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BIRDS OF THE UPPER CLOUD FOREST OF EL TRIUNFO, CHIAPAS, MEXICO

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Resumen. Este artículo presenta datos sobre la abundancia relativa y la composición de especies de aves en un área de 12 km² de bosque mesófilo de montaña en la Reserva de la Biosfera El Triunfo, Chiapas, México. Los datos fueron generados durante 125 días de observaciones de campo de marzo hasta diciembre de 1993. Se registraron 147 especies, de las cuales 79 son especies propias del bosque mesófilo, mientras que 68 especies adicionales son ya sea visitantes ocasionales, aves migratorias que sobrevuelan el bosque y que no interactúan con la avifauna o especies que se encuentran exclusiva- o principalmente en el área desmontada del Campamento El Triunfo. Cuatro especies (de las cuales dos son visitantes ocasionales) representan nuevos registros que no están mapeadas para la Sierra Madre de Chiapas por Howell & Webb (1995). Dieciseis especies adicionales no se encuentran habitualmente en el bosque mesófilo a esas altitudes (arriba de los 1850 m); muchas de ellas se registraron únicamente en el área desmontada, lo cual indica que la perturbación del hábitat beneficia a ciertas especies que no son propias del bosque mesófilo. Se concluye que El Triunfo es un lugar idóneo para realizar estudios ornitológicos sobre migraciones altitudinales y latitudinales, así como de dispersión a gran distancia por aves.

Abstract. This article presents the results of a survey of the relative abundance and species composition of birds in a 12 km² section of upper cloud forest in the El Triunfo Biosphere Reserve, Chiapas, Mexico. Data were obtained during 125 days spent in the area from March to December 1993. A total of 147 species was recorded, of which 79 were core species from the cloud forest and an additional 68 were either vagrants, migrants which only flew over the forest and did not interact with the cloud forest species, or were species found only or mostly in the man-made clearing in the center of the study area. Records of four species (two of them vagrants) represent range extensions that were not mapped in the Sierra Madre de Chiapas by Howell & Webb (1995). Sixteen additional species are not habitually found in cloud forests at this elevation (above 1850 m); many of these were recorded only in the man-made clearing, implying that habitat perturbation benefits certain non cloud forest species. Several observations imply that the study area was a

good place to study altitudinal migration, long-distance latitudinal migration and birds' capacity for long-range dispersal into new habitats. *Accepted 23 September 1998.*

Key words: Birds, avifaunal inventory, cloud forest, Chiapas, Mexico, Horned Guan, *Oreophasis derbianus*.

INTRODUCTION

The El Triunfo Biosphere Reserve encompasses 119,177 hectares in southern Chiapas, Mexico. One quarter of the reserve is made up of the 5 core areas whereas the rest is a buffer zone. The core areas, typified by core area 1 (11,594 hectares), hold five main vegetation types that are representative of the vegetation of the Sierra Madre de Chiapas. The vegetation type that covers the largest area is the "upper cloud forest", dominated by *Quercus oocarpa* (Fagaceae), *Matudaea trinervia* (Hamamelidaceae), *Hedyosmum mexicanum* (Chloranthaceae) and *Dendropanax populifolius* (Araliaceae) (Long & Heath 1991). This forest is best known as one of the main strongholds of the Horned Guan *Oreophasis derbianus* and Resplendent Quetzal *Pharomachrus mocinno*. This article provides an annotated list of bird species recorded in 125 days spent in a 12 km² section of upper cloud forest in 1993.

The upper cloud forest occurs above 1650-1700 m elevation. This forest is dense, with trees 25 to 30 m in height (with emergents up to 40 m tall) and has a very high density of epiphytes. Microhabitat features in the upper cloud forest include small areas of elfin forest on the highest peaks and ridges, many earth banks, numerous gaps in the canopy created by fallen tree trunks and limbs, and a few brushy slopes created by landslides. In this habitat rainfall and mist occur all year long but most precipitation falls between May and October. Frost occurs from January to March and on a few days from as early as November. A few trees, particularly *Morus* sp. (Moraceae) and certain species of *Quercus*, drop their leaves between late September and November.

The park rangers and the small number of short-term visitors (about 100-200 per year in 1989-1991) usually live in 3 houses constructed in a man-made clearing of roughly 12 hectares within the upper cloud forest (Campamento El Triunfo: 15°39'N, 92°48'W). The clearing is located at about 1870 m.

Previous publications on the birds of the reserve include a paper providing a list of bird species (Parker *et al.* 1976) and studies of individual species (*Pharomachrus mocinno*: Avila *et al.* 1996, Solórzano *et al.* in prep.; *Oreophasis derbianus*: González-García 1988, 1994, 1995; Azure-rumped Tanager *Tangara cabanisi*: Heath & Long 1991; Long & Heath 1994; Gómez de Silva 1997).

METHODS

Data were gathered during 125 days spent in a 12 km² section of upper cloud forest in 1993, with records from all months except January and February. The birds were surveyed along five main trails that radiate out from the Campamento El Triunfo clearing (Fig. 1). Most of these trails sample an altitudinal range of from 1870 to nearly 2200 m, but one trail (Cerro El Triunfo trail) climbs to 2450 m. To estimate the area of the study site we mapped the transects and calculated the area of a polygon with corners at the end of Prusia, Malacatal, Cipresal and Palo Gordo transects. This estimate is particularly important as it was used to calculate the population density in the study area of an endangered species, *Oreophasis derbianus* (see Annotated List).

The study area was visited for at least 10 days per month from March through December 1993. Each of the five main transects was walked twice every month (with few excep-

