik 1993). As animals become accustom to humans they may use tourist areas as "escape valves" from predators which avoid human contact (Hindinger 1999). Birds may adopt similar techniques to evade predation. Birds are especially susceptible to predation before they even have a chance to fly.

Nest predation by mammals accounts for a substantial amount of mortality in bird species of Monteverde (Young and McDonald 2000). The presence of more nest sites may be an indicator of fewer predators. On the tourist trail seven nests belonging to seven different species were identified within 25m of the trailhead (Table 2). Studies in Europe have shown that nest predation is reduced in human altered environments (Marhn and Clobert 1996). House Wrens in Monteverde showed a significant increase in nestling success when they nested in close proximity to humans (Winnet-Murray 2000). However, direct observation of predators was not assessed in this study. Predation pressure could be compared between trail types using artificial nests and quail eggs to reveal the degree to which ecotourism affects predator densities (Hartley and Hunter 1998).

One variable this study did not test was the relationship between trail width and species richness and abundance within bird communities. Generally, tourist trails were wider than closed trails. Major trailheads, such as South El Comino and Sendero Bosque Nuboso, had trail widths between two and three meters to accommodate guided tour groups (Rodriguez pers. comm.) Wider trails may increase temperature, available light, and evaporation associated with edge effects (Zartman 2003). These factors alter plant community composition, which could indirectly influence the species richness and abundance of birds (Lovejoy *et al.* 1986). Although the closed trail sampled had very few visitations it was not completely free of human activity. Taking richness and abundance counts farther away from the Preserve would help insure that human activity was not affecting the bird communities found there.

Bruce Young (2000) asserted that ecotourism directly effects just a few hundred of the 20,000 ha preserved in Monteverde, further adding that any negative effects felt by avian populations in areas under the influence of tourism would be negligible with regard to the whole reserve system. However, this is a dangerous attitude to adopt from a conservation standpoint. Tourist activities may be altering predator-prey interactions and changing the distribution of seed dispersers (Hindinger 1999). Tourism can also encourage reserves to enhance nature in an effort to attract more wildlife for the "tourist experience." Tourism does impact local bird communities and future efforts should be made to understand the effects of tourism and how reserves can minimize the impact tourists have on the environment.

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Day	Time and Order of Sites Being Sampled	
	7:00-10:00AM	2:00-5:00PM
1	Sites 1,2,3,4,5,6	Sites 7,8,9,10,11,12
2	Sites 7,8,9,10,11,12	Sites 1,2,3,4,5,6
3	Sites 6,1,2,3,4,5	Sites 12,7,8,9,10,11
4	Sites 12,7,8,9,10,11	Sites 6,1,2,3,4,5
5	Sites 5,6,1,2,3,4	Sites 11,12,7,8,9,10
6	Sites 11,12,7,8,9,10	Sites 5,6,1,2,3,4
7	Sites 4,5,6,1,2,3	Sites 10,11,12,7,8,9
8	Sites 10,11,12,7,8,9	Sites 4,5,6,1,2,3
9	Sites 3,4,5,6,1,2	Sites 9,10,11,12,7,8
10	Sites 9,10,11,12,7,8	Sites 3,4,5,6,1,2
11	Sites 2,3,4,5,6,1	Sites 8,9,10,11,12,7
12	Sites 8,9,10,11,12,7	Sites 2,3,4,5,6,1

Table 1. Rotation order of 12 sample sites used over a 12 day period to avoid sampling bias experienced by increased activity in birds associated with the early morning and late afternoon hours.

