

**BIRD SPECIES DIVERSITY IN RUSTIC CACAO PLANTATIONS IN  
NORTHWESTERN ECUADOR**



Red-legged Honeycreeper *Dacnis cyaneus*

**| Fundación Maquipucuna**



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## INTRODUCTION

### Chocó Endemic Bird Area (EBA)

The Chocó EBA traverses the length of the Pacific slope in western Colombia south into Ecuador where it incorporates the westernmost volcanic peaks and Pacific slope of the Andes south to Cañar province, although the majority of the ranges of its restricted-range species terminate north of Guayaquil at c.2°S. In the lowlands, the EBA extends throughout the Chocó from the southern end of the Serranía de Baudó, south along the Andean foothills and through the Pacific coast lowlands into northern Esmeraldas province, and from there along the base of the Andes in Pichincha, Los Ríos, and northern Guayas provinces of Ecuador.

The EBA is characterized by wet forest, and indeed, with up to 16,000 mm of rain per year in some places, one of the wettest places on earth, however, the major vegetation zones of the Pacific slope vary considerably according to local climatic and altitudinal conditions.

The Chocó has one of the world's richest lowland biotas, with exceptional richness and endemism in a wide range of taxa including plants, reptiles, amphibians and butterflies (Dinerstein et al. 1995). In the case of plants, over 10% (8,000-9,000) of species recorded from the Neotropics have been found from the narrow band of pluvial forest that runs through the Chocó; it has been suggested that 25% of these species are endemic to the area (Salaman 1994, BirdLife International 2003).

### Restricted-range species

The Chocó EBA supports the largest number of restricted-range birds of any EBA in the Americas, with up to 75 species (Ridgely & Greenfield 2001) being endemic to the area. A large number of birds are confined to the tropical lowland and lower subtropical foothill forests, with the remainder primarily found in the subtropical zone; only a few species occur in the high-altitude temperate areas. The birds restricted to the subtropical zone and above are almost invariably found on the disjunct peaks of the Colombian West Andes, and further south in southern Colombia and northern Ecuador (e.g. Nevado Cumbal, Volcán Chiles, Cotacachi, Pichincha).

With relatively little known about the precise distributions, altitudinal movements and ecological requirements of the restricted-range birds, it is not currently possible to further divide this EBA. It does, however, seem likely that the ranges of tropical foothill and lowland species are associated with the band of pluvial forest that runs through the center of the Chocó region (Hilty and Brown 1986); also, (in Colombia) forest composition changes strikingly from lowland to montane at 1,000-1,500 m (L. G. Olarte in litt. 1993), and this may form the natural boundary between distinct groups of tropical lowland and higher Pacific slope birds. Ridgely and Greenfield (2001) in fact divided the Ecuadorian Chocó endemics into Chocó Lowlands (31 species) and West Slope of Andes (44).

In northern Ecuador (e.g. in the Bilsa area), *Haplophaedia lugens* and *Cephalopterus penduliger* (and possibly other species) have been recorded at the same localities as species characteristic of the Tumbesian region (EBA 045), namely Grey-backed Hawk *Leucopternis occidentalis*, Rufous-headed Chachalaca *Ortalis erythroptera* and Slaty Becard *Pachyramphus spodiurus* (Wege and Long 1995). The extent to which these species (and thus the two EBAs) overlap is unknown (BirdLife International 2003).

## Threats and conservation

Unplanned colonization following the completion of roads and massive logging concessions are major threats to the Chocó forests. Since 1960, over 40% of the forest area has been cleared or heavily degraded, and deforestation rates are accelerating (Salaman 1994). Currently, intensive logging, human settlement, cattle-grazing, mining, wildlife exploitation, and coca and palm cultivation all threaten the region, with forest destruction most severe in the coastal plain and foothills below c.2, 000 m.

A total of 16 of the restricted-range species are presently considered to be threatened (with a further 14 Near Threatened), primarily due to the widespread destruction of forest throughout the region. A number of species are extremely poorly known or localized: *Eriocnemis godini*, for example, is known from just one locality in Pichincha province of Ecuador, where it is possibly extinct; *Neomorphus radiolosus* is genuinely localized, being recorded from very few localities; *Eriocnemis mirabilis* is known only from within the boundary of Munchique National Park in Colombia; *Micrastur plumbeus* has recently (since c.1960) been recorded from fewer than five localities and *Dacnis venusta* and *berlepschi* are patchily distributed, occur at low densities and, though poorly known, appear to be genuinely rare (Collar et al. 1994, Salaman and Stiles 1996). Compounding the effects of habitat destruction is hunting pressure, which appears to be having a significant negative impact on *Penelope ortoni* and *Cephalopterus penduliger* (the latter species is also captured for the pet trade). Additional, more widespread threatened species that occur within the EBA include Yellow-eared Parrot *Ognorhynchus icterotis* (classified as Critical) and Brown Wood-rail *Aramides wolffi* (BirdLife International 2003).

## Important Bird Areas (IBA)

Seventeen IBA's were recently identified for the Chocó EBA's threatened species (10 in Colombia and 7 in Ecuador), with at least 10 currently having some form of protected status (Wege and Long 1995). In Ecuador, protected areas include the Awá Forest Reserve Zone, Jatun Sacha Bilsa Biological Reserve, Mindo Nambillo Protection Forest, Maquipucuna Reserve, Guayllabamba Protection Forest and the Río Palenque Scientific Center. Total coverage remains, however, relatively small, with very little lowland and foothill forest (below c.1, 000 m) represented in these primarily montane protected areas, leaving perhaps the most important portion of this EBA insufficiently protected and exposed to yet further degradation (BirdLife International 2003).

## Importance of rustic Cacao plantations in protecting bird diversity

Cacao is a crop of humid lowland tropics, produced mostly by small-scale farmers, often with a canopy of shade trees. Shade-grown and particularly rustic cacao, which is planted beneath thinned primary or old secondary forest, supports a substantially higher level of biological diversity than most other tropical crops. Plant disease and loss of soil fertility, as well as socio-economic problems facing producers often undermines sustainability of this crop. Biodiversity is threatened by continued clearing of forested lands, as well as, conversion of rustic cacao to low diversity monocultures such as, banana and African oil palm (Rice & Greenberg 2000).

Cacao grown under planted shade may provide the best long-term protection for some tropical biodiversity. Cacao grown closer to forest supports a greater biodiversity, perhaps forming a buffer habitat for mobile organisms. Cacao farms could be concentrated in the buffer zone of existing reserves or used to form corridors between small forest reserves (Rice & Greenberg 2000).

Maquipucuna Foundation is working to establish a wildlife-habitat corridor within the Chocó EBA, between the Western Andes and the Northwest lowland tropical rain forest. Shade-grown mature cacao plantations sustain a surprising level of bird diversity, a substantial percentage of the total species found in nearby tropical rain forest. Maintaining these bird-rich agroecosystems vs. conversion to “bird deserts” of banana and oil palm plantations would be a stopgap in the loss of bird habitat throughout the Neotropics.

Smithsonian researchers compared bird populations in shaded cacao plantations with nearby undisturbed tropical forest remnants in Panama. Initial surveys indicate that bird density in shade-grown cacao plantations is comparable to that in forest. 100 bird counts were done in each habitat, cacao and forest, during the winter of 2003/2004. Cacao plantations had 603 individuals, while the forest had 646 individual birds. Bird species diversity was even higher in cacao, with 184 species versus 144 found in tropical forest remnants (Smithsonian National Zoological Park website 2006).

Conversely, studies are currently underway to determine the benefits that birds provide to cacao farmers in Bocas del Toro Province, Panama by examining their effect on plant-eating insects. Enclosures have been set up that keep birds away from cacao plants and prevent them from eating insects that defoliate the plants. Other plots without enclosures will be used for comparison. Preliminary results, from February and April 2004, found higher numbers of arthropods (insects and spiders) and more leaf damage on enclosure trees than on non-enclosure trees. This suggests that birds do play an important role in controlling insects in cacao plantations (Smithsonian National Zoological Park website 2006).

Within this context Maquipucuna Foundation retained Andean Birding to undertake a comprehensive bird survey of prospective lands for acquisition comprising rustic Cacao plantations mixed with or adjacent to secondary and primary forest.

## **METHODS**

Tropical Forests are disappearing too fast to allow time for thorough quantitative studies; therefore, it is imperative to use rapid, reliable information-rich methods, which are adjusted to Tropical conditions and logistic constraints. In order to obtain the most data about the bird population in the shortest amount of time, it is necessary to combine a variety of techniques such as tape recording, MacKinnon lists and mist netting, along with direct observation.

### **Dawn Chorus**

One efficient survey technique is tape recording the dawn chorus and identifying birds by their vocalizations using personal field knowledge along with help from reference recordings. Birds are very active in the early morning, proclaiming their territories with species-specific songs. (Parker 1991, Remsen 1994). Tape recording for up to 30min during each dawn provides a rich source of information and is a basis for the species diversity assessment.

Dawn chorus was recorded for 20-30 minutes starting around 6am on 6 mornings May 30, June 1, 2 at Maldonado, June 3, 4 at Tachina, and June 6 at San Francisco. Also, recordings were made periodically throughout the day of unfamiliar species for subsequent identification.

### **MacKinnon Lists**

Line transects are generally the favored method for bird surveys in the tropics since they allow one to continuously record data rather than losing time traveling between point count stations (Bibby et al. 2000). A particularly effective technique of transect recording is the MacKinnon or 20-species list. Using this method, the researcher proceeds along a transect

recording new species until reaching 20. Then the next list is started, recording different individuals from the first list, but species can be repeated from previous lists. No species can be repeated within the same list. As a result, the observer can obtain the measure of the encounter of new species and generate species accumulation curves from which one can estimate the total number of bird species present at the study site. Lists can be adjusted according to perceived levels of diversity. Twenty species lists are good for more diverse Tropical forests, whereas 10 species list are more appropriate for less diverse forests. (Poulsen et al. 1997, O'Dea et al. 2004). Also, since birds are less conspicuous in closed Neotropical forests, MacKinnon lists are generally preferable than point counts, especially for estimations of species diversity (Bibby et al. 2000).

At Maldonado a total of 21 "20-species" lists were done over four days. At Tachina 12 "20-species" list were done. No MacKinnon lists were done at Durango due to the difficulty of the muddy trail however a list of all the species was recorded. At San Francisco 17 "10-species" lists were done, as this was a lower diversity site.

### **Mist Netting**

Mist netting allows one to catch low-flying, cryptic species, as well as fly-through species that might not otherwise have been visually or audibly observed. This is a labor-intensive technique, which does not allow one to multitask as with the other techniques mentioned above, especially given the presence of only one researcher. Two 9-m mist nets were set on June 2 & 3, from 6-9 am at Maldonado site in an ideal area with lots of undergrowth.

### **Direct Observation**

Direct observation involves identifying the birds visually, as well as by ear, and recording them at the end of the day on a checklist designed for the area, which includes all species suspected of occurring there, according to their geographic distribution, altitude range and habitat requirements as found in Ridgely & Greenfield 2001.

### **Point Counts**

While not originally offered in our proposal, we agreed to perform transects at known point count stations in the study area. Note that point counts are more suitable for conspicuous birds in woody or scrubby habitats and they are less efficient than transects (MacKinnon lists) in terms of data collected per unit effort (Bibby et al. 2000). The following table summarizes the point count data effort for each site.

<b>Maldonado</b>	<b>Date</b>	<b>#point counts</b>
	5/29	0 due to late pm arrival
	5/30	2
	5/31	4
	6/1	3
	6/2	4
<b>Tachina</b>	none were done since no point count stations exist	
<b>Durango</b>	<b>Date</b>	<b>#point counts</b>
	6/5	7
<b>San Francisco</b>	<b>Date</b>	<b>#point counts</b>
	6/6	4

## **Synthesis of the data**

The data obtained from all techniques were combined and analyzed in order to estimate the total number of bird species (species richness) within the study area. Note that while “species richness” is the precise ecological/statistical term for numbers of species, we will be using the lay term “diversity”, which does not imply the Shannon(-Wiener) index of diversity, an index that is inherently problematic and less relevant in tropical systems.

## **Change in field plans**

Originally the team was supposed to have two full days at San Francisco but Andres and Bernardo changed this to one day at Durango and one day at San Francisco. On the way back from Durango we visited San Francisco in the afternoon for site reconnaissance for the next day’s fieldwork.

At Durango there were 16 point count stations along a long a muddy trail – that were not mentioned previously to Roger. We passed some in darkness and did one in secondary forest and six in primary forest. It is not possible to do all the point counts and MacKinnon lists during one day along the trail as it takes too long just to walk the trail. Much more time is needed to survey this forest trail. We walked from 5:30 am to 1:30 pm taking notes on all species seen.

## **RESULTS**

### **Habitat descriptions and perceived threats**

#### **Maldonado**

The trail into the study area starts from the main highway between San Lorenzo and Esmeraldas about 1 km south of Rio Santiago (Map 1). Almost immediately the trail enters a large scrubby clearing. Past this clearing, the cacao plantations begin in mixed secondary forest with dense undergrowth dominated by Heliconias (Two point counts here, #1 & #2). After about 700 m the trails enters another scrubby clearing and 200 m later again enters secondary forest and cacao plantations, but with less undergrowth (Two point counts here, #3 & #4). From here the trail continues into better secondary forest with side trails.

Beyond the second clearing 1-2 chain saws were heard throughout the day and mules were going back and forth carrying out planks. We also met several hunters along the trail. One day in Maldonado we were shown a Three-toed Sloth *Bradypus variegatus*, a Boa *Boa constrictor* and a Green Iguana *Iguana iguana* all caught for eating.

#### **Tachina**

This small village is about 1 hr upstream from Maldonado along the Río Santiago with 45 inhabitants (Map 2). Close to the village and along the river is a ~3 ha cacao plantation with some bananas bordered by secondary forest. Behind the village is a new, small ~1 ha clearing with cacao, bananas and borojó. Ten min down the river by canoe is another farm, Nueva Brisa. This farm is larger with cacao, bananas and other fruits and a small rice paddy bordered by secondary forest.