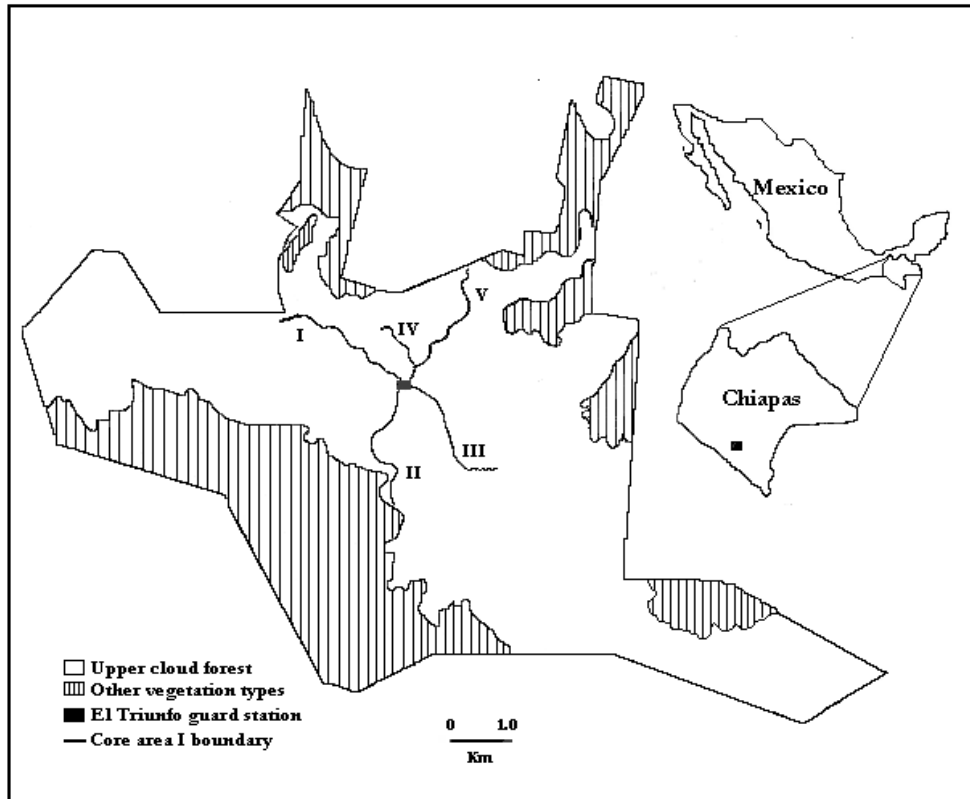


FIG. 1. Schematic map of core area I of the El Triunfo Biosphere Reserve, Chiapas, México, showing the extent of the “upper” cloud forest and the location and lengths of the five transects used in this study. Lengths of transects (distances on foot; straight-line distances 0.6 times the foot distances): I. Palo Gordo, 3 km; II. Cipresal, 3.2 km; III. Malacatal, 2.3 km; IV. Cerro El Triunfo, 1.7 km, V. Prusia, 4 km.

tions, see Fig. 2) resulting in 99 days of censuses. During censuses, 272 km were covered in 302 hours. Observations on the remaining days, and on the afternoons of census days, were opportunistic.

For the censuses, transects were walked at an average speed of 1 km/h by the same observer (HGdS), from 0700 to between 0900 and 1122 h. The duration depended on the length of the transect. Thick foliage, rough terrain, and often misty conditions made it necessary to rely largely on sound to census the birds. Birds were recorded to an unlimited distance (i.e., as far as the bird

could be seen/heard). During each transect, the number of individuals of every species was estimated and recorded, as well as the duration of the transect (in minutes) and the weather encountered. The weather was coded as 1 (sunny, not windy; with mist, if any, for less than 30 minutes), 2 (either with strong wind throughout the transect; or with a combination of low cloud, occasional strong wind, mostly misty conditions), or 3 (misty throughout the transect, and – except for one day – with a combination of drizzle, strong rain, and strong wind).

Three species of birds heard during the

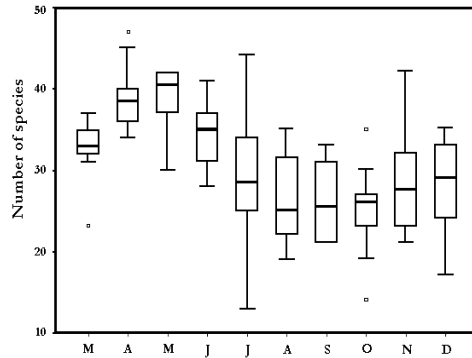


FIG. 2. Monthly variation in species counts, showing maximum, minimum and median values. Blank squares represent outliers. Most months were censused 10 days, except June and October (both, 9 days) and August (11 days).

transects were not included in the annotated list for special reasons. The Pheasant Cuckoo (*Dromococcyx phasianellus*) was heard often from the very top of Cerro El Triunfo from March to June. The singing bird was apparently near Santa Rita, 3 km away, as were also the roosters (*Gallus gallus*) that were heard on the same dates. The Rufescent Tinamou (*Crypturellus cinamomeus*) and the Rufous-and-white Wren (*Thryothorus rufalbus*) were both heard far downslope of the last stretch of the Cipresal transect, where the “lower cloud forest” approaches the transect to within perhaps 100 m. Because of these circumstances, these species were not considered to be part of the cloud forest avifauna of the study site.

The census results from all transects were pooled to assess the seasonality and abundance of each species (see Annotated List). As we considered that every bird we recorded was actually present, whereas, clearly, not every bird present was actually recorded by us, we based the assessment of abundance on the highest morning count from the whole data set. The alternative, averaging the abundance values of different days and different transects, would affect the counts of those

species present only during some seasons or of species that were not active and vocal on certain days. Species whose abundance and seasonality were assessed by other means are those species that were rarely encountered and that were either not recorded during censuses or recorded very few times. These include nocturnal species, species that were usually flying above the canopy (such as swifts, swallows, diurnal raptors) and the species that were only found in the clearing of Campamento El Triunfo. We paid more attention to the species of the cloud forest interior than to those that flew above the canopy and/or were found only at Campamento El Triunfo.

Data from all transect days were used for the descriptive statistics (averages, highest counts, lowest counts). A finer analysis using inferential statistics employed data for only 75 days between May and December owing to missing or ambiguous information for most days in March and April and for one day in June, and for one day in August. This analysis used a log-linear model to evaluate the effect of different factors that may modify the census results (Duration, Weather, Transect and Month), following methods described by McCullagh & Nelder (1991) and using the software GLIM 3.77 (Aitkin *et al.* 1989).

Bird names in English follow Howell & Webb (1995). Scientific nomenclature and systematic order follow A.O.U. (1997). Both English and scientific names are given in Tables 1 and 2 and in Annotated List.

RESULTS

All species recorded in the area are included in the Annotated List, with comments on abundance, seasonality, and other details. Following Remsen (1994) we believe that it is important to separate the “core species” of a study site from “those species represented only by wandering or dispersing

TABLE 1. “Core species” of the cloud forest. “S” denotes species with only 5 to 10 records during the entire study.