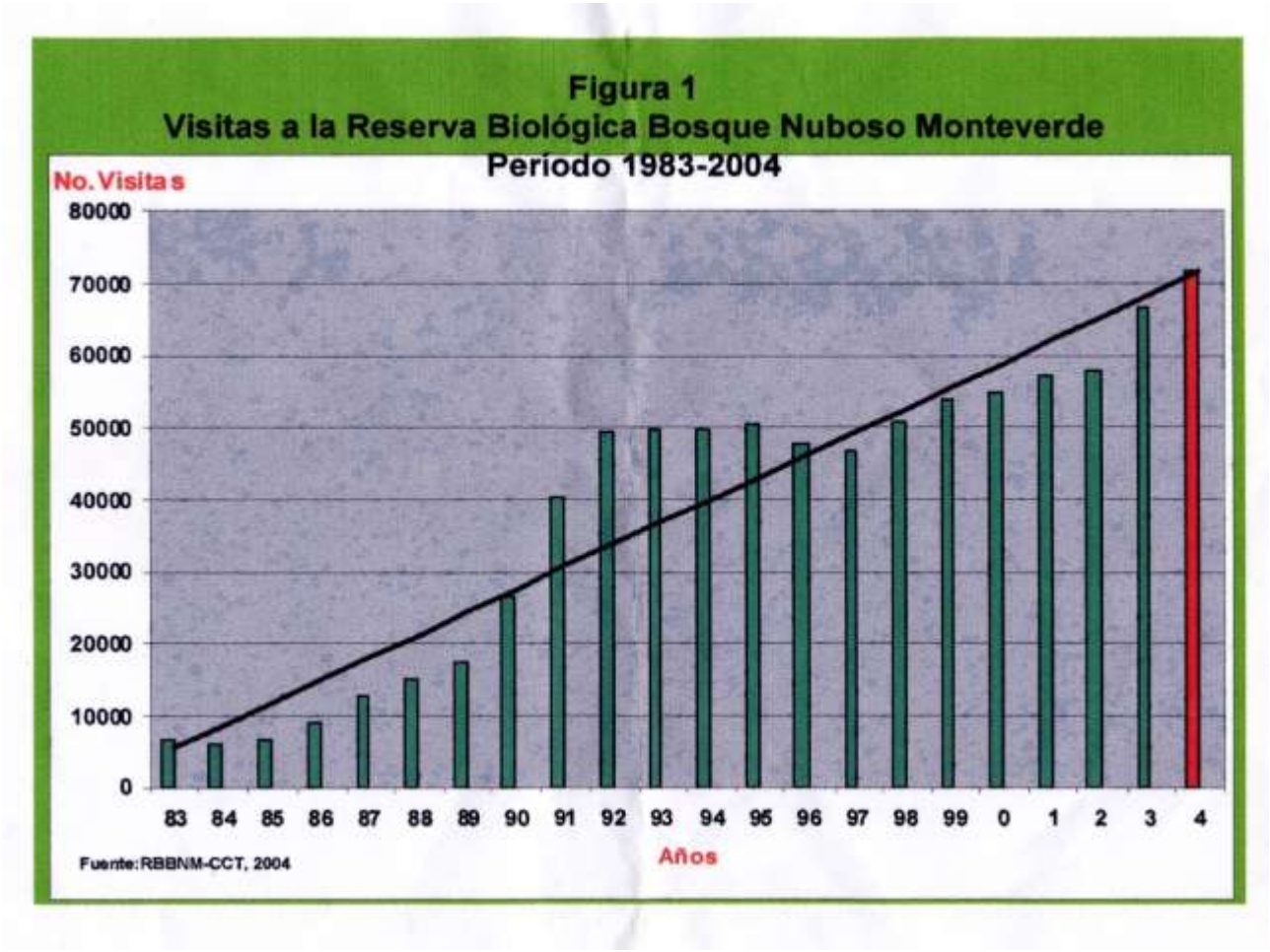

Figure 1. Number of tourists to visit the Monteverde Cloud Forest Preserve from 1983 to 2004. Ecotourism has increased dramatically in Costa Rica in the last two decades reaching over 3.2 million in 2004.