Chain saws were heard on one day. There was a new clearing in secondary forest nearby with recently planted cacao and bananas.



Four groups of Rufous-headed Chachalacas were heard and seen in and around the clearing so there is presumably less hunting pressure here.

### **Durango**

This small village (220 m) along the highway halfway between Alto Tambo and San Lorenzo within the Sirúa community has access to primary and good secondary forest along a trail to Valle del Virgen (Map 3). We walked this trail one day starting at 5:30 am. The trail soon crosses Río Durango and later Río Bogotá before entering secondary forest (6 point counts) and later primary forest (10 point counts). A ridge called Cuchillo del Rey (366 m) marks the halfway to Valle del Virgen. We walked as far as this ridge and returned along another trail. All trails were very muddy.

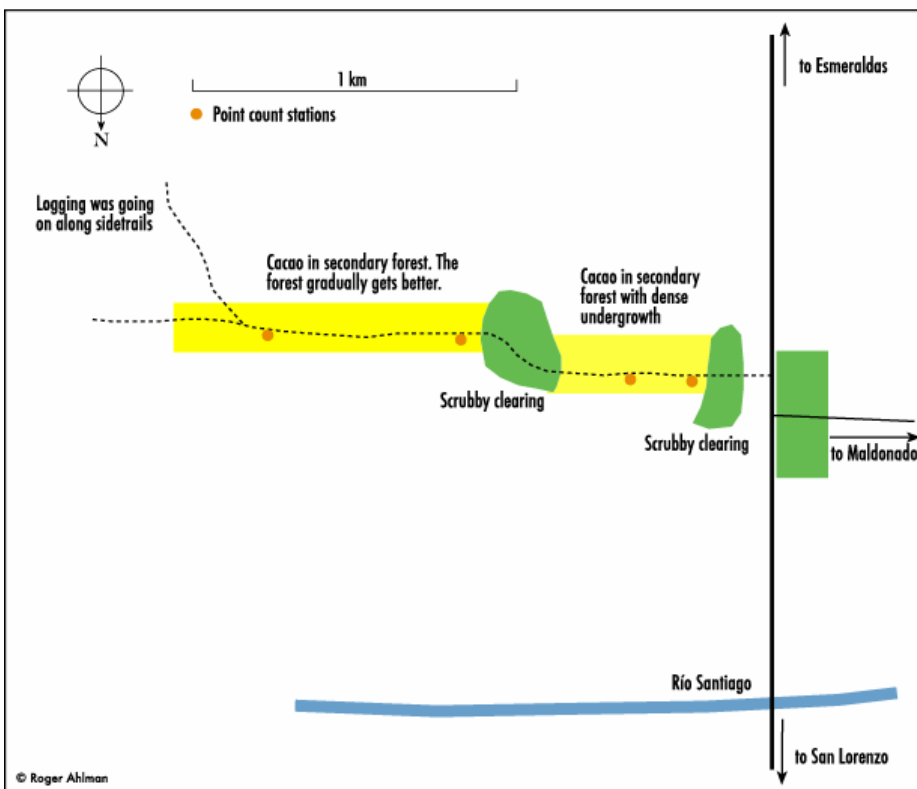
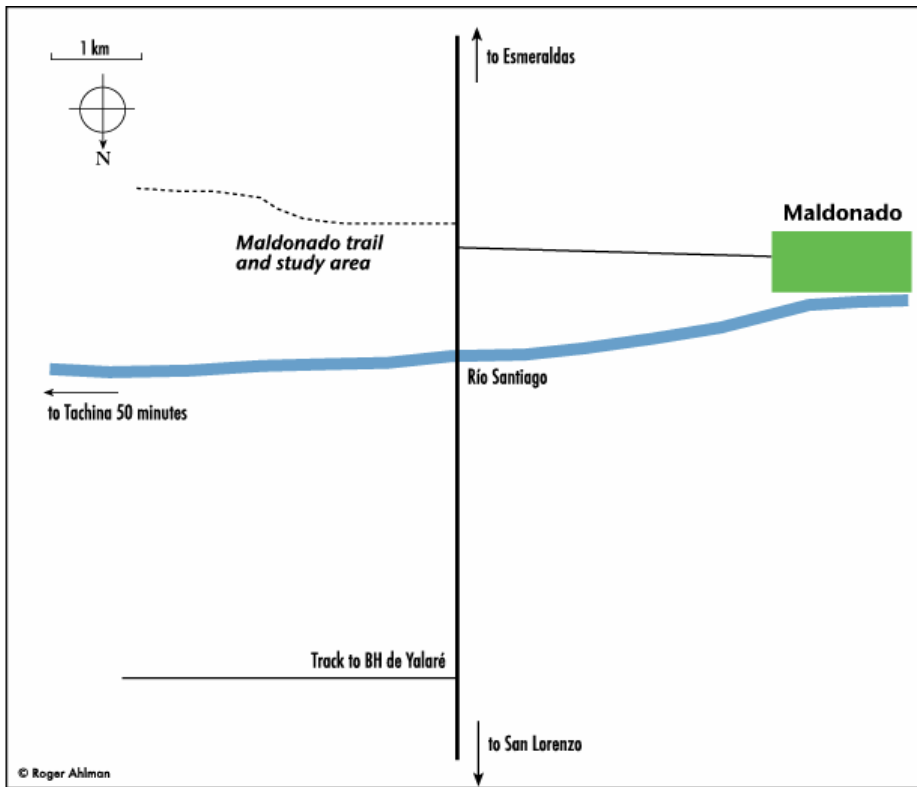
A logging company wants to build a road through the forest to log in the Valle del Virgen but the local community will not allow this. The logging company had cut a trail and marked it with sticks and paint. We didn't hear any chain saws here.

Two local hunters were encountered along the trail and also interviewed about game birds.

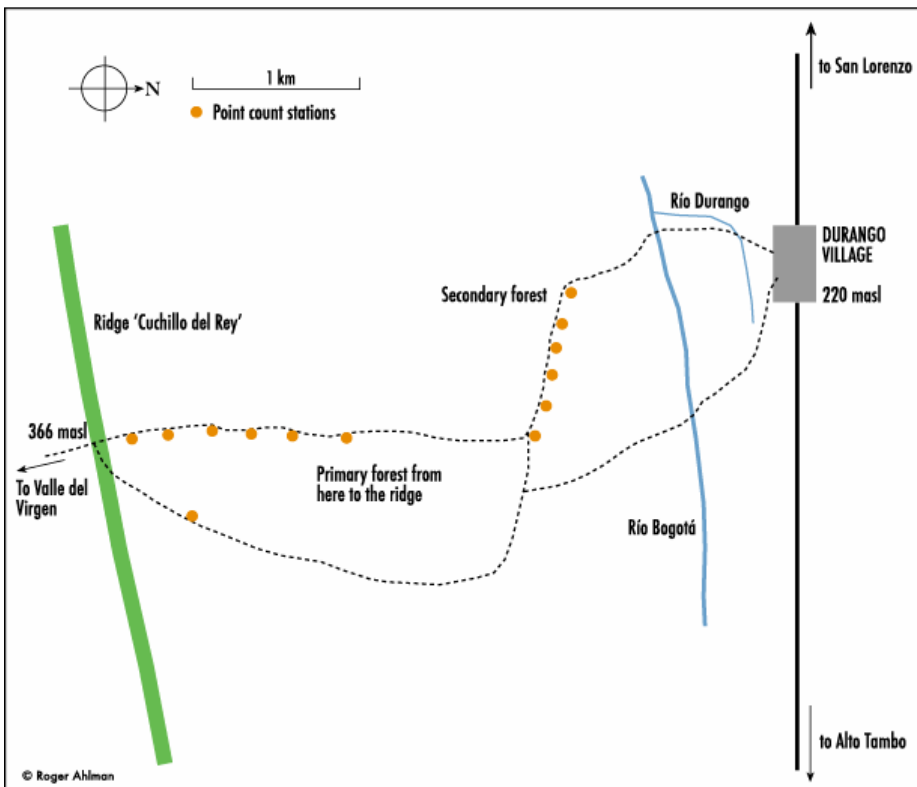
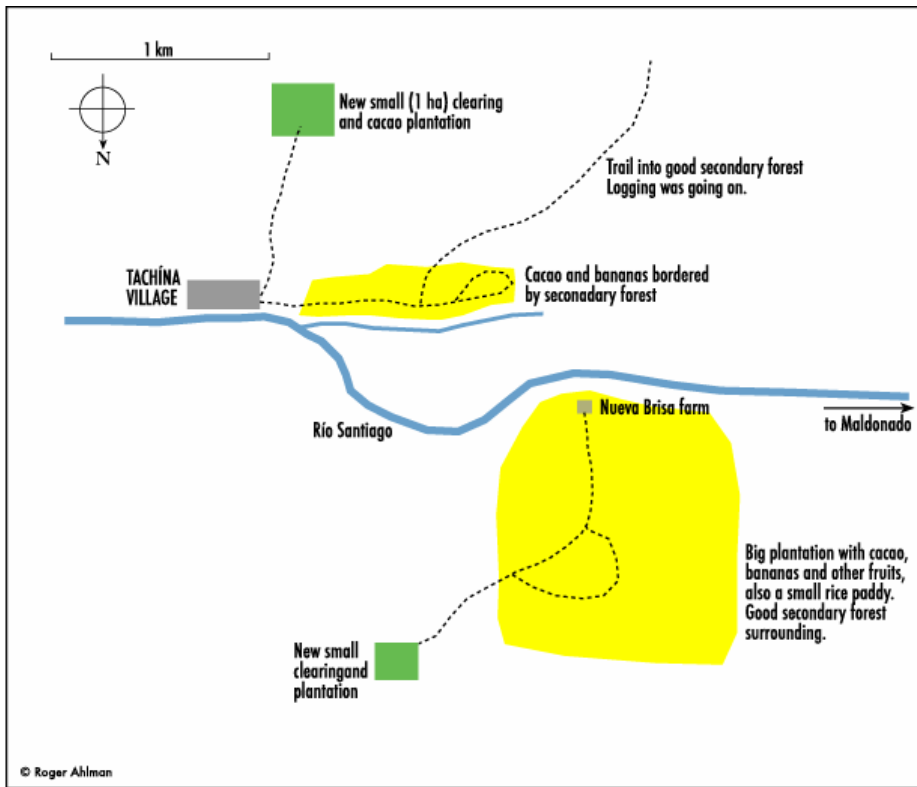
### **San Francisco**

This village located on a side road off the main highway near San Lorenzo, has a lot of plantations nearby (Map 4). There are four point count stations at various sites around the village. They are all in cacao but there are many other crops like bananas and other fruits and also some oil palm plantations around the village, with patches of secondary forest.

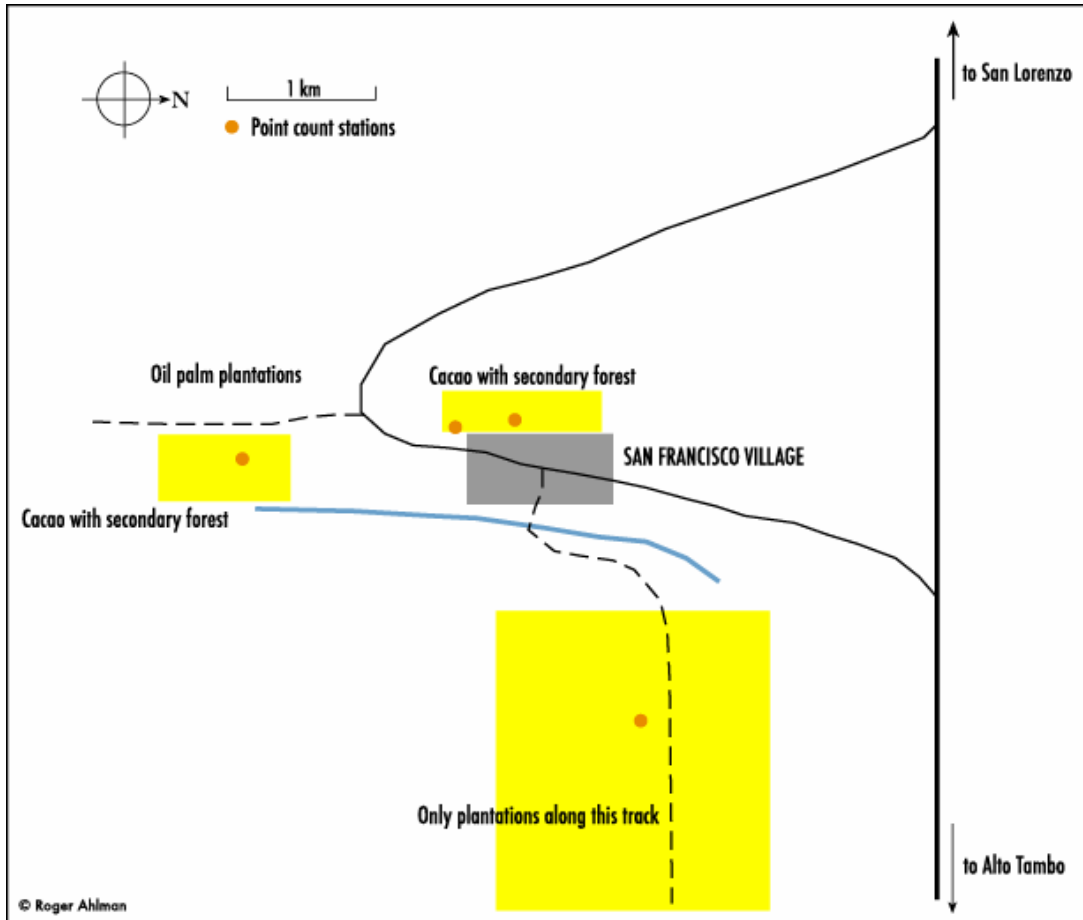
This area had the least amount of forest nearby. We did not hear any chain saws but there was little forest left to cut down. We didn't meet any hunters presumably since there was little game left.