Black Vulture <i>Coragyps atratus</i>	Hairy Woodpecker <i>Picooides villosus</i>
Turkey Vulture <i>Cathartes aura</i>	Golden-olive Woodpecker <i>Piculus rubiginosus</i>
Red-tailed Hawk <i>Buteo jamaicensis</i>	Spectacled Foliage-gleaner <i>Anabacerthia variegaticeps</i>
Barred Forest Falcon <i>Micrastur ruficollis</i>	Ruddy Foliage-gleaner <i>Automolus rubiginosus</i>
Highland Guan <i>Penelopina nigra</i>	Tawny-throated Leaf-tosser <i>Sclerurus mexicanus</i>
Horned Guan <i>Oreophasis derbianus</i>	Spotted Woodcreeper <i>Xiphorhynchus erythrogygus</i>
Singing Quail <i>Dactylortyx thoracicus</i>	Spot-crowned Woodcreeper <i>Lepidocopptes affinis</i>
Band-tailed Pigeon <i>Columba fasciata</i>	Scaled Antpitta <i>Grallaria guatemalensis</i>
White-faced Quail Dove <i>Geotrygon albigacies</i>	Black Phoebe <i>Sayornis nigricans</i> (1)
Barred Parakeet <i>Bolborhynchus lineola</i>	Paltry Tyrannulet <i>Zimmerius vilissimus</i>
Squirrel Cuckoo <i>Piaya cayana</i> (S)	Eye-ringed Flatbill <i>Rhynchocyclus brevirostris</i>
Fulvous Owl <i>Strix fulvescens</i>	Stub-tailed Spadebill <i>Platyrinchus cancerminus</i>
Mexican Whip-poor-will <i>Caprimulgus vociferus</i> <i>arizonae</i> (S)	Tufted Flycatcher <i>Mitrephanes phaeocercus</i>
Black Swift <i>Cypseloides niger</i>	Western Wood Pewee <i>Contopus sordidulus</i>
Chestnut-collared Swift <i>Streptoprocne rutilus</i>	Yellowish Flycatcher <i>Empidonax flavescens</i>
White-collared Swift <i>Streptoprocne zonaris</i>	Rose-throated Becard <i>Pachyramphus aglaiae</i>
Vaux's Swift <i>Chaetura vauxi</i>	Black-capped Swallow <i>Notiochelidon pileata</i>
Violet Saberwing <i>Campylopterus hemileucurus</i>	Black-throated Jay <i>Cyanolyca pumilo</i>
Green Violetear <i>Colibri thalassinus</i> (S)	Unicolored Jay <i>Abelocoma unicolor</i>
Emerald-chinned Hummingbird <i>Abeillia abeillei</i>	Rufous-browed Wren <i>Troglodytes rufociliatus</i>
Black-crested Coquette <i>Papposia helena</i> (S) (2)	White-breasted Wood-Wren <i>Henicorbina</i> <i>leucophrys</i>
White-eared Hummingbird <i>Hylocharis leucotis</i> (S)	Brown-backed Solitaire <i>Myadestes occidentalis</i>
Green-throated Mountain-gem <i>Lampornis viridipallens</i>	Ruddy-capped Nightingale Thrush <i>Catharus</i> <i>frantzii</i>
Amethyst-throated Hummingbird <i>Lampornis</i> <i>amethystinus</i>	Spotted Nightingale Thrush <i>Catharus dryas</i>
Garnet-throated Hummingbird <i>Lamprolaima rhami</i> (S)	Swainson's Thrush <i>Catharus ustulatus</i>
Magnificent Hummingbird <i>Eugenes fulgens</i> (S)	Black Thrush (Robin) <i>Turdus infuscatus</i>
Whine-throated Hummingbird <i>Atthis ellioti</i>	Mountain Thrush (Robin) <i>Turdus plebejus</i>
Mountain Trogon <i>Trogon mexicanus</i>	White-throated Thrush (Robin) <i>Turdus assimilis</i>
Collared Trogon <i>Trogon collaris</i>	Gray Silky <i>Ptilogonys cinereus</i>
Resplendent Quetzal <i>Pharomacrus mocinno</i>	Solitary Vireo <i>Vireo cassinii</i>
Blue-throated Motmot <i>Aspatha gularis</i>	Chestnut-sided Shrike Vireo <i>Vireolanus melitophrys</i>
Emerald Toucanet <i>Aulacorhynchus prasinus</i>	Tennessee Warbler <i>Vermivora peregrina</i> (S)

TABLE 1. Continuation.

Crescent-chested Warbler <i>Verminora supervillosa</i>	Stripe-backed Tanager <i>Piranga bidentata</i>
Townsend's Warbler <i>Dendroica townsendi</i>	Common Bush Tanager <i>Chlorospingus ophthalmicus</i>
Black-and-White Warbler <i>Mniotilta varia</i> (S)	Yellow Gosbeak <i>Pheucticus chrysopheplus</i>
Louisiana Waterthrush <i>Seiurus motacilla</i>	Yellow-throated Brushfinch <i>Atlapetes gutturalis</i>
Wilson's Warbler <i>Wilsonia pusilla</i>	Chestnut-capped Brushfinch <i>Atlapetes</i>
Slate-throated Redstart <i>Myioborus miniatus</i>	<i>bruneinucha</i>
Golden-browed Warbler <i>Basileuterus belli</i>	Cinnamon-bellied Plowpiercer <i>Diglossa baritula</i>
Blue-hooded Euphonia <i>Euphonia elegantissima</i>	Hooded Grosbeak <i>Coccothraustes abeillei</i>
Blue-crowned Chlorophonia <i>Chlorophonia occipitalis</i>	

individuals.” Species that were recorded more than four times in the upper cloud forest are listed in Table 1 and are considered core species, whereas those species that were either considered as vagrants (less than five records in all), or that were only or mostly found in the clearing of Campamento El Triunfo, and/or species that appeared to be relatively regular and widespread but apparently only flew over the area (rarely stopping or feeding) are listed in Table 2.

Most of the species listed in Table 1 occurred in all five transects. The exceptions were *Colibri thalassinus*, *Abeillia abeillei*, *Papposia helena*, *Hylocharis leucotis*, *Lampornis amethystinus*, *Lamprolaima rhami*, *Eugenes fulgens*, *Atthis elliotti*, *Platyrinchus cancrorum*, *Catharus ustulatus*, *Turdus assimilis*, *Seiurus motacilla*, and *Atlapetes gutturalis*.

Species number was correlated with length and duration of transects ($P < 0.00009$ for duration in minutes vs. species number). Prusia transect had the highest average number of species recorded (35.8, SE 4.99), as was expected, this being the longest transect (both in distance and in duration). On the other hand, the highest count was made in Palo Gordo transect (47 species). The shortest transect, Cerro El Triunfo, recorded the lowest average number of species (27.0, SE

7.218) and the lowest count (13 species).

Once Duration was accounted for by using it as a covariable in the analysis, Month was the factor that most strongly affected species counts (Table 3). April and May transects recorded the highest numbers of species on average (39.2, SE 4.077, and 39.0, SE 3.8, respectively) and the highest total on a transect was recorded in April (47 species). However one transect in November recorded a number as high as the highest May transects (42 species) and one day in July recorded the second-to-highest count (44 species). The lowest species counts were for July and October (See Fig. 2).