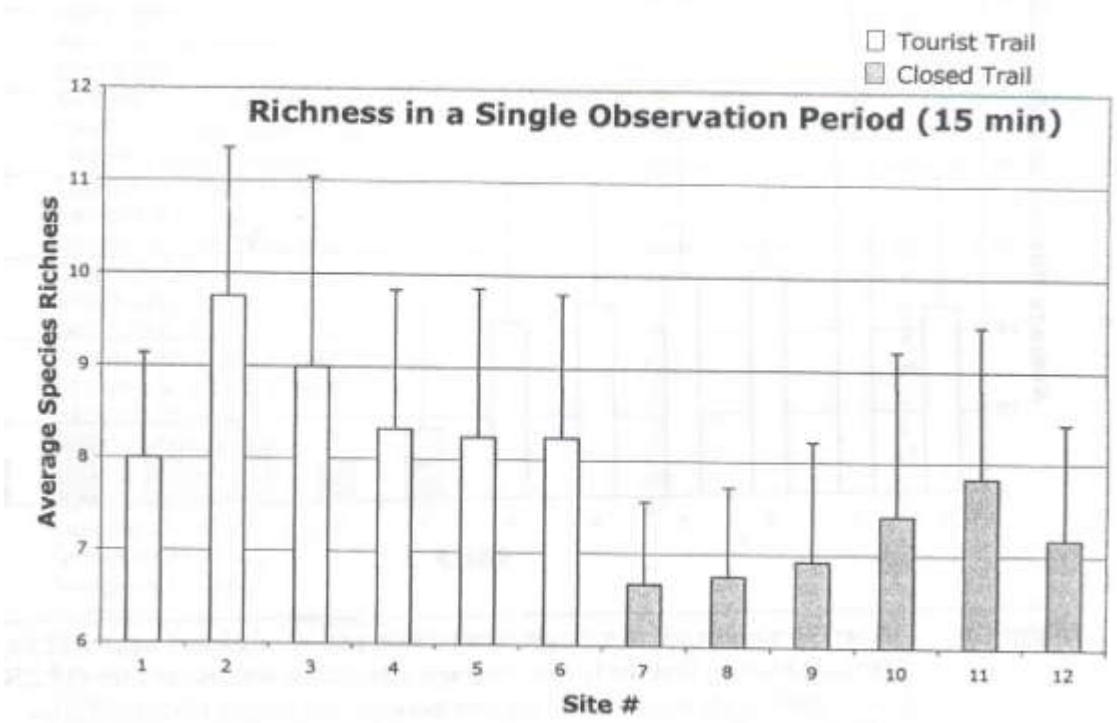

Figure 2. Average species richness in a single observation period of 15min for tourist and closed sites over a 12 day period showing that the lowest average species rich site for tourist trails (8.000 +/- 1.128) is greater than the highest average species rich site for closed trails (7.833 +/- 1.642). All comparisons significantly different at $p < 0.05$ except 1 = 3 =4 = 5 = 6 = 9 = 10 = 11 = 12; 2 = 3; 7 = 8.