Map 1. Maldonado



Map 2 & 3. Tachina and Durango



Map 4. San Francisco

### **Dawn Chorus**

A total of 51 species were recorded on MiniDisk from all sites and are catalogued in Appendix 4. Nine of these species were never seen, two of which were discovered later by Charlie Vogt, only after carefully review of the recordings.

### **MacKinnon Lists**

Table 1. summarizes the data from the MacKinnon Lists. At Maldonado the 21 “20-species” lists recorded a total number of 87 species. At Tachina the 12 “20-species” lists recorded a total number of 91 species. At San Francisco the 16 “10-species” lists recorded a total number of 64 species.

**Table 1. MacKinnon Lists**

**Maldonado**

date	List #	# new spp	spp accum	daily acc.
30-May	1	20	20	
	2	10	30	
	3	12	42	
	4	7	49	44
	5	5	54	
	6	4	58	
	7	4	62	
31-May	8	3	65	94
	9	2	67	
	10	2	69	
	11	1	70	
	12	2	72	114
	13	1	73	
	14	1	74	
	15	2	76	
	16	1	77	133
	17	0	77	
	18	4	81	
	19	1	82	
	20	3	85	134
	21	2	87	

**Tachina**

date	List #	# new spp	spp accum	daily accum
3-Jun	1	20	20	
	2	12	32	
	3	13	45	
	4	7	52	44
	5	6	58	
	6	6	64	
4-Jun	7	3	67	
	8	5	72	88
	9	5	77	
	10	4	81	
	11	7	88	
	12	3	91	107

**San Francisco**

List #	# new spp	spp accum	Total recorded
0	14	14	
1	7	21	
2	6	27	
3	7	34	
4	4	38	
5	5	43	
6	0	43	
7	3	46	
8	3	49	
9	4	53	
10	4	57	
11	4	61	
12	1	62	
13	0	62	
14	1	63	
15	1	64	
16	0	64	75

### **Mist Netting**

Results of the 2 mornings of mist netting effort yielded the capture of three adult Violet-bellied Hummingbirds as well as one female White-bearded Manakin. These are species, which were otherwise seen and/or heard at other times during the study. Due to the low yields in capture, as well as the considerable time required for completing MacKinnon lists and point counts, it was decided not to perform mist netting on any other mornings.

### **Direct Observation and acoustical detection**

All bird species visually observed and/or heard were noted and recorded on a checklist at the end of each day and are summarized along with other data for the species in the Bird List (Appendix 1). A significant number of species in addition to those detected by other techniques were intercepted during the course of these informal transects. About 45 species were added at Maldonado, 16 at Tachina and 10 at San Francisco. All of the 70 species recorded at Durango were detected this way.

### **Point Counts**

At Maldonado the 13 point counts recorded a total number of 57 individual birds of 22 species. At Durango and the 7 point counts recorded a total number of 17 individuals of 8 species. At San Francisco the 4 point counts recorded a total number of 37 individuals of 30 species. There were no species recorded during point counts that were not otherwise recorded by other techniques.

### **Detectability**

Bird species vary in their ease of Detectability and this can also vary with the season. Some species are easily observed due to conspicuous perching, flying or other behaviors. Others are almost never seen. With some exceptions such as some hummingbirds and tanagers, most birds sing a distinctive song, however this can be seasonal and non-territorial vocalizations can be easily confused with other species.

In general bird singing and activity is less during sunny and dry periods of the day and or the year. In the region of the study area, bird activity is a bit lower in August-September, however, unpredictable dry spells can lower activity as well.

Species which were never seen but detected easily by sound during this study included:

- Southern Nightingale-Wren
- Little Tinamou
- White-breasted Wood-Wren
- Slaty-capped Shrike-Vireo
- White-throated Crake
- Buff-throated Foliage-gleaner

## Estimation of Bird species diversity

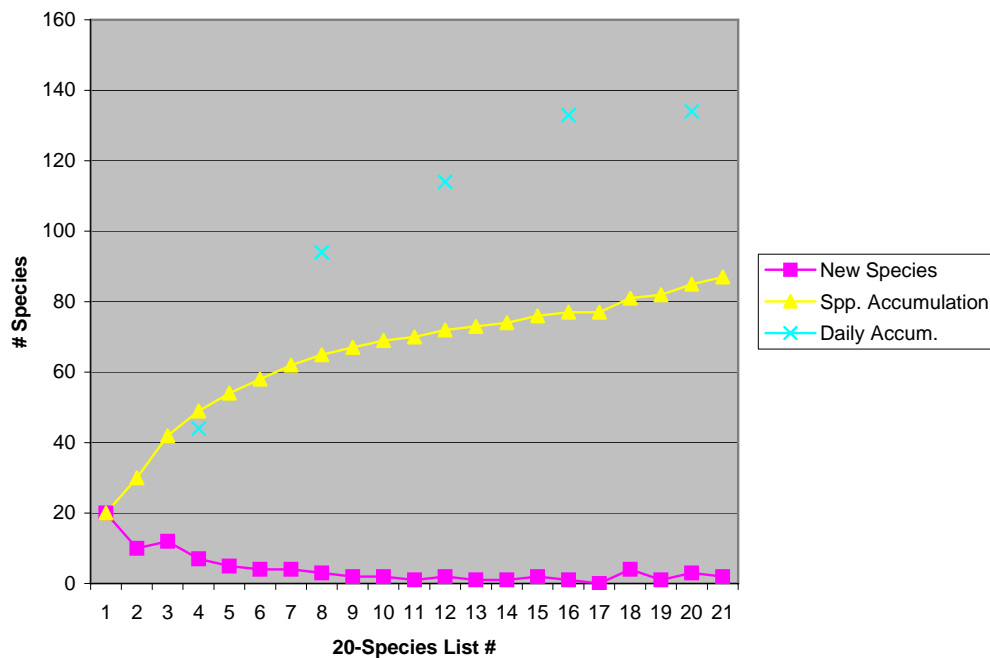
### Maldonado

The total number recorded for this site was 135 species over a 4 day period starting on the late afternoon of day 1 through mid-day of day 5. The highest daily total was 77 species (Appendix 1). This is a short time frame for an accurate assessment of species diversity; however, the daily accumulation of species from all sampling techniques indicates a leveling-off of around 160-180 species (Figure 1). Note the last day was a half-day so that fewer new species were encountered than if it had been a full day. Therefore, if it had been a full day, this data point would have been higher.

The MacKinnon list data from this site fall short of this estimate because the lists were not performed all day long due to other activities, and the fact that it was not a circular trail and doing the lists both directions would be double-counting individuals. Hence the lists were only done in one direction, starting either at the near or far end of the trail.

A total of 22 species of concern (endemics, plus species-at-risk) were recorded from this site.

Fig. 1 Maldonado



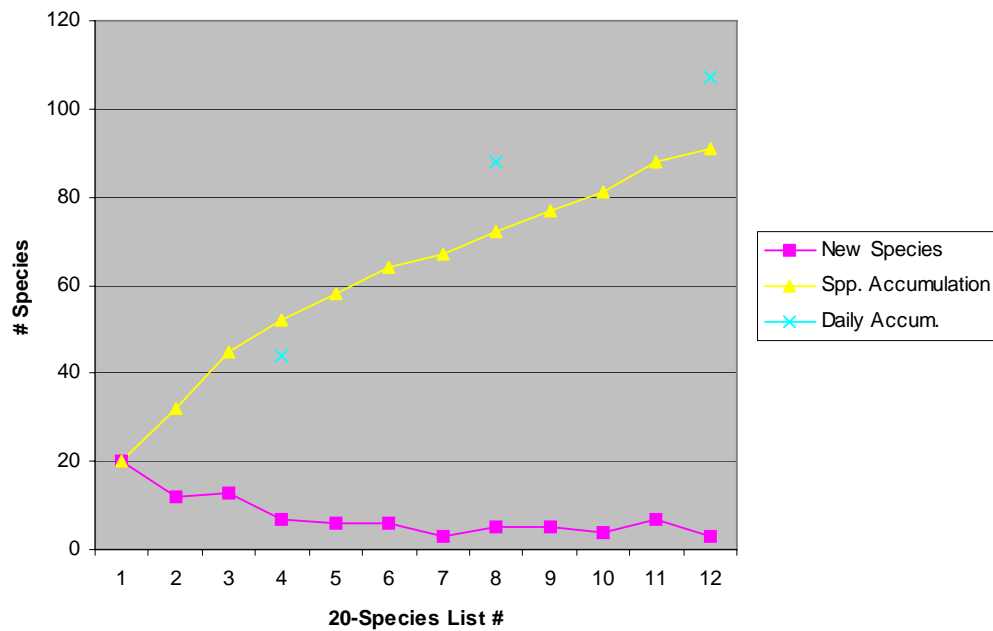


## Tachina

The total number of species recorded from all techniques was 107 over a 2½-day period. The highest daily total was 81 species (Appendix 1). This is an extremely short time for a diversity assessment, however, a very rough estimate would be somewhere between 140-170 species (Figure 2). This is probably somewhat less diverse than the Maldonado site.

A total of 13 species of concern (endemics, plus species-at-risk) were recorded from this site.

Fig. 2 Tachina



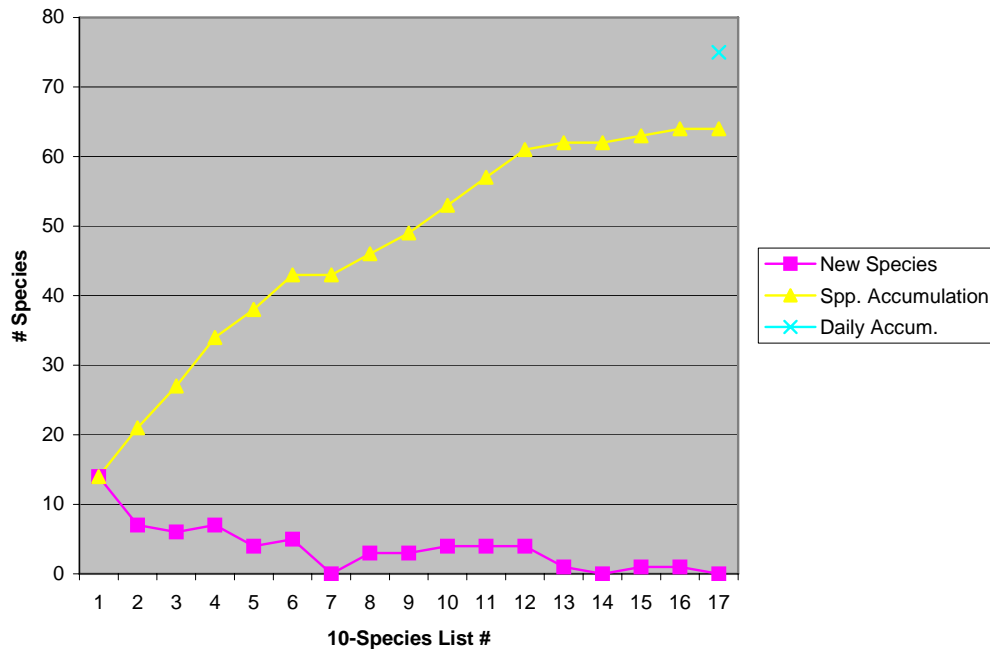
## Durango

With only one day's assessment and no MacKinnon list data collected, it is not really possible to estimate species diversity here. A daily total of 70 species puts it a bit below what was recorded at the other sites (Appendix 1). However, in only one day, 13 species of concern (endemics, plus species-at-risk) were recorded, which exceeds that found in 2½ days at Tachina and more than what was recorded in any one day at all the other sites. In addition, 16 species were unique to this site, which also exceeds all other sites for a daily count of unique species. These figures corroborate Roger's impression of the habitat and bird diversity of this forested site. All these factors indicate that Durango is an important area for species of concern and should be a priority acquisition in order to preserve the primary and secondary forest as well as maintaining the rustic cacao plantations.

## San Francisco

While only one day's effort was involved, the data from 17 MacKinnon lists (10-species were allows us to make a very rough estimate of species diversity for this site of between 100-120 (Figure 3). A total of only 7 species of concern (endemics, plus species-at-risk) were recorded from this site (Appendix 1). This is substantially less than the other sites and to be expected from an area, which appears to have little forest left. While the daily total of 76 species is higher than Durango, this is probably an artifact of the visibility of birds in open versus closed (forest) habitats.

Fig. 3 San Francisco



## **Comparisons of bird diversity with nearby forest reserves**

Two forest reserves in the vicinity of the study area with comprehensive bird lists serve as a useful comparison. Playa de Oro, located about 20 kilometers southeast and upriver at a similar elevation, has a bird list of 337 species. Canandé, a private reserve owned by the Jocotoco foundation, located about 100 kilometers southeast at a slightly higher elevation (200-400m) has a bird list of around 320 species. Our estimates of bird diversity in the study area for the better-studied sites of Maldonado and Tachina yield between 47-53% and 42-50% respectively of the total bird species documented at Playa de Oro. However, it must be noted that the area of Playa de Oro is a mosaic of habitats and if one only considers a homogeneous habitat of closed primary forest, the list would drop to around 180 species (Olaf Jahn pers. comm.). Therefore, the estimate of bird diversity for Maldonado rustic cacao plantations would be equivalent or 90-100% to that found in closed forest.

## **Comparisons of bird diversity in cacao versus nearby forest**

Comparison of bird distribution in cacao vs. tropical forests in Panama indicated that 184 different kinds of birds were found in cacao plantations with 90 exclusively found there while 144 were found in tropical forest remnants, 50 exclusively. 234 different kinds of birds were found in all habitats (Smithsonian National Zoological Park website. 2006). The Panama data are found in Appendix 3.

Comparing the 59 species, which were recorded in surveys in Panama, in Ecuador 36 were recorded in the same habitat (cacao or forest respectively), and 23 in the other habitat. It should be noted that very little time was spent in actual forest in the Ecuador survey (Appendix 2). In our study, 139 species occurred in cacao and only 64 species were recorded in the forest. However, 57 additional species recorded from cacao are also known to occur regularly in forests giving a total of 121 species. Again this shows an equivalent amount of bird diversity between rustic cacao and forested areas.