The effects of Weather and Transect were also significant (Table 2 and Figs 3 and 4). The worst weather produced significantly smaller species counts than the best weather ($P < 0.0340$), but the intermediate weather was not significantly different ($P < 0.1556$). The only transect producing significantly different counts (once Duration is taken into account) is Cerro El Triunfo (compared with Palo Gordo transect, $P = 0.0150$). This is also the only trail to rise above the maximum elevation of other trails. Differences between Palo Gordo and other transects were not significant, ranging from $P = 0.5552$ (with Cipresal transect) to $P = 0.9298$ (with Prusia

TABLE 2. Species considered as vagrants (5 records or less), that were only or mostly found in the man-made clearing of Campamento El Triunfo, and/or seem to be more regular and widespread but apparently only fly over the area (sometimes rarely stopping or feeding). Numbers in parentheses after a scientific name refer to the number of days in which a species was recorded and are given only for species recorded on one or two days (note that this is relevant to *Papbosia belenae* in Table 1 as well).

Great Egret <i>Ardea alba</i> (1)	Dusky-capped Flycatcher <i>Myiarchus tuberculifer</i>
Cattle Egret <i>Bubulcus Ibis</i> (1)	Sulphur-bellied Flycatcher <i>Myiodynastes luteiventris</i>
King Vulture <i>Sarcorampbus papa</i> (1)	Olive-sided Flycatcher <i>Contopus cooperi</i> (1)
Hook-billed Kite <i>Condobierax uncinatus</i> (1)	Scissor-tailed Flycatcher <i>Tyrannus forficatus</i> (1)
Mississippi Kite <i>Ictinea mississippiensis</i> (1)	Cassin's Kingbird <i>Tyrannus vociferus</i> (1)
Sharp-shinned Hawk <i>Accipiter striatus</i>	Violet-green Swallow <i>Tachycineta thalassina</i> (2)
Cooper's Hawk <i>Accipiter cooperi</i> (1)	Bank Swallow <i>Riparia riparia</i> (2)
Gray Hawk <i>Asturina nitida</i> (1)	Cliff Swallow <i>Petrochelidon pyrrhonota</i>
Short-tailed Hawk <i>Buteo brachyurus</i>	Barn Swallow <i>Hirundo rustica</i> (2)
Broad-winged Hawk <i>Buteo platyterus</i> (2)	Spotted-breasted Wren <i>Thryothorus maculipectus</i>
Black Hawk-Eagle <i>Spizaetus tyrannus</i> (2)	Hermit Thrush <i>Catharus guttatus</i>
Ornate Hawk-Eagle <i>Spizaetus ornatus</i> (2)	Clay-colored Thrush (Robin) <i>Turdus grayi</i>
Bat Falcon <i>Falco rufigularis</i> (1)	Rufous-collared Thrush (Robin) <i>Turdus rufitorques</i>
American Kestrel <i>Falco sparverius</i> (1)	Blue-and-white Mockingbird <i>Melanotis hypoleucus</i>
Red-billed Pigeon <i>Columba flavirostris</i>	Cedar Waxwing <i>Bombycilla cedrorum</i>
Mourning Dove <i>Zenaida macroura</i>	Brown-capped/Warbbling Vireo <i>Vireo leucophrys/gihus</i> (2)
Green Parakeet <i>Aratinga holochlora (sensu lato)</i>	Blue-winged Warbler <i>Vermivora pinus</i> (1)
Black-billed Cuckoo <i>Coccyzus erythrophthalmus</i> (1)	Nashville Warbler <i>Vermivora ruficapilla</i> (2)
Groove-billed Ani <i>Crotophaga sulcirostris</i>	Yellow-rumped Warbler <i>Dendroica coronata</i>
Wood Owl <i>Ciccaba virgata</i>	Black-throated Green Warbler <i>Dendroica virens</i>
White-throated Swift <i>Aeronautes saxatalis</i> (1)	Hermit Warbler <i>Dendroica occidentalis</i> (1)
Rufous Saberwing <i>Campylopterus rufus</i> (1)	Worm-eating Warbler <i>Helminthos vermivorus</i> (1)
White-bellied Emerald <i>Amazilia candida</i> (1)	Ovenbird <i>Seiurus aurocapillus</i> (1)
Berylline Hummingbird <i>Amazilia beryllina</i>	Canada Warbler <i>Wilsonia canadensis</i> (2)
Sparkling-tailed Woodstar <i>Tilmatura dupontii</i>	McGillivray's Warbler <i>Oporornis tolmiei</i>
Ruby-throated Hummingbird <i>Archilochus colubris</i> (1)	Summer Tanager <i>Piranga rubra</i> (2)
Green Kingfisher <i>Chloroceryle americana</i> (1)	Yellow Grosbeak <i>Phencticus chrysopheplus</i> (Table 1)
Acorn Woodpecker <i>Melanerpes formicivorus</i>	Rose-breasted Gorsebeak <i>Phencticus ludovicianus</i> (2)
Yellow-breasted Sapsucker <i>Sphyrapicus varius</i> (2)	Blue Gosbeak <i>Guiraca caerulea</i> (1)
Barred Antshrike <i>Tamnophilus doliatus</i> (1)	Indigo Bunting <i>Passerina cyanea</i> (1)
Hammond's Flycatcher <i>Empidonax hammondi</i>	Lincoln's Sparrow <i>Melospiza lincolnii</i>
Narrow-billed Flycatcher <i>Empidonax affinis/minimus</i>	

TABLE 2. Continuation.

Rufous-collared Sparrow <i>Zonotrichia capensis</i>	Bronzed Cowbird <i>Molothrus aeneus</i>
Melodious Blackbird <i>Dives dives</i>	Orchard Oriole <i>Icterus spurius</i> (1)
Great-tailed Grackle <i>Quiscalus mexicanus</i> (1)	

transect). Counterintuitively, we recorded more species per day at Cerro El Triunfo trail than at other transects, once the effects of other factors were taken into account (even though the total number of species recorded on that transect is lower than for the other transects).

ANNOTATED LIST OF BIRDS

Comments and records refer to the upper cloud forest, not to the Campamento El Triunfo clearing, unless otherwise stated. Abundances are based on the maximum number of individuals recorded on a transect (“low numbers” = up to 9; “moderate numbers” = 10–19; “numerous” = > 19). The abundance of species considered to have low detectability (especially if not detectable when more than 15 m away from the trail) such as *Grallaria guatemalensis* and *Atlapetes brunneinucha* were usually upgraded conservatively by one category. Assessment of seasonality is based on comparison of the maximum counts for spring (April to June), summer (July to September) and fall (October to December). Feeding records are given for a few, especially frugivorous, birds; these are biased toward observations on *Morus* sp. (March) and *Citharexylum mocinnii* (Verbenaceae; April to June), the main species for which tree watches were made after transects and on non-transect days.