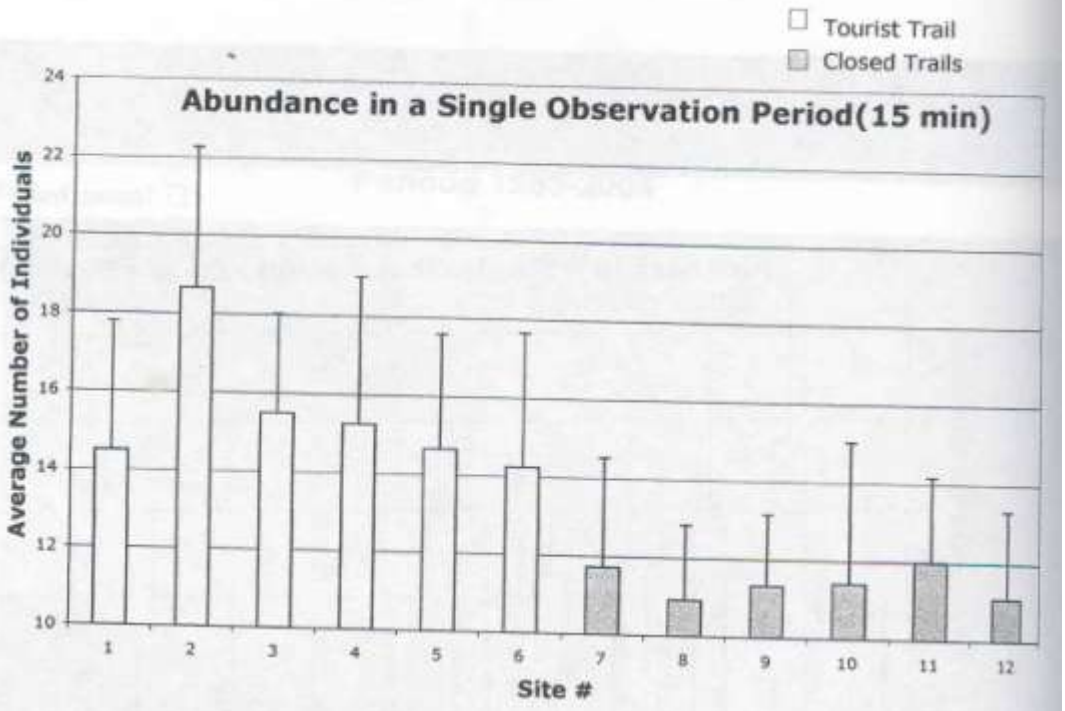

Figure 3. Average abundance in a single observation period of 15 min over a 12 day period showing that the lowest average abundance for tourist sites (14.250 +/- 3.289) is greater than the highest average abundance for closed sites (12.000 +/- 2.174). All comparisons significantly different at $p < 0.05$ except $1 = 3 = 4 = 5 = 6$; $5 = 11$; $7 = 8 = 9 = 10 = 11 = 12$.

Species	Tourist Trails	Closed Trails
Azure-hooded Jay	9	3
Barred Forest Falcon	0	3
Black-breaseted Wood-Quail	4	8
Blackburian Warbler	1	0
Black-faced Solitare	104	79
Black Guan	30	16
Blue-crowned Motmot	1	0
Brown Jay	2	0
Buff-fronted Quail Dove	0	1
Chesnut-capped Brush Finch	18	6
Common Bush Tanager	158	123
Coppery-headed Emerald	9	5
Emerald Toucanet	16	25
Golden-browed Chlorophonia	90	56
Green-crowned Brilliant	7	2
Green-eared Violet	1	0
Green Hermit	3	4
Grey-breasted Wood Wren	123	86
Grey-throated Leaf-tosser	6	5
Hariy Woodpecker	0	2
Lineated Foilage-gleaner	17	23
Mountain Robin	28	21
Ochraceous Wren	21	7
Olivacheous Woodcreeper	1	1
Orange-bellied Trogon	1	0
Prong-billed Barbet	32	37
Purple-throated Mountain Gem	28	15
Red-faced Spinetail	1	0
Resplendent Quetzal	23	11
Ruddy-ground Dove	4	10
Ruddy Treerunner	3	6
Silver-throated Tanager	13	6
Slaty Antshrike	1	26
Slaty-backed Nightingale Thrush	94	94
Slat-Throated Redstart	102	35
Smokybrown Woodpecker	1	2
Spotted Barbtail	2	0
Spotted Woodcreeper	10	23
Swainsons Thrush	5	3
3-Striped Warbler	35	18
Wattled Bellbird	1	0
Western Peewee	1	0
White-throated Robin	108	80
White-throated Spadebill	0	1
Wilson's Warbler	3	1
Yellow-thighed Finch	1	0
Yellow-throated Euphonia	1	0

Appendix 1. List of species found on both trail types and their total abundances as recorded over a 12 day period.