## **Restricted range species**

A total of 23 restricted range species were recorded from all sites, of which 16 are Chocó endemics and 7 are Tumbesian endemics and are indicated on the annotated birdlist (Appendix 1). Considering known species distributions (Ridgely and Greenfield 2001) and records from Playa de Oro, there are a total of 30 lowland Chocó endemics possible within the study area. During this short study we were able to record 53% of these species which is some indicator of the relative importance of this habitat in maintaining exemplary species from the Chocó EBA. The remaining Chocó endemics possible should be flagged and looked for carefully in future monitoring studies in the area; these are:

- Plumbeous Forest-Falcon
- Brown Wood-Rail
- Banded Ground-Cuckoo
- Chocó Poorwill
- Humboldt's Sapphire
- Purple-chested Hummingbird
- Five-colored Barbet
- Chocó Woodpecker
- Double-banded Graytail
- Rufous-crowned Antpitta
- Long-wattled Umbrellabird

- Blue-whiskered Tanager
- Scarlet-browed Tanager

### **Deforestation, changes in climate and bird distributions**

Along with deforestation in the lowland Chocó, there have been recent dramatic changes in the climate including longer dry spells and forest fires of anthropogenic origin, which never used to occur. The result of these changes is reflected in shifting bird distributions, in particular, many species of the Tumbesian region as well as species of drier and more open areas have moved in to the area. In particular, Olivaceous Woodcreeper, Streak-headed Woodcreeper, Masked Water-Tyrant, Guira Tanager, which were recorded in this study are recent invaders to the region (Olaf Jahn pers. comm.). These indicators point to a disturbing trend of profound ecological changes for the lowland Northwest.

### **Species-at-Risk**

A total of 16 species-at-risk were recorded in the study area, of which one is Critical, 6 Endangered, 6 Vulnerable and 3 Near-threatened. The most remarkable of these species, which happens to be critically endangered, is the Great Currawong. While its presence has not yet been confirmed, a recording was made which may contain a vocalization of the species and this was also heard on another occasion. Only about 50 individuals remain in Ecuador in a remote belt of lowland forest between Canandé and El Placer with many local hunters in pursuit (O. Jahn pers. comm.). Most of the other species are confirmed and are detailed below.

#### **Berlepsch's Tinamou *Crypturellus berlepschi***

2006 IUCN Red List Category: Least Concern. Endangered in Ecuador

This Chocó endemic is found from the watersheds of the Rios Mataje and Mira in Esmeraldas to Mindo-Milpe and may be in the Rio Palenque watershed as well. Found in humid and very humid lowland evergreen forest normally below 300 m.

The species is rare to uncommon in the buffer zone of Cotacachi-Cayapas ecological reserve and in the Rio Onzole watershed. There are sight records from Mache-Chindul but the present status is unknown in Pichincha province. Threats to its habitat have increased drastically in the last decade due to new roads, changes in land use, especially cattle ranching and African palm plantations as well as logging. Estimated population in Ecuador is between 6,000-18,000 mature individuals. Additional threat from hunting is a significant factor (Granizo et al. 2002).

While not directly recorded in this study, interviews revealed that the species is locally known and hunted.

#### **Rufous-headed Chachalaca *Ortalis erythroptera***

2006 IUCN Red List Category: Vulnerable

This Tumbesian and near-Ecuadorian endemic is distributed patchily along the Western slope and coastal plain from Esmeraldas to Loja. It is found in tropical dry forest, as well as borders of humid forest, has a small and contracting range, affected by rapid habitat loss and severe fragmentation. Its population is suspected to be small and rapidly declining, owing to the effects of hunting and habitat destruction. It is no longer seen in Río Palenque and the total population is estimated at less than 5,000 individuals. This combination of factors results

in classification as Vulnerable. Hunting of the species is prohibited in Ecuador (Granizo et al. 2002, BirdLife International 2003).

This species was heard on two occasions at Maldonado and Tachina and a flock of 9 were seen on June 4th at Tachina.

### **Baudó Guan *Penelope ortoni***

2006 IUCN Red List Category: Endangered

This Chocó endemic has been uplisted to Endangered because of intensifying habitat loss and hunting, from which very rapid population declines are inferred.

*Penelope ortoni* has been recorded locally along the west Andean foothills throughout west Colombia and in Ecuador, south to Naranjal, Guayas. In Colombia, recent reports are from Chocó, Valle del Cauca and Nariño. In Ecuador, it occurs in the Mindo-Nambillo area, Pichincha, but the majority of modern records are from Esmeraldas. Its range and population have undoubtedly contracted greatly.

It inhabits humid and wet forest in the tropical zone, up to 1,500 m elevation. In Esmeraldas and Azuay, specimens have been taken on the coastal plain, but only near the base of the Andes, and it seems to be a bird of the foothills and immediately adjacent lowlands.

This species is extremely sensitive to habitat modification and hunting. Large parts of its range have long since been deforested and plans to colonize and develop more remote regions are progressing through the rapid expansion of the road network. Colonization is in turn increasing the impact of small-scale agriculture, hunting for food and gold mining. Logging and intensive agriculture, especially oil-palm and banana plantations and cattle-farming are major threats and have already transformed over 90% of the Ecuadorian landscape below 900 m. New legislation and the transfer of land-rights to local communities has been exploited by large businesses, for whom it has become cheap and easy to buy land.

Conservation of the species is aided due to its occurrence in Cotacachi-Cayapas Ecological Reserve. Additional conservation measures would include; surveys of appropriate habitats, especially in poorly-known areas as well as extending and improving the network of protected areas in Nariño and Esmeraldas (BirdLife International. 2003).

While not directly recorded in this study, interviews revealed that the species appears to be locally known and hunted. Some confusion might occur with the Crested Guan so confirmation is needed.

### **Crested Guan *Penelope purpurascens***

2006 IUCN Red List Category: Least Concern. Endangered in Ecuador.

Accelerated deforestation in coastal Ecuador has drastically diminished its habitat. The major part of its estimated population of 5,000-15,000 adults is in the province of Esmeraldas. Small populations survive in remote areas on the Western slopes of Pichincha down to Loja and in the Cordillera Chongón-Colonche in the Western part of Manabí and Guayas. The major threats to this species are high hunting pressure as well as deforestation and habitat fragmentation due to logging and expansion of the agricultural frontier. The Crested Guan is present in Cotacachi-Cayapas, Mache-Chindul, Jauneche Ecological Reserves as well as Machalilla National Park and probably in the Awá Ethnic Reserve. Hunting of this species is prohibited in Ecuador (Granizo et al. 2002).

While not directly recorded in this study, interviews revealed that the species appears to be locally known and hunted. Some confusion might occur with the Baudó Guan so confirmation is needed.

**Great Curassow *Crax rubra***

2006 IUCN Red List Category: Near Threatened, CRITICAL in Ecuador

*Crax rubra* has a wide, but now highly fragmented, distribution in undisturbed humid evergreen forest (also seasonally dry forest in some areas) and mangroves, Mexico south through Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama to west Colombia and, very rarely, west Ecuador. Widely hunted for food (and legally in Belize), and further threatened by severe habitat loss and fragmentation, it has undergone a considerable (and continuing) decline, becoming uncommon to rare or locally extinct throughout much of its range.

In the last 15 years there are only reports from hunters of this species from the buffer zone of Cotacachi-Cayapas, Mache-Chindul as well as in Bilsa reserve. In the largest population survives in the watersheds of the Rios Bravo, Guaduro, Chimbagal, Hoja Blanca and Onzole where groups of up to 10 individuals were reported in 1998-99. It is estimated that the total population for Ecuador consists of between 30-60 adults. As the species preferred habitat is below 400 m and very little of this land is protected, being outside the major reserves, it is considered of Critical national concern. Hunting of the species is prohibited in Ecuador (Granizo et al. 2002, BirdLife International 2003).

A vocalization presumed to be this species was heard on two occasions and recorded on MiniDisk. Some locals are familiar with the species, which is locally known as “Miguelón” Confirmation is needed.

**Tawny-faced Quail *Rhynchortyx cinctus***

2006 IUCN Red List Category: Least Concern. Endangered in Ecuador.

While the species is uncommon to common in the buffer zone of Cotacachi-Cayapas, and in the Rio Onzole watershed, so far it has not been recorded outside of the province of Esmeraldas. Due to severe deforestation and habitat fragmentation the estimated adult population of 30,000-90,000, it is considered endangered in Ecuador. As it exhibits extremely secretive behavior, hunting does not constitute a threat (Granizo et al. 2002).

While not directly recorded in this study, interviews revealed that the species is locally known and hunted.

**Indigo-crowned Quail-dove *Geotrygon purpurata***

2006 IUCN Red List Category: Least Concern. Vulnerable in Ecuador.

This Chocó endemic has been recorded from various sites in Esmeraldas, Imbabura and Pichincha with past records from the Rio Toachi. Found in very humid pre-montane and pluvial montane Forest between 150 and 700 m elevation. Due to severe deforestation and habitat fragmentation the estimated population of 2,000-10,000 is considered endangered in Ecuador. As it exhibits extremely secretive behavior, hunting does not constitute a threat (Granizo et al. 2002).

While not directly recorded in this study, interviews revealed that the species appears to be locally known and hunted. Some confusion might occur with the Olive-backed Quail-dove, so confirmation is needed.

**Olive-backed Quail-dove *Geotrygon veraguensis***

2006 IUCN Red List Category: Least Concern. Endangered in Ecuador.

This species is found in Esmeraldas from the Rio Mataje watershed to the Rio Onzole in the interior and borders of humid and very humid lowland evergreen forest up to 900 m. Most of its estimated population of 6,000-18,000 individuals is found in the buffer zone of Cotacachi-Cayapas, and the Santiago, Cayapas and Onzole watersheds. All known records come from unprotected areas. Due to severe deforestation, habitat fragmentation and hunting pressure combined with lack of protected lowland habitat the species is considered endangered in Ecuador (Granizo et al. 2002).

While not directly recorded in this study, interviews revealed that the species appears to be locally known and hunted. Some confusion might occur with the Indigo-crowned Quail-dove, so confirmation is needed.

**Chocó Trogon *Trogon comptus***

2006 IUCN Red List Category: Least Concern. Near-threatened in Ecuador.

This Chocó endemic is found in very humid lowland and premontane evergreen forest between 50 and 100 m. in Esmeraldas, the species is uncommon to more or less common in Alto Tambo, the buffer zone of Cotacachi-Cayapas and in Mache-Chindul south to Tinalandia in Pichincha. The estimated population of 25,000-75,000 individuals is threatened by deforestation, cattle ranching and African Palm (Granizo et al. 2002).

One individual was recorded on June 6th at San Francisco.

**Slaty-tailed Trogon *Trogon massena***

2006 IUCN Red List Category: Least Concern. Endangered in Ecuador.

Distributed from Mexico through Panama and Western Colombia this species is found at the southern edge of its range in extreme Northwestern Ecuador, in the lower valley of Rio Mataje and the Borbón area. Here it is restricted to bamboo as well as primary and secondary humid forest near the coast, normally below 200 m. There are only a few specimens and only a few recent reports of this species from Ecuador, first when seen and tape recorded near some Lorenzo in 1997 and 1998 originally by Nilsson; it has also been seen by M. Lysinger from la Chiquita reserve near that city. Recorded only below about 200 m. Severe recent deforestation resulting from the opening of the Borbón-Mataje and San Lorenzo-Ibarra highways facilitating logging and agricultural expansion, (including loss of mangroves from shrimp farming) has drastically reduced the habitat of this species. The estimated population of 6,000-18,000 individuals is considered endangered in Ecuador (Granizo et al. 2002).

The total of three individuals were recorded just outside of the study area. The species undoubtedly occurs within the study area but confirmation is needed.

**Streak-chested Antpitta *Hylopezus perspicillatus***

2006 IUCN Red List Category: Least Concern. Vulnerable in Ecuador.

Distributed from Honduras to Colombia and Western Ecuador, this species is found in the Rio Mataje and Mira watersheds in Esmeraldas, south to Pichincha on the floor of humid and very humid tropical and premontane forests below 800 m. Most of the estimated population of 12,000-36,000 individuals is found in Esmeraldas in the buffer zone of Cotacachi-Cayapas and west to the Rio Onzole watershed. The species is threatened due to deforestation and habitat fragmentation as it is only found in forest interiors. Apparently, it was extirpated from Rio Palenque during the 1980s (Granizo et al. 2002).

Four individuals were heard on June 5th at Durango.

### **Ochraceous Attila** *Attila torridus*

2006 IUCN Red List Category: Vulnerable

This species' habitat has diminished rapidly since c.1960, and deforestation is continuing apace. The range and population are now small and severely fragmented. It therefore qualifies as Vulnerable.

*Attila torridus* is known mainly from west Ecuador in Esmeraldas, Pichincha, Manabí, Los Ríos, Guayas, Cañar, El Oro and Loja. There is a concentration of known localities on the west slope of the Cordillera de Celica, Loja. It is rare or uncommon in all but a few areas, and numbers have decreased considerably. No population estimates are available for the species.

It inhabits humid and semi-humid forest, also secondary forest and **occasionally cacao plantations**, from sea level to 1,000 m, occasionally as high as 2,400 m. Some seasonal movements are thought to occur, but the nature of these remains unclear. The diet consists of fruit and arthropods, especially spiders. Breeding is thought to occur in the wet season, between January and March.

Below 900 m, only 4.4% of the original forest cover remains in west Ecuador, with most of this destruction since c.1960. High levels of habitat loss are continuing, at least in unprotected areas of both Ecuador and Peru, and will soon remove almost all remaining lowland forest if effective action is not taken urgently. In higher parts of the species' range, rates of habitat destruction are not as great, but logging, conversion of land for agriculture and plantations continue. Disturbance and degradation of remaining forest patches through heavy grazing by goats and cattle also poses a threat, particularly in deciduous forests. Illegal settling and deforestation, as well as livestock grazing affect even some of the protected areas and habitat clearance by people with land-rights.