Other vegetation types found in core area I of the El Triunfo Biosphere Reserve are 1) tropical evergreen forest dominated by the trees *Garcinia intermedia* (Guttiferae), *Inga calderonii* (Fabaceae) and *Desmopsis lanceolata* (Annonaceae), found below 1200 m; 2) a

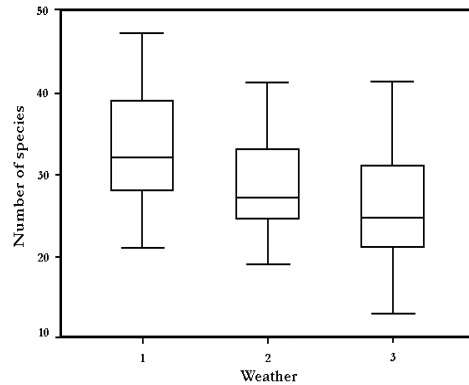


FIG. 3. Variation in species counts due to weather (1 = best, 2 = intermediate, 3 = worst; see methods. Maximum, minimum and median values are given. Sample sizes are different: best weather (n = 33), intermedia (n = 36), worst (n = 14).

“lower cloud forest” dominated by the trees *Ficus cookii* (Moraceae), *Coccoloba matudae* (Polygonaceae), *Dipholis minutiflora* (Sapotaceae) and *Sapium schippii* (Euphorbiaceae), found between 1200 and 1600 m; 3) pine-oak-sweetgum forest dominated by *Liquidambar styraciflua* (Hamamelidaceae), *Quercus segoviensis* and *Pinus oocarpa* var. *ochoteranae* (Pinaceae), found between around 1400 and 1700 m on the northern slope of the mountain range; 4) *Quercus salicifolia* forest on ridges between 1000 and 1200 m on the Pacific slope of the mountain range; and 5) small patches of conifer forest dominated by *Cupressus benthamii* var. *lindleyi* (Cupressaceae) and *Pinus oocarpa* var. *ochoteranae* on the upper ridges of the Pacific slope between 1600 and 1900 m.

TABLE 3. Analysis of deviance. Data are number of species in 75 mornings (representing 8 months), 5 trails and 3 categories of meteorological condition, corrected by the duration of transects (min). Significance of each effect and their interaction are shown (interactions between effects not significant).

Effect	<i>p</i>
Month x Trail x Weather	0.4634
Trail x Weather	0.7581
Month x Weather	0.9762
Month x Trail	0.9890
Weather	0.0008
Trail	0.0111
Month	< 0.0009

Great Egret *Ardea alba*. One record, 21 May, at Campamento El Triunfo.

Cattle Egret *Bubulcus ibis*. One record, a bird at Campamento El Triunfo on 28 October.

Black Vulture *Coragyps atratus*. Occasionally soars above the forest in low or moderate numbers.

Turkey Vulture *Cathartes aura*. Five records, from different seasons. Clearly much less numerous than the previous species.

King Vulture *Sarcoramphus papa*. One record, a subadult flying over the top of Cerro El Triunfo on 25 April.

Hook-billed Kite *Chondrohierax uncinatus*. One record of three females on migration over Cerro El Triunfo on 25 October.

Mississippi Kite *Ictinia mississippiensis*. One record, a bird on migration on 26 October.

Sharp-shinned Hawk *Accipiter striatus*. Flies

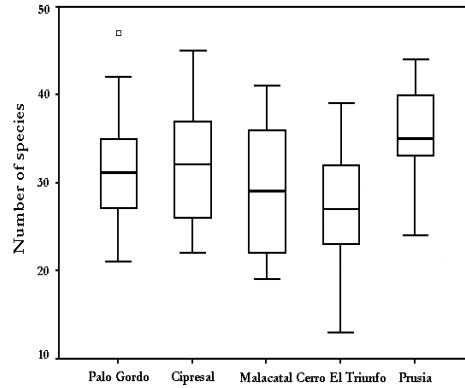


FIG. 4. Variation in species counts among transects, showing maximum, minimum and median values. The blank square represents an outlier. Sample sizes are different among transects: Palo Gordo and Cerro El Triunfo ($n = 21$), Cipresal and Malacatal ($n = 20$), Prusia ($n = 17$).

over in numbers on migration, best seen from the top of Cerro El Triunfo.

Cooper's Hawk *Accipiter cooperi*. One record, a bird on migration on 26 October.

Gray Hawk *Asturina nitida*. One record, a bird soaring low over Campamento El Triunfo on 25 March.

Short-tailed Hawk *Buteo brachyurus*. Four records. Spring and fall.

Broad-winged Hawk *Buteo platypterus*. Two records, both in fall.

Red-tailed Hawk *Buteo jamaicensis*. Found during the entire study period soaring over the forest in very low numbers.

Black Hawk-Eagle *Spizaetus tyrannus*. Two records, in April and May. On the night of 14/15 May, an adult roosted in a tree in the forest at the edge of Campamento El Triunfo (it flew to its perch at 18:44 h and flew away

the next morning at 05:42 h). This species is not usually recorded at this elevation in Mexico (Howell & Webb 1995) but has been recorded locally up to 2000 m asl in Costa Rica (Stiles & Skutch 1989).

Ornate Hawk-Eagle *Spizaetus ornatus*. At least two records, in April and May. Four unidentified hawk-eagles (*Spizaetus* sp.) seen in March and May may have been this species (considering the translucent windows in the middle primaries). This species is not usually recorded at this elevation in Mexico (Howell & Webb 1995) but has been recorded “wandering sporadically as high as 3000 m” in Costa Rica (Stiles & Skutch 1989).

Barred Forest-Falcon *Micrastur ruficollis*. Recorded in low numbers in the cloud forest. Possibly underrecorded because this species is not conspicuous except when calling, and mainly calls around dawn and dusk. This species is not usually recorded at this elevation in Mexico (Howell & Webb 1995) although it has been recorded up to “at least 1850 m” in Costa Rica (Stiles & Skutch 1989). The highest elevation at which it was recorded in the present study is half way up Cerro El Triunfo, about 2200 m.

Bat Falcon *Falco ruficularis*. One record, a bird seen briefly flying not very high over the forest near the end of Cipresal transect, not far upslope of where the upper and lower cloud forests merge (11 December).

American Kestrel *Falco sparverius*. One record from the top of Cerro El Triunfo of a bird obviously on migration (18 April).