It occurs in two large protected areas, Machalilla National Park, Ecuador, and Northwest Peru Biosphere Reserve, Peru, and two smaller reserves, Río Palenque Scientific Center and Jauneche Biological Research Station, Ecuador. Historical specimens have been taken in the area now protected as Cotacachi-Cayapas Ecological Reserve, and there are possible records from other reserves in northwest Ecuador.

Conservation measures would include;

- Surveys to assess its population and distribution.
- Determine its status in the Cotacachi-Cayapas Ecological Reserve.
- Strengthen habitat protection in the Northwest Peru Biosphere Reserve and Machalilla National Park.
- Protect the Cordillera de Celica (Granizo et al. 2002, BirdLife International 2003).



One individual was recorded at Maldonado and two individuals were recorded on separate days at Tachina. Due to its tolerance of open habitats including cacao plantations, this could be a flagship species for the cacao project.

**Blue Cotinga *Cotinga nattererii***

2006 IUCN Red List Category: Least Concern. Vulnerable in Ecuador.

Distributed from Panama, Colombia, Venezuela and Northwestern Ecuador, it is found in the Rios Mataje and Mira in Esmeraldas to Northwestern Pichincha. Scarce and local in the canopy and borders of humid and very humid lowland evergreen forest, normally below 500 m. Rare in Cotacachi-Cayapas and uncommon in Cayapas-Mataje and in Cerro Mutiles east of Atacames and Muisne with a few records from Pedro Vicente Maldonado and one from San Miguel de los Bancos. At the present time there are no known records from protected areas. The estimated population of 25,000-10,000 individuals is threatened by deforestation and habitat fragmentation (Granizo et al. 2002).

Three individuals were seen at Maldonado on May 31st and three individuals were seen at Tachina on June 3. This dazzling blue and purple, dove-like Cotinga, along with the striking Scarlet-breasted Dacnis profiled below, could easily be poster birds for the cacao project.

**Scarlet-thighed Dacnis *Dacnis venusta***

2006 IUCN Red List Category: Least Concern. Near-threatened in Ecuador.

Distributed from Costa Rica, Western Colombia to Northwestern Ecuador, it is found in canopy and borders of humid and very humid tropical and premontane forests normally below 800 m. The species is rare to uncommon from Esmeraldas west to Mache-Chindul to Northern Guayas and Southeast Pichincha at Rio Palenque. Possibly nesting in the foothills and dispersing to lower altitudes after reproduction. The estimated population of 10,000-30,000 individuals is threatened by deforestation and habitat fragmentation (Granizo et al. 2002).

The species was recorded on four occasions, occurring at least once at all sites.

**Scarlet-breasted Dacnis *Dacnis berlepschi***

2006 IUCN Red List Category: Vulnerable

Habitat loss in the core part of this Chocó endemic's small range has been extensive, and the rate of destruction is predicted to increase. Parallel declines in population and range are inferred, and it has been lost from former locations. The total population is suspected to be small and to consist of very small, severely fragmented subpopulations. It is therefore classified as Vulnerable.

*Dacnis berlepschi* occurs on the Pacific slopes and lowlands of southwest Colombia (Nariño) and northwest Ecuador (Esmeraldas, Imbabura, Pichincha). It is restricted to wet lowland and foothill-forest, forest edge, and tall, second growth from sea level to 1,200 m. It forages in the canopy, sometimes joining mixed-species flocks. In this part of the Chocó region, habitat, and thus the species' distribution, is now extremely fragmented. Despite numerous field studies, there have been very few recent Colombian records. It has always been considered uncommon to rare. Total population in Ecuador and Colombia is estimated at 2,500-9,999.

Logging in the Chocó has intensified since the mid-1970s. In the late 1990s, primary forests in Nariño and within 60 km of San Lorenzo, Esmeraldas, were selectively logged, and then

converted to oil palm plantations at a rapid rate with a further 500-540 km<sup>2</sup> of oil palm company land in Esmeraldas due to be deforested by 2001-2002. Two-thirds of known localities, albeit some in protected areas, are within this region, which is further affected by a new mining concession. Colonization and land development are progressing through infrastructure improvement, particularly the expansion of road networks, and in turn are increasing the impact of logging, cattle ranching, etc. New legislation and the transfer of land-rights to local communities have been exploited by large businesses, as it has become cheap and easy to buy land. International investment in the region has been lacking in concern for the environment.

Conservation measures are underway for the species. Land has been purchased for a proposed biological corridor between Awá and Cotacachi-Cayapas. It has been recorded in:

- Río Ñambi Community Nature Reserve, Colombia
- Awá Forest Reserve Zone
- Río Palenque Scientific Center
- Jatun Sacha Bilsa Biological Station
- Cayapas-Mataje Ecological Reserve
- Cotacachi-Cayapas Ecological Reserve

Conservation measures proposed for the protection of *Dacnis berlepschi* include:

- survey the tracts of forest that remain NW Ecuador
- clarify its ecological requirements
- establish a biological corridor linking Awá and Cotacachi-Cayapas
- designate Awá, Cotacachi-Cayapas and the biological corridor as a biosphere reserve
- sustainably manage a buffer zone to the Awá, Cotacachi-Cayapas protected areas (Granizo et al. 2002, BirdLife International 2003).

Two individuals were recorded at Maldonado on June 2nd. This is a famous and eagerly sought out bird for birdwatchers and an appropriate poster bird for the project.

### **Rufous-winged Tanager *Tangara lavinia***

2006 IUCN Red List Category: Least Concern. Near-threatened in Ecuador.

Distributed from Guatemala, Western Colombia to Northwestern Ecuador, the species is found in the Rios Mataje, Mira, Santiago and Cayapas in Esmeraldas to Northwestern Pichincha with recent records from San Miguel de los Bancos. It inhabits canopy and borders of humid and very humid tropical and premontane forests normally below 750 m. The estimated population of 15,000-45,000 individuals is threatened by deforestation and habitat fragmentation. Populations exist in Cotacachi-Cayapas and probably the Awá protected areas (Granizo et al. 2002).

Four individuals were seen at Durango on June 5th.

## **Conclusions**

This rapid assessment of bird diversity in rustic cacao plantations and adjacent forests indicate equivalent species numbers in both habitats with the exception of the San Francisco site, which had a significantly lower species diversity. The estimate for Maldonado of 160-180 species was the highest and has the most confidence due to higher sampling effort of four

days. The estimate for Tachina of 140-170 species is next but with lower confidence due to less sampling effort of 2.5 days. With 16 McKinnon lists done for the San Francisco site, we were able to make a rough estimate of 100-120 species. While the total number of species recorded in one day at Durango was the lowest (70) of the full-day totals at other sites, it is the most important site for the presence of intact forest and appears to harbor a higher number of restricted range species and species-at-risk, as reflected in the highest daily total for this group.

All the data from this study supports the conclusion sustaining that rustic cacao is extremely important in high bird diversity and should be targeted for acquisition or otherwise maintained as status quo

## **Recommendations**

1. Substituting a transect method instead of point counts should be considered for future surveys in the study area. Travel time between point counts stations results in the loss of valuable time for data collection, which is crucial especially during high bird activity in the early morning. Transects allow for continuous interception, detection and recording of individuals and species. In particular, the Multi Time-window Transect-mapping (MTW) technique is a powerful tool, which is optimized for increased species detectability and has been used to accurately predict species richness, numbers of individuals as well as density in terms of biomass of birds per unit area (Olaf Jahn pers. comm.).
2. Particular attention should be paid to restricted range species as well as species-at-risk in all future surveys and weighted factors should be applied to these species in terms of their importance for conservation.
3. We would suggest performing 20 McKinnon lists of 1 day's effort in both an exemplary banana, and African oil palm plantation in the vicinity in order to provide hard data to support the assumption of their failure of maintaining a diverse bird population.
4. High priority sites for acquisition and management for the conservation of bird species would be Maldonado, Tachina and Durango. The San Francisco site would be of lower priority.
5. All hunting and logging should be actively discouraged in the study areas. Educational and incentive programs for curbing hunting should be developed with particular attention to game bird species such as the Cracids (Great Currasow, Rufous-headed Chachalaca, Crested and Baudó Guan), as well as Tawny-faced Quail, Indigo-Crowned Quail-Dove, and Olive-backed Quail-Dove.
6. Several spectacular and colorful Chocó endemics would serve as charismatic flagship species suitable for posters and other public educational programs such as; Scarlet-thighed Dacnis, Scarlet-breasted Dacnis and Blue Cotinga.

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31	Dusky Pigeon	Columba goodsoni	1		X!	X	X	X	X	X	X	X	X	X
32	Ecuadorian Ground-Dove	Columba buckleyi	2											(X)
33	Blue Ground-Dove	Claravis pretiosa		2	X	X	X!	X				X		
34	Pallid Dove	Leptotila pallida	1		X	X	X!	X	X	X	X			X
35	Ruddy Quail-Dove	Geotrygon Montana		L										
36	Indigo-crowned Quail-Dove	Geotrygon purpurata	VU,1	L?										
37	Olive-backed Quail-Dove	Geotrygon veraguensis	EN	L?										
	<b>PARROTS &amp; MACAWS</b>	<b>PSITTACIDAE</b>												
38	Chestnut-fronted Macaw	Ara severa					2							
39	Pacific Parrotlet	Forpus coelestis	2	2	X	X	X							(X)
40	Rose-faced Parrot	Pionopsitta pulchra	1		7							2		1
41	Blue-headed Parrot	Pionus menstruus			X	X	X	X	X	X	X	X	X	X
42	Bronze-winged Parrot	Pionus chalcopterus				X								
43	Red-lored Amazon	Amazona autumnalis					6!							
44	Mealy Amazon	Amazona farinosa					2					6!	X	X
	<b>CUCKOOS &amp; ANIS</b>	<b>CUCULIDAE</b>												
45	Squirrel Cuckoo	Piaya cayana		1	X	X	X						X	X
46	Smooth-billed Ani	Crotophaga ani			X	X	X	X	X			X	X	X
47	Striped Cuckoo	Tapera naevia		1	X!	X	X	X			X	X		X
	<b>TYPICAL OWLS</b>	<b>STRIGIDAE</b>												
48	Crested Owl	Lophotrix cristata					1h							
	<b>NIGHTJARS &amp; NIGHTHAWKS</b>	<b>CAPRIMULGIDAE</b>												
49	Pauraque	Nyctidromus albicollis						X	X	X	X	X	X	
	<b>SWIFTS</b>	<b>APODIDAE</b>												
50	White-collared Swift	Streptoprocne zonaris				X	X	X	X	X		X	X	X
51	Chestnut-collared Swift	Cypseloides rutilus						X				X		X
52	Band-rumped Swift	Chaetura spinicauda					X							
53	Gray-rumped Swift	Chaetura cinereiventris												X
54	Lesser Swallow-tailed Swift	Panyptila cayennensis			X		X							
	<b>HUMMINGBIRDS</b>	<b>TROCHILIDAE</b>												
55	Bronzy Hermit	Glaucis aenea										X		
56	Band-tailed Barbthroat	Threnetes ruckeri					2				1	1		1
57	White-whiskered Hermit	Phaethornis yaruqui	1											1!
58	Stripe-throated Hermit	Phaethornis striigularis		1	X	X	X	X			X	X		
59	White-necked Jacobin	Florisuga mellivora					2							1
60	Green-crowned Woodnymph	Thalurania fannyi			1									
61	Violet-bellied Hummingbird	Damophila julie			2	2	3	2						1
62	Rufous-tailed Hummingbird	Amazilia tzacatl			1	1		1			1			1
63	Blue-chested Hummingbird	Amazilia amabilis			2			1				1		
64	Purple-crowned Fairy	Heliophryx barroti			2	1	1							1
65	Long-billed Starthroat	Heliomaster longirostris			1									
	<b>TROGONS &amp; QUETZALS</b>	<b>TROGONIDAE</b>												
66	Chocó Trogon	Trogon comptus	NT,1											X!
67	Slaty-tailed Trogon	Trogon massena	EN				(2)							(1)
68	Western White-tailed Trogon	Trogon chionurus					h!	X	X	X	X	X	X	X
	<b>KINGFISHERS</b>	<b>ALCEDINIDAE</b>												
69	Ringed Kingfisher	Megaceryle torquata					(2)			2	1	1		
70	Green Kingfisher	Chloroceryle americana								1				1
	<b>MOTMOTS</b>	<b>MOMOTIDAE</b>												
71	Broad-billed Motmot	Electron platyrhynchum												X
72	Rufous Motmot	Baryphthengus martii									1			X
	<b>JACAMARS</b>	<b>GALBULIDAE</b>												
73	Rufous-tailed Jacamar	Galbula ruficauda										1		
	<b>PUFFBIRDS</b>	<b>BUCCONIDAE</b>												
74	White-necked Puffbird	Notharchus macrorhynchos			2	2		1						1
75	Black-breasted Puffbird	Notharchus pectoralis						h	h		3	h		
76	Pied Puffbird	Notharchus tectus						2	1!		2			

77	White-whiskered Puffbird	Malacoptila panamensis		4						2	2	
	<b>NEW WORLD BARBETS</b>	<b>CAPITONIDAE</b>										
78	Orange-fronted Barbet	Capito squamatus	1	2	1	X	X		X	X	X	X
	<b>TOUCANS</b>	<b>RAMPHASTIDAE</b>										
79	Stripe-billed Araçari	Pteroglossus sanguineus	1	5			2			4		
80	Chocó Toucan	Ramphastos brevis	1		h	h	h				X!	
81	Chestnut-mandibled Toucan	Ramphastos swainsonii				h			h		X	h
	<b>WOODPECKERS &amp; PICULETS</b>	<b>PICIDAE</b>										
82	Olivaceous Piculet	Picumnus olivaceus				1						
83	Lineated Woodpecker	Dryocopus lineatus				2!	2	2	2		(1)	
84	Black-cheeked Woodpecker	Melanerpes pucherani		X	X	X	X!	X	X	X	X	X
85	Red-rumped Woodpecker	Veniliornis kirkii		1					1			
86	Scarlet-backed Woodpecker	Veniliornis callonotus	2						1			
87	Guayaquil Woodpecker	Campophilus guayaquilensis	2	1	2		1			1		
	<b>OVENBIRDS</b>	<b>FURNARIIDAE</b>										
88	Pacific Hornero	Furnarius cinnamomeus	2		(X)							X
89	Slaty Spinetail	Synallaxis brachyura		1!					X	X		X
90	Buff-throated Foliage-gleaner	Automolus ochrolaemus		X		X			X	X		
91	Plain Xenops	Xenops minutus		2							X	
	<b>WOODCREEPERS</b>	<b>DENDROCOLAPTIDAE</b>										
92	Plain-brown Woodcreeper	Dendrocincla fuliginosa			2	1			1			
93	Olivaceous Woodcreeper	Sittasomus griseicapillus				1						
94	Black-banded Woodcreeper	Dendrocolaptes picumnus										1
95	Spotted Woodcreeper	Xiphorhynchus erythropygius		1								
96	Streak-headed Woodcreeper	Lepidocolaptes souleyetii		3	5	X	X		X		X	X
97	Red-billed Scythebill	Campylorhamphus pucherani										h!
	<b>TYPICAL ANTIBIRDS</b>	<b>THAMNOPHILIDAE</b>										
98	Great Antshrike	Taraba Major			h				X			
99	Western Slaty-Antshrike	Thamnophilus atrinucha		X	2	2!	X					
100	Pacific Antwren	Myrmotherula pacifica			!				X	X	X	X
101	Checker-throated Antwren	Myrmotherula fulviventris									X!	
102	White-flanked Antwren	Myrmotherula axillaris							X			
103	Dot-winged Antwren	Microrhophias quixensis			2							
104	Dusky Antbird	Cercomacra tyrannina		3!	X	X	X		X	X	X	X
105	Immaculate Antbird	Myrmeciza immaculata										1
106	Chestnut-backed Antbird	Myrmeciza exsul		X	X!	X	X	X	X	X	X	X
107	Esmeraldas Antbird	Myrmeciza nigricauda	1									1
108	Stub-tailed Antbird	Myrmeciza berlepschi	1									5
109	Bicolored Antbird	Gymnophythis leucaspis			X							
	<b>ANTPITTAS &amp; ANTTHRUSHES</b>	<b>FORMICARIIDAE</b>										
110	Streak-chested Antpitta	Hylopezus perspicillatus	VUe									4!
	<b>TYRANT FLYCATCHERS</b>	<b>TYRANNIDAE</b>										
111	Sooty-headed Tyrannulet	Phylloscopus griseiceps		1	2	1	1					
112	Golden-faced Tyrannulet	Zimmerius chrysops		X								
113	Brown-capped Tyrannulet	Ornithion brunneicapillum		1	1	1	2		X!	X		X
114	Southern Beardless-Tyrannulet	Campostoma obsoletum		h	2	1				X	X	X
115	Yellow-crowned Tyrannulet	Tyrannulus elatus		X!	X	X	X		X	X	X	X
116	Gray Elaenia	Myiopagis caniceps				1						
117	Yellow-bellied Elaenia	Elaenia flavogaster		X								
118	Olive-striped Flycatcher	Mionectes olivaceus										2
119	Ochre-bellied Flycatcher	Mionectes oleagineus		X		X				X		
120	Scale-crested Pygmy-Tyrant	Lophotriccus pileatus		X	X!	X	X	X	X	X	X	
121	Black-headed Tody-Flycatcher	Todirostrum nigriceps		1!		1						
122	Common Tody-Flycatcher	Todirostrum cinereum		1		1			1			X
123	Pacific Flatbill	Rhynchocyclus pacificus	1								1	
124	Yellow-margined Flatbill	Tolmomyias flavotectus		1					1			
125	Bran-colored Flycatcher	Myiophobus fasciatus							1			







## Appendix 2. Comparison of bird species occurrence in Cacao vs. Forest

x = recorded in this study

+ = additional species known to occur in forest

Note: Birds seen in clearings or secondary forest, immediately bordering cacao plantations, have been included in “Cacao”. Also note that much more time was spent in cacao plantation than in forest.

		Cacao	Forest
<b>TINAMOUS</b>	<b>TINAMIDAE</b>		
Little Tinamou	<i>C. soui</i>	x	+
<b>HERONS, BITTERNs, AND EGRETS</b>	<b>ARDEIDAE</b>		
Great Egret	<i>A. alba</i>	x	
Snowy Egret	<i>Egretta thula</i>	x	
Cattle Egret	<i>Bubulcus ibis</i>	x	
Striated Heron	<i>Butorides striatus</i>	x	
<b>AMERICAN VULTURES</b>	<b>CATHARTIDAE</b>		
King Vulture	<i>Sarcoramphus papa</i>		x
Black Vulture	<i>Coragyps atratus</i>	x	
Turkey Vulture	<i>Cathartes aura</i>	x	x
<b>KITES, EAGLES, AND HAWKS</b>	<b>ACCIPITRIDAE</b>		
Gray-headed Kite	<i>Leptodon cayanensis</i>	x	+
Swallow-tailed Kite	<i>Elanoides forficatus</i>	x	
Snail Kite	<i>Rostrhamus sociabilis</i>	x	
Tiny Hawk	<i>A. superciliosus</i>		x
Semiplumbeous Hawk	<i>L. semiplumbea</i>		x
Roadside Hawk	<i>B. magnirostris</i>	x	
<b>FALCONS AND CARACARAS</b>	<b>FALCONIDAE</b>		
Laughing Falcon	<i>Herpetotheres cachinnans</i>	x	x
Bat Falcon	<i>F. ruficularis</i>	x	x
<b>RAILS, GALLINULES, AND COOTS</b>	<b>RALLIDAE</b>		
White-throated Crake	<i>L. albigularis</i>	x	
<b>PIGEONS AND DOVES</b>	<b>COLUMBIDAE</b>		
Rock Pigeon	<i>Columba livia</i>	x	
Scaled Pigeon	<i>C. speciosa</i>	x	x
Pale-vented Pigeon	<i>C. cayennensis</i>	x	
Ruddy Pigeon	<i>C. subvinacea</i>	x	x
Dusky Pigeon	<i>C. goodsoni</i>	x	x
Ecuadorian Ground-Dove	<i>C. buckleyi</i>		
Blue Ground-Dove	<i>Claravis pretiosa</i>	x	
Pallid Dove	<i>L. pallida</i>	x	+
<b>PARROTS AND MACAWS</b>	<b>PSITTACIDAE</b>		
Pacific Parrotlet	<i>F. coelestis</i>	x	
Rose-faced Parrot	<i>Pionopsitta pulchra</i>	x	+
Blue-headed Parrot	<i>Pionus menstruus</i>	x	+
Red-lored Amazon	<i>Amazona autumnalis</i>	x	+
Mealy Amazon	<i>A. farinosa</i>	x	x
<b>CUCKOOS AND ANIS</b>	<b>CUCULIDAE</b>		
Squirrel Cuckoo	<i>Piaya cayana</i>	x	+
Smooth-billed Ani	<i>C. ani</i>	x	
Striped Cuckoo	<i>Tapera naevia</i>	x	
<b>TYPICAL OWLS</b>	<b>STRIGIDAE</b>		
Crested Owl	<i>Lophotrix cristata</i>	x	+
<b>NIGHTJARS AND NIGHTHAWKS</b>	<b>CAPRIMULGIDAE</b>		
Pauraque	<i>Nyctidromus albicollis</i>	x	

<b>SWIFTS</b>	<b>APODIDAE</b>		
White-collared Swift	<i>Streptoprocne zonaris</i>	x	x
Chestnut-collared Swift	<i>Cypseloides rutilus</i>	x	x
Band-rumped Swift	<i>C. spinicauda</i>	x	+
Gray-rumped Swift	<i>C. cinereiventris</i>	x	+
Lesser Swallow-tailed Swift	<i>Panyptila cayennensis</i>	x	
<b>HUMMINGBIRDS</b>	<b>TROCHILIDAE</b>		
Bronzy Hermit	<i>G. aenea</i>	x	+
Band-tailed Barbthroat	<i>Threnetes ruckeri</i>	x	+
White-whiskered Hermit	<i>Phaethornis yaruqui</i>		x
Stripe-throated Hermit	<i>P. striigularis</i>	x	x
White-necked Jacobin	<i>Florisuga mellivora</i>	x	+
Green-crowned Woodnymph	<i>T. fannyi</i>	x	+
Violet-bellied Hummingbird	<i>Damophila julie</i>	x	+
Rufous-tailed Hummingbird	<i>Amazilia tzacatl</i>	x	
Blue-chested Hummingbird	<i>A. amabilis</i>	x	x
Purple-crowned Fairy	<i>Heliothryx barroti</i>	x	+
Long-billed Starthroat	<i>Heliomaster longirostris</i>	x	+
<b>TROGONS AND QUETZALS</b>	<b>TROGONIDAE</b>		
Chocó Trogon	<i>T. comptus</i>		x
Slaty-tailed Trogon	<i>T. massena</i>		x
Western White-tailed Trogon	<i>T. chionurus</i>	x	x
<b>KINGFISHERS</b>	<b>ALCEDINIDAE</b>		
Ringed Kingfisher	<i>Megaceryle torquata</i>		
Green Kingfisher	<i>C. americana</i>		
<b>MOTMOTS</b>	<b>MOMOTIDAE</b>		
Broad-billed Motmot	<i>Electron platyrhynchum</i>		x
Rufous Motmot	<i>Baryphthengus martii</i>	x	x
<b>JACAMARS</b>	<b>GALBULIDAE</b>		
Rufous-tailed Jacamar	<i>G. ruficauda</i>	x	+
<b>PUFFBIRDS</b>	<b>BUCCONIDAE</b>		
White-necked Puffbird	<i>Notharchus macrorhynchos</i>	x	+
Black-breasted Puffbird	<i>N. pectoralis</i>	x	+
Pied Puffbird	<i>N. tectus</i>	x	+
White-whiskered Puffbird	<i>M. panamensis</i>	x	x
<b>NEW WORLD BARBETS</b>	<b>CAPITONIDAE</b>		
Orange-fronted Barbet	<i>C. squamatus</i>	x	x
<b>TOUCANS</b>	<b>RAMPHASTIDAE</b>		
Stripe-billed Araçari	<i>P. sanguineus</i>	x	+
Chocó Toucan	<i>R. brevis</i>		x
Chestnut-mandibled Toucan	<i>R. swainsonii</i>		x
<b>WOODPECKERS AND PICULETS</b>	<b>PICIDAE</b>		
Olivaceous Piculet	<i>P. olivaceus</i>	x	
Lineated Woodpecker	<i>Dryocopus lineatus</i>	x	+
Black-cheeked Woodpecker	<i>M. pucherani</i>	x	+
Red-rumped Woodpecker	<i>V. kirkii</i>	x	+
Scarlet-backed Woodpecker	<i>V. callonotus</i>	x	
Guayaquil Woodpecker	<i>C. gayaquilensis</i>	x	+
<b>OVENBIRDS</b>	<b>FURNARIIDAE</b>		
Pacific Hornero	<i>Furnarius cinnamomeus</i>	x	
Slaty Spinetail	<i>S. brachyura</i>	x	
Buff-throated Foliage-gleaner	<i>A. ochrolaemus</i>		x
Plain Xenops	<i>X. minutus</i>	x	x
<b>WOODCREEPERS</b>	<b>DENDROCOLAPTIDAE</b>		
Plain-brown Woodcreeper	<i>D. fuliginosa</i>	x	+
Olivaceous Woodcreeper	<i>Sittasomus griseicapillus</i>	x	+
Black-striped Woodcreeper	<i>X. lachrymosus</i>	x	+

Spotted Woodcreeper	<i>X. erythropygius</i>	x	+
Streak-headed Woodcreeper	<i>Lepidocolaptes souleyetii</i>	x	x
<b>TYPICAL ANT BIRDS</b>	<b>THAMNOPHILIDAE</b>		
Great Antshrike	<i>Taraba major</i>	x	
Western Slaty-Antshrike	<i>T. atrinucha</i>	x	x
Russet Antshrike	<i>Thamnistes anabatinus</i>		x
Pacific Antwren	<i>M. pacifica</i>	x	
Checker-throated Antwren	<i>M. fulviventris</i>		x
White-flanked Antwren	<i>M. axillaris</i>		x
Dot-winged Antwren	<i>Microrhopias quixensis</i>		x
Dusky Antbird	<i>C. tyrannina</i>	x	x
Immaculate Antbird	<i>M. immaculata</i>		x
Chestnut-backed Antbird	<i>Myrmeciza exsul</i>	x	x
Esmeraldas Antbird	<i>M. nigricauda</i>		x
Stub-tailed Antbird	<i>M. berlepschi</i>		x
Bicolored Antbird	<i>Gymnopithys leucaspis</i>		x
<b>ANTPITTAS AND ANTTHRUSHES</b>	<b>FORMICARIIDAE</b>		
Streak-chested Antpitta	<i>Hylopezus perspicillatus</i>		x
<b>TYRANT FLYCATCHERS</b>	<b>TYRANNIDAE</b>		
Sooty-headed Tyrannulet	<i>P. griseiceps</i>	x	
Golden-faced Tyrannulet	<i>Zimmerius chrysops</i>	x	
Brown-capped Tyrannulet	<i>O. brunneicapillum</i>	x	x
Southern Beardless-Tyrannulet	<i>Camptostoma obsoletum</i>	x	
Yellow-crowned Tyrannulet	<i>Tyrannulus elatus</i>	x	x
Gray Elaenia	<i>Myiopagis caniceps</i>	x	+
Yellow-bellied Elaenia	<i>Elaenia flavogaster</i>	x	
Olive-striped Flycatcher	<i>M. olivaceus</i>		x
Ochre-bellied Flycatcher	<i>M. oleagineus</i>	x	+
Scale-crested Pygmy-Tyrant	<i>Lophotriccus pileatus</i>	x	x
Black-headed Tody-Flycatcher	<i>Todirostrum nigriceps</i>	x	+
Common Tody-Flycatcher	<i>T. cinereum</i>	x	
Pacific Flatbill	<i>Rhynchocyclus pacificus</i>		x
Yellow-margined Flatbill	<i>T. flavotectus</i>	x	+
Bran-colored Flycatcher	<i>M. fasciatus</i>	x	
Long-tailed Tyrant	<i>Colonia colonus</i>	x	
Masked Water-Tyrant	<i>Fluvicola nengeta</i>	x	
Bright-rumped Attila	<i>Attila spadiceus</i>	x	+
Ochraceous Attila	<i>A. torridus</i>	x	+
Western Sirsystes	<i>S. albogriseus</i>	x	+
Dusky-capped Flycatcher	<i>Myiarchus tuberculifer</i>	x	+
Boat-billed Flycatcher	<i>Megarynchus pitangua</i>	x	+
Rusty-margined Flycatcher	<i>M. cayanensis</i>	x	
Gray-capped Flycatcher	<i>M. granadensis</i>	x	
Piratic Flycatcher	<i>Legatus leucophaeus</i>	x	x
Tropical Kingbird	<i>Tyrannus melancholicus</i>	x	
Cinnamon Becard	<i>P. cinnamomeus</i>	x	
Masked Tityra	<i>T. semifasciata</i>	x	x
Black-crowned Tityra	<i>T. inquisitor</i>	x	+
<b>COTINGAS</b>	<b>COTINGIDAE</b>		
Blue Cotinga	<i>Cotinga nattererii</i>	x	+
Black-tipped Cotinga	<i>Carpodectes hopkei</i>		x
Purple-throated Fruitcrow	<i>Querula purpurata</i>	x	x
<b>MANAKINS</b>	<b>PIPRIDAE</b>		
White-bearded Manakin	<i>Manacus manacus</i>	x	x
<b>VIREOS, PEPPERSHRIKES, SHRIKE-</b>	<b>VIREONIDAE</b>		
Slaty-capped Shrike-Vireo	<i>Vireolanius leucotis</i>		x
Red-eyed Vireo	<i>Vireo olivaceus</i>	x	+