Highland Guan *Penelopina nigra*. Found in moderate numbers in the forest. Recorded much less frequently in summer, largely due to lack of vocalizing by adult males (in summer, only heard 31 July). Almost all summer

records are of females with juveniles or of immature males (i.e., with patches of “female” plumage, especially on thighs and sides of tail), suggesting possible altitudinal migration by adult males. The males’ ascending whistle was heard from as early as 2 October, whereas their “crashlanding” or “fallen tree” sound apparently produced by the vibrating tips of their primaries was not heard until November. In spring, recorded feeding most often on the berries of *Morus* sp., *Conostegia volcanalis* (Melastomataceae) and *Citbaharexylum mocinnii*. In summer and fall, observed feeding on leaves of a small hemiepiphytic *Solanum* (Solanaceae) and on fruits of *Trophis cuspidata* (Moraceae; locally known as “aretillo”), *Rhamnus capraeifolia* var. *grandifolia* (Rhamnaceae; locally known as “canzucar”) and *Prunus brachybotrya* (Rosaceae; locally known as “coxoc”). Courtship feeding (fruits of *C. volcanalis*) was observed on 7 March (FG), courtship seen on 30 March, a nest was found on 11 March and a female whose behavior suggested she had an active nest was observed on 1 May.

Horned Guan *Oreophasis derbianus*. Found in low numbers in the cloud forest. Recorded infrequently and never more than one or a pair of individuals during censuses. No records from summer transects (and a single record of 3 immature birds in September, outside of census hours) possibly indicate (partial?) altitudinal migration.

Two methods may be used to estimate the population density of this species, based on the observation that most individuals can be recognized by a combination of sex, horn length and orientation, individual markings especially in the face and tail plumage, and on simultaneous sightings of separate individuals. First, in March, April and May more non-census hours were spent in the first 1600 m of Palo Gordo than on any other transect. At least 9 Horned Guan individuals were recog-

nized, which is three times the number that were seen on this transect during censuses. This segment of trail has been mapped to yield a straight-line distance of 1393 m. To convert this count into a density estimate, it is necessary to calculate how far these individuals ranged perpendicular to the trail. The home range of a single Horned Guan was estimated as 8-20 hectares (González-García & Bubb 1989). The more conservative estimate of 20 hectares, which is close to the home-range size reported for another large cracid (36 hectares for *Mitu tuberosa*; calculated from data in Terborgh *et al.* 1990), would be equivalent to a square home-range of 447 x 447 m. We may use this distance to estimate the density of Horned Guans if we assume that the 9 individuals recognized live within 450 m to either side of the 1400 m segment of trail. The area represented by this count would therefore be 1,260,000 m² and the estimated density of Horned Guans is 7.14 individuals/km². This estimate has the disadvantage that it may be overestimating the true density if home-range sizes are larger than 20 hectares (or underestimating them if home-range size is smaller). The second method of estimating the population density in the study area is based on observations made along the five main transects, where at least 27 individuals were recognized. With the reasonable assumption that there were at least twice or more likely three times that many birds in the 12 km², given their very low detectability (see previous paragraph) and the large extent of unexplored areas between trails, the density can be estimated as at least 4.5 individuals/km² (if there were twice as many guans as actually recognized and counted) or 6.75 individuals/km² if there were three times as many.

We note that these density estimates are similar to those reported for other large cracids in certain forests unaffected by hunting: 2.5 pairs/km² for *Mitu tuberosa*. (Terborgh *et*

al. 1990; therein called *Crax mitu*) and 8.37 individuals/km² for *Crax alector* (Thiollay 1989). However, reported density estimates for large cracids vary widely in the literature (up to 40 individuals/km²; reported for *Pauxi unicornis* by Cox 1990), a situation partly due to widely varying accuracies of the estimation methods employed. We believe that our estimates, though not precise, are more accurate than some such as those based on averages of transect counts, especially when the transects were smaller than or equal to the diameter of the home range of individuals counted. Our Horned Guan density estimates are based on cumulative counts of individuals known to be different and attempt to incorporate knowledge of their home ranges; thus they are more similar to territory-mapping than to regular transect counts.

Previous studies had reported that the males' courtship call can be heard from at least January to May (González-García 1988, 1995). During this study this call was occasionally heard also from October to December (first heard 22 October) and two courting pairs were seen in November, indicating that the breeding season begins earlier than previously assumed. An empty eggshell of this species was found on 28 April away from the main trails.

During this survey, this species was recorded feeding on several plants on which it had not been observed to feed previously, increasing the list of known food plants given in González-García (1994). Specimens of many of these plants await identification. Observed drinking water from bromeliads.

Singing Quail *Dactylortyx thoracicus*. Found in moderate numbers in the forest. Recorded less often in summer and fall. Found at dusk on two occasions, roosting around 3 or 4 m high on bushes overhanging the trail.

Red-billed Pigeon *Columba flavirostris*. One

pair was recorded in the clearing in April, May and June; the birds were seen mating on 20 April and a free-flying juvenile was seen on 22 May. Three individuals were heard singing by FG on 23 May (perhaps the pair and juvenile?). The species had apparently never been recorded in the area before (R. Solís and I. Gálvez, pers. comm.) and does not normally occur at this elevation (Howell & Webb 1995).

Band-tailed Pigeon *Columba fasciata*. Found in the forest in low numbers. There is a marked decrease in vocalization from spring to summer and from summer to fall, when rarely recorded, although many were seen to fly into the tops of large oak trees on Cerro El Triunfo in December. In spring, recorded feeding on *Morus* sp. (Moraceae) fruits.

Mourning Dove *Zenaida macroura*. One record. A single bird at the clearing from 26 to 29 October. The species had not been recorded in the area before except once in the large man-made clearing of Palo Gordo around 6 km from Campamento El Triunfo (R. Solís and I. Gálvez, pers.comm.).

White-faced Quail Dove *Geotrygon albigularis*. Found in moderate numbers in the forest. There is a strongly marked decrease from spring to summer and from summer to fall. Single nests with two eggs were found on Cerro El Triunfo and on Prusia trail on 19 May. Both were messy platforms of sticks about 1.5 to 2 metres above the ground in a tangle of vines, eggs whitish with a strong peach wash. Two or three juveniles were seen foraging by themselves on 24 June and 6 August.

Green Parakeet *Aratinga holochlora (sensu lato)*. Recorded flying over the canopy in small groups, most often in a south-north direction (only once seen to perch on a tree in the

upper cloud forest, apparently because that day their flight over the forest was interrupted by strong rain and heavy mist). Sometimes seen flying northwards high over the lower cloud forest and pine-cypress forest in the Pacific slope, suggesting that these flocks originate in the lowlands on one side of the mountain range and cross over to the lowlands on the opposite side. This observation has taxonomic significance because it indicates that populations on both sides of the Sierra Madre de Chiapas may not be genetically isolated (see Discussion).