<b>SWALLOWS AND MARTINS</b>	<b>HIRUNDINIDAE</b>		
Gray-breasted Martin	<i>P. chalybea</i>	x	
Blue-and-white Swallow	<i>N. cyanoleuca</i>	x	
Southern Rough-winged Swallow	<i>Stelgidopteryx ruficollis</i>	x	
<b>WRENS</b>	<b>TROGLODYTIDAE</b>		
Band-backed Wren	<i>C. zonatus</i>	x	+
Bay Wren	<i>Thryothorus nigricapillus</i>	x	+
Stripe-throated Wren	<i>T. leucopogon</i>		x
House Wren	<i>Troglodytes aedon</i>	x	
White-breasted Wood-Wren	<i>Henicorhina leucosticta</i>		x
Southern Nightingale-Wren	<i>Microcerculus marginatus</i>		x
<b>GNATCATCHERS AND GNATWRENS</b>	<b>POLIOPTILIDAE</b>		
Tropical Gnatcatcher	<i>Polioptila plumbea</i>	x	
<b>NEW WORLD WARBLERS AND WRENS</b>	<b>PARULIDAE</b>		
Tropical Parula	<i>Parula pitiayumi</i>	x	+
Buff-rumped Warbler	<i>B. fulvicauda</i>	x	x
<b>TANAGERS, HONEYCREEPERS, BANANAS</b>	<b>THRAUPIDAE</b>		
Bananaquit	<i>Coereba flaveola</i>	x	+
Purple Honeycreeper	<i>C. caeruleus</i>	x	+
Red-legged Honeycreeper	<i>C. cyaneus</i>	x	+
Green Honeycreeper	<i>Chlorophanes spiza</i>	x	+
Yellow-tufted Dacnis	<i>D. egregia</i>	x	+
Scarlet-thighed Dacnis	<i>D. venusta</i>	x	x
Scarlet-breasted Dacnis	<i>D. berlepschi</i>	x	+
Guira Tanager	<i>Hemithraupis guira</i>	x	+
Thick-billed Euphonia	<i>Euphonia laniirostris</i>	x	+
White-vented Euphonia	<i>E. minuta</i>		x
Fulvous-vented Euphonia	<i>E. fulvicrissa</i>	x	+
Emerald Tanager	<i>T. florida</i>		x
Blue-necked Tanager	<i>T. cyanicollis</i>	x	
Golden-hooded Tanager	<i>T. larvata</i>	x	+
Rufous-winged Tanager	<i>T. lavinia</i>		x
Blue-gray Tanager	<i>Thraupis episcopus</i>	x	
Palm Tanager	<i>T. palmarum</i>	x	x
Lemon-rumped Tanager	<i>R. icteronotus</i>	x	
Lemon-spectacled Tanager	<i>Chlorothraupis olivacea</i>		x
Dusky-faced Tanager	<i>Mitrospingus cassinii</i>	x	
Tawny-crested Tanager	<i>T. delatrii</i>		x
<b>SALTATORS, GROSBEAKS, AND CARDINALS</b>	<b>CARDINALIDAE</b>		
Buff-throated Saltator	<i>Saltator maximus</i>	x	+
Slate-colored Grosbeak	<i>S. grossus</i>	x	x
Blue-black Grosbeak	<i>Cyanocopsa cyanooides</i>	x	x
<b>EMBERIZINE FINCHES</b>	<b>EMBERIZIDAE</b>		
Blue-black Grassquit	<i>Volatinia jacarina</i>	x	
Lesser Seed-Finch	<i>Oryzoborus angolensis</i>	x	
Variable Seedeater	<i>S. corvina</i>	x	
Orange-billed Sparrow	<i>Arremon aurantirostris</i>	x	x
<b>NEW WORLD BLACKBIRDS AND ORIOLES</b>	<b>ICTERIDAE</b>		
Shiny Cowbird	<i>Molothrus bonariensis</i>	x	
Yellow-tailed Oriole	<i>I. mesomelas</i>	x	
<b>Total species recorded</b>		<b>139</b>	<b>64</b>
<b>Total species expected</b>			<b>121</b>

### Appendix 3. Comparison of bird distribution in cacao vs. tropical forests in Panama

184 different kinds of birds were found in cacao plantations with 90 exclusively found there while 144 were found in tropical forest remnants, 50 exclusively. 234 different kinds of birds were found in all habitats (Smithsonian National Zoological Park website, 2006).

Common Name	Scientific Name	Cacao	Forest
Great Tinamou	<i>Tinamus major</i>		x
Little Tinamou	<i>Crypturellus soui</i>	x	x
Great Egret	<i>Casmerodius albus</i>	x	
Little Blue Heron	<i>Egretta caerulea</i>	x	
Cattle Egret	<i>Bulbulcus ibis</i>	x	
Rufescent Tiger-Heron	<i>Tigrisoma lineatum</i>		x
Green-backed Heron	<i>Butorides striatus</i>	x	
Yellow-crowned Night-Heron	<i>Nyctanassa violasea</i>	x	
King Vulture	<i>Sarcoramphus papa</i>	x	x
Turkey Vulture	<i>Cathartes aura</i>	x	
Black Vulture	<i>Coragyps atratus</i>	x	x
Gray-headed Kite	<i>Leptodon cayanensis</i>	x	
Hook-billed Kite	<i>Chondrohierax uncinatus</i>	x	
White-tailed Kite	<i>Elanus leucurus</i>	x	
Double-toothed Kite	<i>Harpagus bidentatus</i>	x	x
Plumbeous Kite	<i>Ictinia plumbea</i>	x	
Semiplumbeous Hawk	<i>Leucopternis semiplumbea</i>		x
White Hawk	<i>Leucopternis albicollis</i>	x	
Common Black-Hawk	<i>Buteogallus anthracinus</i>	x	
Roadside Hawk	<i>Buteo magnirostris</i>	x	
Broad-winged Hawk	<i>Buteo platypterus</i>	x	
Black Hawk-Eagle	<i>Spizaetus tyrannus</i>	x	

Collared Forest-Falcon	<i>Micrastur semitorquatus</i>		x
Laughing Falcon	<i>Herpetheres cachinnans</i>	x	x
Bat Falcon	<i>Falco rufigularis</i>	x	
Gray-headed Chachalaca	<i>Ortalis cinereiceps</i>	x	x
Black-eared Wood-Quail	<i>Odontophorus melanotis</i>		x
White-throated Crake	<i>Laterallus albiguratis</i>	x	
Gray-necked Wood-Rail	<i>Aramides cajanea</i>	x	
Purple Gallinule	<i>Porphyryla martinica</i>	x	
Northern Jacana	<i>Jacana spinosa</i>	x	
Spotted Sandpiper	<i>Actitis macularia</i>	x	
Pale-vented Pigeon	<i>Columba cayennensis</i>	x	x
Scaled Pigeon	<i>Patagioenas speciosa</i>	x	x
Red-billed Pigeon	<i>Patagioenas flavirostris</i>	x	x
Short-billed Pigeon	<i>Patagioenas nigrirostris</i>	x	x
Common Ground-Dove	<i>Columbina passerina</i>	x	
Ruddy Ground-Dove	<i>Columbina talpacoti</i>	x	
Blue Ground-Dove	<i>Claravis pretiosa</i>	x	
Gray-chested Dove	<i>Leptotila cassini</i>	x	x
Olive-backed Quail-Dove	<i>Geotrygon veraguensis</i>		x
Crimson-fronted Parakeet	<i>Aratinga finschi</i>	x	
Olive-throated Parakeet	<i>Aratinga nana</i>	x	x
Brown-hooded Parrot	<i>Pionopsitta haematotis</i>	x	x
Blue-headed Parrot	<i>Pionus menstruus</i>	x	x
White-crowned Parrot	<i>Pionus senilis</i>	x	
Red-ored Parrot	<i>Amazona autumnalis</i>	x	
Mealy Parrot	<i>Amazona farinosa</i>	x	x
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	x	



Squirrel Cuckoo	<i>Piaya cayana</i>	x	x
Striped Cuckoo	<i>Tapera naevia</i>	x	
Groove-billed Ani	<i>Crotophaga sulcirostris</i>	x	
Black-and-white Owl	<i>Ciccaba nigrolineata</i>	x	
Common Pauraque	<i>Nyctidromus albicollis</i>	x	
Great Potoo	<i>Nyctibius grandis</i>	x	
White-collared Swift	<i>Streptoprocne zonaris</i>	x	
Gray-rumped Swift	<i>Chaetura cinereiventris</i>	x	
Bronzy Hermit	<i>Glaucis aenea</i>	x	x
Band-tailed Barbthroat	<i>Threnetes ruckeri</i>	x	x
Green Hermit	<i>Phaethornis guy</i>		x
Long-tailed Hermit	<i>Phaethornis superciliosus</i>	x	x
Little Hermit	<i>Phaethornis longuemareus</i>	x	x
White-necked Jacobin	<i>Florisuga mellivora</i>	x	x
Green-breasted Mango	<i>Anthracothorax prevostii</i>	x	
Black-crested Coquette	<i>Lophornis helenae</i>	x	
Violet-crowned Woodnymph	<i>Thalurania colombica</i>		x
Blue-chested Hummingbird	<i>Amazilia amabilis</i>	x	x
Rufous-tailed Hummingbird	<i>Amazilia tzacatl</i>	x	
Bronze-tailed Plumeleteer	<i>Chalybura urochrysis</i>	x	x
Purple-throated Mountain-gem	<i>Lampornis calolaema</i>		x
Purple-crowned Fairy	<i>Heliophryx barroti</i>	x	
Long-billed Starthroat	<i>Heliomaster longirostris</i>	x	
Violaceous Trogon	<i>Trogon violaceus</i>	x	x
Black-throated Trogon	<i>Trogon rufus</i>		x
Slaty-tailed Trogon	<i>Trogon massena</i>	x	x
Rufous Motmot	<i>Baryphthengus martii</i>		x
Broad-billed Motmot	<i>Electron platyrhynchum</i>		x

Amazon Kingfisher	<i>Chloroceryle amazona</i>	x	
American Pygmy Kingfisher	<i>Chloroceryle aenea</i>	x	
White-necked Puffbird	<i>Notharchus macrorhynchos</i>	x	x
Pied Puffbird	<i>Notharchus tectus</i>	x	x
White-whiskered Puffbird	<i>Malacoptila panamensis</i>	x	
Emerald Toucanet	<i>Aulacorhynchus prasinus</i>		x
Collared Aracari	<i>Pteroglossus torquatus</i>	x	x
Keel-billed Toucan	<i>Ramphastos sulfuratus</i>	x	x
Chestnut-mandibled Toucan	<i>Ramphastos swainsonii</i>		x
Black-cheeked Woodpecker	<i>Melanerpes pucherani</i>	x	x
Rufous-winged Woodpecker	<i>Piculus simplex</i>		x
Cinnamon Woodpecker	<i>Celeus loricatus</i>	x	x
Chesnut-colored Woodpecker	<i>Celeus castaneus</i>		x
Lineated Woodpecker	<i>Dryocopus lineatus</i>	x	x
Pale-billed Woodpecker	<i>Campephilus guatemalensis</i>	x	x
Slaty Spinetail	<i>Synallaxis brachyura</i>	x	
Buff-throated Foliage-gleaner	<i>Automolus ochrolaemus</i>	x	x
Plain Xenops	<i>Xenops minutus</i>	x	x
Plain-brown Woodcreeper	<i>Dendrocincla fuliginosa</i>		x
Ruddy Woodcreeper	<i>Dendrocincla homochroa</i>		x
Wedge-billed Woodcreeper	<i>Glyphorhynchus spirurus</i>	x	x
Northern-Barred Woodcreeper	<i>Dendrocolaptes sanctithomae</i>	x	x
Cocoa Woodcreeper	<i>Xiphorhynchus susurrans</i>	x	x
Black-striped Woodcreeper	<i>Xiphorhynchus lachrymosus</i>		x
Streak-headed Woodcreeper	<i>Lepidocolaptes souleyetii</i>	x	x
Fasciated Antshrike	<i>Cymbilaimus lineatus</i>		x
Great Antshrike	<i>Taraba major</i>	x	