Barred Parakeet *Bolborhynchus lineola*. Found in moderate numbers. Usually seen flying over the forest in small flocks, rarely up to 34 individuals in a flock. Once, up to 81 individuals counted in a single late afternoon (three flocks). Only once seen perched in the trees, four birds apparently feeding on the flowers of a tree locally known as “cedrillo” (probably *Gnarea glabra* or *Cedrela* sp., Meliaceae) on 20 November. The calls of perched birds are reminiscent of the call of *Melanerpes formicivorus*. Recorded less often June to October.

Black-billed Cuckoo *Coccyzus erythrophthalmus*. One record, a single bird on 13 May.

Squirrel Cuckoo *Piaya cayana*. Scarce in the cloud forest, recorded more often in the edge of the man-made clearing of Campamento El Triunfo.

Groove-billed Ani *Crotophaga sulcirostris*. Two records, both in April, at the clearing.

Mottled Owl *Ciccaba virgata*. A single individual could frequently be heard calling from the forest and old second-growth at the edge of the clearing during all months of the study.

Fulvous Owl *Strix fulvescens*. Found in moderate numbers in the forest. The largest number

recorded was on the night of 22 March, when, from the visitor's cabin in Campamento El Triunfo at least seven individuals could be heard calling from different spots in the surrounding forest within a few minutes of each other. Occasionally found in their daytime roost, singly or in pairs, on low to high branches. Heard on two occasions singing in daylight (26 August at 07:31 h; 22 June at 17:44 h).

Mexican Whip-poor-will *Caprimulgus vociferus arizonae*. Found in the forest in low numbers, especially in treefall gaps and at the edge of the clearing.

Black Swift *Cypseloides niger*. Small numbers, recorded infrequently from March to late September. Usually single individuals, flocks of around 15 on two occasions.

Chestnut-collared Swift *Streptoprocne rutilus*. Recorded in moderate numbers over the forest from March to November.

White-collared Swift *Streptoprocne zonaris*. Recorded in moderate numbers over the cloud forest, all months of the study.

Vaux's Swift *Chaetura vauxi*. Recorded in small numbers over the cloud forest, March to June. HGdS has seen this species in the adjacent lowlands at other months (e.g., in November in Jaltenango).

White-throated Swift *Aeronautes saxatalis*. One record, a single bird from the top of Cerro El Triunfo, 24 March.

Violet Sabrewing *Campylopterus hemileucurus*. Found in moderate numbers in the forest. Slightly higher numbers recorded in summer, slightly lower numbers in fall.

Rufous Sabrewing *Campylopterus rufus*. One

record, at a brushy hillside in the ecotone of upper cloud forest, lower cloud forest and pine-cypress forest. Found regularly in the lower cloud forest.

Green Violetear *Colibri thalassinus*. Scarce. Few records, most of which are from the top of Cerro El Triunfo and the brushy hillside on the ecotone between the upper cloud forest and the pine-cypress forest.

Emerald-chinned Hummingbird *Abeillia abeillei*. Found in seasonally low to moderate numbers in the forest. Song heard occasionally in November. Not recorded in spring.

Black-crested Coquette *Paphosia helenae*. Scarce visitor, probably an altitudinal migrant. Two adult males and one immature male on 19 November at flowers of *Sechium compositum* (Cucurbitaceae) on Prusia transect, and two females on 22 November on Cipresal transect, are the only records from the region. These records are far above the normal altitudinal range of this species. These sightings coincided with the peak of flowering of *Sechium compositum*, on which four of the birds were seen to be feeding (see Discussion).

White-eared Hummingbird *Hylocharis leucotis*. Scarce, mainly recorded on brushy slopes (including one at the ecotone with pine-cypress forest) and at the clearing.

White-bellied Emerald *Amazilia candida*. One record, on 26 October. This species is normally found at lower elevations. The record coincides with the beginning of flowering of *Sechium compositum* (see Discussion).

Berylline Hummingbird *Amazilia beryllina*. Three records, 22 September and 22 and 26 October. These records coincide with the flowering of *Sechium compositum* (see Discussion). More regularly recorded in the lower

cloud forest.

Green-throated Mountain-gem *Lampornis viridipallens*. Numerous resident during all months of the study. A type of display was observed on 21 and 22 September. On the former date, one female was observed performing six slow wingbeats, with stiff wings, upon perching after each brief bout of hovering (it was observed performing this action ten times). On the latter date, another female was observed beating its wings in the same manner three or four times after each bout of hovering.

Amethyst-throated Hummingbird *Lampornis amethystinus*. Scarce, recorded only at treefall gaps and brushy slopes. Most records in summer, none in fall. Most records are of females, only one of an immature male with iridescent pink patches on the throat (Prusia transect, 29 April). Interestingly, our only other sighting of a male in the Sierra Madre de Chiapas (6 May, brushy slope between the pine-cypress and the lower cloud forest, thus around 1.5 km south of the upper cloud forest), was of a blue-throated individual (HGdS). Iridescent blue throats are found in the subspecies (sometimes considered a full species) from Michoacán, Guerrero and southern Oaxaca, but never before from Chiapas. This situation merits further study.

Garnet-throated Hummingbird *Lamprolaima rhami*. Scarce. Records are of single birds (both sexes) on the top of Cerro El Triunfo (18 and 25 April, 17 May, 31 August) feeding from the flowers of *Cavendishia bracteata* (Ericaceae) and *Clusia* sp. (Guttiferae), a single bird in the highest part of Palo Gordo transect around 2500 m from Campamento El Triunfo (16 May) feeding from *Cavendishia bracteata*, and a male and a female in Prusia transect (6 December), the male sallying for flying insects and feeding from the flowers of

Clethra mexicana (Clethraceae), and the female sallying for insects. Possibly an altitudinal migrant, tracking the flowering of preferred species.

Magnificent Hummingbird *Eugenes fulgens*. Scarce. Recorded infrequently in spring and fall on Cerro El Triunfo transect and (probably this species) Palo Gordo transect.

Sparkling-tailed Hummingbird *Tilmatura dupontii*. Four records, single females (Palo Gordo transect, 5 March; Prusia transect, 30 October) and a pair feeding on flowers of *Secbium compositum* on Prusia transect, 19 November (see Discussion).

Ruby-throated Hummingbird *Archilochus colubris*. Two females at a brushy slope in ecotone of pine-cypress and upper cloud forest, 26 October.

Wine-throated Hummingbird *Atthis ellioti*. Seasonally found in moderate to fairly large numbers. Very few records in spring, possibly partly due to error (unfamiliarity with the song at the beginning of the study). Perhaps two or three breeding events in a year, judging from peaks of display and song.

Mountain Trogon *Trogon mexicanus*. Found in the forest in low numbers. Recorded markedly less often in summer and fall, partly owing to the decreased frequency of singing (no song heard between July and early September, a period similar to that in which *Pharomachrus mocinno* is also largely absent). Probably a partial altitudinal migrant, as has been observed in the Gómez Fariás region of Tamaulipas (Arvin 1990).