Western Slaty Antshrike	<i>Thamnophilus atrinucha</i>		x
Plain Antvireo	<i>Dysithamnus mentalis</i>		x
Spot-crowned Antvireo	<i>Dysithamnus puncticeps</i>		x
Checker-throated Antwren	<i>Myrmotherula fulviventris</i>		x
White-flanked Antwren	<i>Myrmotherula axillaris</i>		x
Dot-winged Antwren	<i>Microrhopias quixensis</i>		x
Dusky Antbird	<i>Cercomacra tyrannina</i>	x	x
Chestnut-backed Antbird	<i>Myrmeciza exsul</i>	x	x
Dull-mantled Antbird	<i>Myrmeciza laeosticta</i>		x
Bicolored Antbird	<i>Gymnopathys leucaspis</i>		x
Black-faced Antthrush	<i>Formicarius analis</i>		x
Black-headed Antthrush	<i>Formicarius nigricapillus</i>		x
Streak-chested Antpitta	<i>Hylopezus perspicillatus</i>		x
Thicket Antpitta	<i>Hylopezus dives</i>		x
Yellow-bellied Tyrannulet	<i>Ornithion semiflavum</i>	x	
Brown-capped Tyrannulet	<i>Ornithion brunneicapillum</i>	x	x
Yellow Tyrannulet	<i>Capsiempis flaveola</i>	x	
Forest Elaenia	<i>Myiopagis galmardii</i>		x
Yellow-bellied Elaenia	<i>Elaenia flavogaster</i>	x	
Ochre-bellied Flycatcher	<i>Mionectes oleagineus</i>	x	x
Slaty-capped Flycatcher	<i>Leptopogon superciliaris</i>	x	
Paltry Tyrannulet	<i>Zimmerius vilissimus</i>	x	x
Black-capped Pygmy-Tyrant	<i>Myiornis atricapillus</i>	x	x
Northern Bentbill	<i>Oncostoma cinereigulare</i>	x	x
Common Tody-Flycatcher	<i>Todirostrum cinereum</i>	x	x
Black-headed Tody-Flycatcher	<i>Todirostrum nigriceps</i>	x	x
Yellow-olive Flycatcher	<i>Tolmomyias sulphurescens</i>	x	

Yellow-margined Flycatcher	<i>Tolmomyias assimilis</i>	x	x
Eastern Wood-Pewee	<i>Contopus virens</i>	x	
Tropical Pewee	<i>Contopus cinereus</i>	x	x
Yellow-bellied Flycatcher	<i>Empidonax flaviventris</i>	x	x
Long-tailed Tyrant	<i>Colonia colonus</i>	x	
Bright-rumped Attila	<i>Attila spadiceus</i>	x	x
Rufous Mourner	<i>Rhytipterna holerythra</i>		x
Dusky-capped Flycatcher	<i>Myiarchus tuberculifer</i>	x	x
Great-crested Flycatcher	<i>Myiarchus crinitus</i>	x	
Great Kiskadee	<i>Pitangus sulphuratus</i>	x	x
Boat-billed Flycatcher	<i>Megarhynchus pitangua</i>	x	x
Social Flycatcher	<i>Myiozetetes similis</i>	x	x
Gray-capped Flycatcher	<i>Myiozetetes granadensis</i>	x	
Piratic Flycatcher	<i>Legatus leucophaeus</i>	x	
Tropical Kingbird	<i>Tyrannus melancholicus</i>	x	
Rufous Piha	<i>Lipaugus unirufus</i>		x
Cinnamon Becard	<i>Pachyramphus cinnamomeus</i>	x	
White-winged Becard	<i>Pachyramphus polychopterus</i>	x	
Masked Tityra	<i>Tityra semifasciata</i>	x	x
Black-crowned Tityra	<i>Tityra inquisitor</i>	x	x
Snowy Cotinga	<i>Carpodectes nitidus</i>		x
Purple-throated Fruitcrow	<i>Querula purpurata</i>		x
White-collared Manakin	<i>Manacus candei</i>	x	x
Golden-collared Manakin	<i>Manacus vitellinus</i>	x	x
White-ruffed Manakin	<i>Corapipo altera</i>		x
Blue-crowned Manakin	<i>Pipra coronata</i>		x
Red-capped Manakin	<i>Pipra mentalis</i>		x
Yellow-throated Vireo	<i>Vireo flavifrons</i>	x	

Red-eyed Vireo	<i>Vireo olivaceus</i>	x	
Lesser Greenlet	<i>Hylophilus decurtatus</i>	x	x
Tawny-crowned Greenlet	<i>Hylophilus ochraceiceps</i>		x
Green Shrike-Vireo	<i>Vireolanius pulchellus</i>		x
Black-chested Jay	<i>Cyanocorax affinis</i>	x	x
Brown Jay	<i>Cyanocorax morio</i>	x	x
Band-backed Wren	<i>Campylorhynchus zonatus</i>	x	x
Bay Wren	<i>Thryothorus nigricapillus</i>	x	x
Plain Wren	<i>Thryothorus modestus</i>	x	
White-breasted Wood-Wren	<i>Henicorhina leucosticta</i>	x	x
House Wren	<i>Troglodytes aedon</i>	x	
Scaly-breasted Wren	<i>Microcerculus marginatus luscini</i>		x
Song Wren	<i>Cyphorhinus phaeocephalus</i>		x
Long-billed Gnatwren	<i>Ramphocaenus melanurus</i>	x	x
Tropical Gnatcatcher	<i>Polioptila plumbea</i>	x	x
Black-headed Nightingale Thrush	<i>Catharus mexicanus</i>		x
Wood Thrush	<i>Hylocichla mustelina</i>		x
Clay-colored Robin	<i>Turdus grayi</i>	x	x
Blue-winged Warbler	<i>Vermivora pinus</i>	x	
Golden-winged Warbler	<i>Vermivora chrysoptera</i>	x	
Tennessee Warbler	<i>Vermivora peregrina</i>	x	x
Yellow Warbler	<i>Dendroica petechia</i>	x	
Magnolia Warbler	<i>Dendroica magnolia</i>	x	
Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>	x	x
Bay-breasted Warbler	<i>Dendroica castanea</i>	x	
Black-and-White Warbler	<i>Mniotilta varia</i>	x	x
American Redstart	<i>Setophaga ruticilla</i>	x	

Prothonotary Warbler	<i>Protonotaria citrea</i>	x	
Northern Waterthrush	<i>Seiurus noveboracensis</i>	x	
Kentucky Warbler	<i>Oporornis formosus</i>		x
Mourning Warbler	<i>Oporornis philadelphia</i>	x	
Olive-crowned Yellowthroat	<i>Geothlypis semiflava</i>	x	
Buff-rumped Warbler	<i>Phaeothlypis fulvicauda</i>		x
Bananaquit	<i>Coereba flaveola</i>	x	
Dusky-faced Tanager	<i>Mitrospingus cassinii</i>	x	
Olive Tanager	<i>Chlorothraupis carmioli</i>	x	
White-shouldered Tanager	<i>Tachyphonus luctuosus</i>	x	x
White-lined Tanager	<i>Tachyphonus rufus</i>	x	
Red-throated Ant-Tanager	<i>Habia fuscicauda</i>	x	x
Summer Tanager	<i>Piranga rubra</i>	x	x
Crimson-collared Tanager	<i>Ramphocelus sanguinolentus</i>	x	
Passerini/Es (Scarlet-rumped) Tanager	<i>Ramphocelus passerinii</i>	x	x
Blue-gray Tanager	<i>Thraupis episcopus</i>	x	x
Palm Tanager	<i>Thraupis palmarum</i>	x	x
Yellow-crowned Euphonia	<i>Euphonia luteicapilla</i>	x	x
Olive-backed Euphonia	<i>Euphonia gouldi</i>	x	x
White-vented Euphonia	<i>Euphonia minuta</i>	x	
Emerald Tanager	<i>Tangara florida</i>		x
Plain-colored Tanager	<i>Tangara inornata</i>	x	x
Golden-hooded Tanager	<i>Tangara larvata</i>	x	x
Scarlet-thighed Dacnis	<i>Dacnis venusta</i>	x	x
Blue Dacnis	<i>Dacnis cayana</i>	x	x
Shining Honeycreeper	<i>Cyanerpes lucidus</i>	x	
Red-legged Honeycreeper	<i>Cyanerpes cyaneus</i>	x	

Golden-Browed Chlorophonia	<i>Chlorophonia callophrys</i>		x
Blue-black Grassquit	<i>Volatinia jacarina</i>	x	
Variable Seedeater	<i>Sporophila americana</i>	x	
White-collared Seedeater	<i>Sporophila torqueola</i>	x	
Thick-billed Seed-Finch	<i>Oryzoborus funereus</i>	x	
Orange-billed Sparrow	<i>Arremon aurantirostris</i>	x	x
Black-striped Sparrow	<i>Arremonops conirostris</i>	x	
Buff-throated Saltator	<i>Saltator maximus</i>	x	x
Black-headed Saltator	<i>Saltator atriceps</i>	x	
Slate-colored Grosbeak	<i>Pitylus grossus</i>	x	x
Black-faced Grosbeak	<i>Caryothraustes pollogaster</i>	x	x
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>	x	
Blue-black Grosbeak	<i>Cyanocompsa cyanoides</i>	x	x
Giant Cowbird	<i>Molothrus oryzivorus</i>	x	
Black-cowled Oriole	<i>Icterus dominicensis</i>	x	x
Yellow-tailed Oriole	<i>Icterus mesomelas</i>	x	
Baltimore Oriole	<i>Icterus galbula</i>	x	x
Yellow-billed Cacique	<i>Amblycercus holosericeus</i>	x	
Scarlet-rumped Cacique	<i>Cacicus uropygialis</i>	x	x
Chestnut-headed Oropendula	<i>Psarocolius wagleri</i>	x	x
Montezuma Oropendula	<i>Psarocolius montezuma</i>	x	x

**Notes:**

- An 'x' in the **cacao** or **forest** column indicates that the bird was observed in that habitat.
- Bird surveys were conducted during the winter of 2003/2004 and the summer of 2004.

## **Appendix 4. Minidisk Recordings - Cacao Study 2006**

### **Disk 1**

#### **Tracks 1-6**

**May 30 6:15 – 6:35 am**

**Dawn chorus at the start of the Maldonado trail**

Little Tinamou, Red-lore Amazon, Blue-headed parrot, Striped Cuckoo, Dusky Antbird, Cinnamon Becard, Lemon-rumped Tanager, Yellow-crowned Tyrannulet, Orange-billed Sparrow, Pale-vented Pigeon, Western White-tailed Trogon, Long-billed Gnatwren, Buff-throated Saltator. Checker-throated Antwren.

#### **Tracks 7-13**

**May 30-31**

**Along the Maldonado trail**

Recordings made of Little Tinamou, Laughing Falcon, Rufous-headed Chachalaca, Black-headed Tody-Flycatcher, Bright-rumped Attila, Blue-black Grosbeak, Ruddy Pigeon. An Western White-tailed Trogon, Ochraceous Attila, Pacific Antwren, Chocó Trogon.

#### **Tracks 14-20**

**June 1 5:55 – 6:28 am**

**Dawn chorus at point count 4 in secondary forest and cacao**

Little Tinamou, Scaled Pigeon, Ruddy Pigeon, Blue-headed Parrot, Orange-fronted Barbet, Western Slaty-Antshrike, Chestnut-backed Antbird, White-bearded Manakin, Western Slaty-Antshrike, Piratic Flycatcher, Dusky-capped Flycatcher, Great Currasow (?).

#### **Tracks 21-23**

**June 1**

**Recordings along the Maldonado trail**

Blue Ground-Dove, Lineated Woodpecker, Pied Puffbird, Gray-capped Flycatcher

#### **Tracks 24-27**

**June 2 6:05 – 6:25 am**

**Dawn chorus at point count station 2 along the Maldonado trail. Cacao and secondary forest with dense undergrowth.**

Little Tinamou, Ruddy Pigeon, Red-lore Amazon, Blue-headed Parrot, Black-cheeked Woodpecker, Dusky Antbird, Chestnut-backed Antbird, Cinnamon Becard, White-bearded Manakin, Bay Wren, Buff-throated Saltator, Scale-crested Pygmy-Tyrant

### **Disks 2**

#### **Track 1-4**

**June 3 6:10 – 6:30 am**

**Dawn chorus at Tachina in secondary forest bordering cacao plantation and Río Santiago.**



Roadside Hawk, Dusky Antbird, Chestnut-backed Antbird, Brown-capped Tyrannulet, Bay Wren, Orange-billed Sparrow, White-whiskered Hermit.

**Track 5-8**

**June 3**

**Recordings near Tachína**

Dusky Antbird, Bright-rumped Attila, Bay Wren, Dusky Pigeon.

**Track 9-12**

**June 4 6:25 – 6:45 am**

**Dawn chorus at Nueva Brisa farm, Tachína. Mainly cacao and bananas with patches of trees and some bamboo nearby.**

Roadside Hawk, Mealy Amazon, Blue-headed Parrot, Slaty Spinetail, Pacific Antwren, Dusky Antbird, Chestnut-backed Antbird, Lesser Greenlet, Bananaquit, Buff-throated Saltator.

**Track 13**

**June 4**

**Recordings at Nueva Brisa farm, Tachína**

Rufous-headed Chachalaca

**Track 14-23**

**June 5**

**Recordings along the Durango trail mainly in primary forest**

Dusky Pigeon, Chocó Trogon, Chocó Toucan, Chestnut-backed Antbird, Streak-chested Antpitta, Lemon-spectacled Tanager.

**Track 24-26**

**June 6 6:20 – 6:35 am**

**Dawn chorus near San Francisco in cacao with oil palm plantation and secondary forest nearby**

Blue-headed Parrot, Black-cheeked Woodpecker, Red-billed Scythebill, Dusky Antbird, Bright-rumped Attila, Cinnamon Becard, Lesser Greenlet, Buff-rumped Warbler, Lemon-rumped Tanager