Collared Trogon *Trogon collaris*. Found in the forest in low numbers. Recorded markedly less often in summer and even less in fall. A juvenile seen on 6 August. Perhaps a partial

altitudinal migrant.

Resplendent Quetzal *Pharomachrus mocinno*. Found in the forest in low numbers. Strongly marked decrease in summer. Known to be an altitudinal migrant, usually departing in May and June (L. Noble and S. Solórzano, pers. comm.). However, it is likely that at least some individuals depart later or return to the upper cloud forest for at least a few days in summer, because the species was heard in Palo Gordo transect in June and was recorded near the beginning of Palo Gordo transect from 29 July to 4 August (6 or 7 individuals, an unusually high number, were seen on a fruiting tree there 3 August; there never was more than one bird in the tree at one time, though the others could be heard calling from nearby trees). The species was not recorded again until 1 October.

Blue-throated Motmot *Aspatha gularis*. Found in the forest in low numbers. Recorded markedly less often in summer and even less in fall.

Green Kingfisher *Chloroceryle americana*. A single individual at the edge of the stream that runs through the clearing of Campamento El Triunfo, 19 May (FG).

Emerald Toucanet *Aulacorhynchus prasinus*. Found in moderate numbers in the forest. There is a strongly marked decline in fall records, though occasionally up to five recorded at fruiting trees. Perhaps a partial altitudinal migrant, as has been observed in Los Tuxtlas, Veracruz (Howell & Webb 1995: 40). A nestling was seen on 19 May sticking its head out of a nest hole, the same natural hollow in which the species nested in 1992, four meters up in a *Matudaea trinervia* trunk (FG). Immatures were seen on separate days in June in different parts of the study area. Recorded feeding on *Morus* sp., *Citharexylum*

mocinnii, *Trophis cuspidata*, *Rhamnus capraeifolia* var. *grandifolia* and *Prunus brachybotrya*. Observed drinking water from bromeliads.

Acorn Woodpecker *Melanerpes formicivorus*. Scarce, mainly in and around the clearing in spring and fall.

Yellow-breasted Sapsucker *Sphyrapicus varius*. Two records (19 March and 20 November). Silent and probably underrecorded.

Hairy Woodpecker *Picoides villosus*. Found in moderate numbers. Recorded less often in summer and fall. Probably a partial altitudinal migrant, as has been recorded in the Valley of Mexico (Howell & Webb 1995: 40-41).

Golden-olive Woodpecker *Piculus rubiginosus*. Found in low numbers. Recorded less often in summer and fall.

Spectacled Foliage-gleaner *Anabacerthia variegaticeps*. Found in moderate numbers in the forest. Recorded slightly less often in fall.

Ruddy Foliage-gleaner *Automolus rubiginosus*. Found in moderate numbers. Nests and roosts in holes in earth banks (such as those on the sides of some of the trails). Recorded less often in summer and still less in fall. Perhaps a partial altitudinal migrant.

Tawny-throated Leaf-tosser *Sclerurus mexicanus*. Found in low or perhaps moderate numbers in the cloud forest. Probably underrecorded because the species is most vocal for a few minutes before and after dawn, and at other times mainly recorded by sight on or near the trails. Slight decrease in fall records not significant.

Spotted Woodcreeper *Xiphorhynchus erythropygius*. Found in moderate numbers in the cloud forest, probably slightly less numerous

than the next species. Recorded slightly less often in summer and fall.

Spot-crowned Woodcreeper *Lepidocolaptes affinis*. Found in moderate numbers in the forest. Recorded slightly less often in summer and still less in fall (recorded as a partial altitudinal migrant in Gómez Farías region, Tamaulipas; Arvin 1990). Parent feeding nestling in hole on 14 May.

Barred Antshrike *Thamnophilus doliatus*. One record (heard only). Two birds heard near the top of Cerro El Triunfo, far above their normal elevation, on 17 March.

Scaled Antpitta *Grallaria guatemalensis*. Found in the forest in very low numbers, but probably underrecorded because song never heard (antpittas elsewhere normally sing very little and mainly before or at dawn; J. Kingery, pers. comm.) and therefore can not be detected from distances of more than 10 or 15 m from the trails. Not recorded in fall.

Paltry Tyrannulet *Zimmerius vilissimus*. Numerous in the cloud forest. Strongly marked decline from spring to summer and from summer to fall. Perhaps a partial altitudinal migrant. The peculiar sound of two individuals fighting in flight can be heard from at least March to May (less frequently in the latter month) and very rarely from 31 August to December. Seen carrying nesting material May 16 (FG). An active nest found on 4 August.

Eye-ringed Flatbill *Rhynchocyclus brevirostris*. Found in the forest in low numbers. Recorded much less often in summer and still less in fall. Perhaps a partial altitudinal migrant. A free-flying immature bird being fed on August 6. Not previously recorded at these elevations in Mexico (Howell & Webb 1995), though the species does reach this high locally

in Costa Rica (Stiles & Skutch 1989).

Stub-tailed Spadebill *Platyrinchus cancrominus*. Found in the forest in very low numbers. Altitudinal migrant recorded only in spring and fall. In spring, recorded only on Palo Gordo and Malacatal transects. In fall, recorded only once on Palo Gordo transect (December) but more often in November and December on Cipresal transect (where up to 2 individuals) and from late October on at Malacatal transect (where up to 3 individuals). These records are higher than the normal elevational range of this species in Mexico and Costa Rica (Howell & Webb 1995; Stiles & Skutch 1989), although a closely related species has been recorded at this elevation in Costa Rica (Stiles & Skutch 1989).

Tufted Flycatcher *Mitrephanes phaeocercus*. Found in moderate numbers. Less often recorded in summer. Perhaps a partial altitudinal migrant, as has been observed in the Gómez Farías region of Tamaulipas (Arvin 1990).

Western Wood Pewee *Contopus sordidulus*. Transient (April to May and late August to October) in very low numbers, more frequently recorded at Campamento El Triunfo.

Olive-sided Flycatcher *Contopus cooperi*. One record. A single individual in the clearing of Campamento El Triunfo on 20 May (FG).

Yellowish Flycatcher *Empidonax flavescens*. Found in moderate numbers in the forest. Strongly marked decrease in summer and fall. Perhaps a partial altitudinal migrant, as has been observed in Los Tuxtlas (Howell & Webb 1995: 40).

Hammond's Flycatcher *Empidonax hammondi*. "Winter" visitor (at least October to April). Only four records from the cloud forest,

more often recorded at Campamento El Triunfo. Probably underrecorded because it is mostly silent.

Pine/Dusky/Least Flycatcher *Empidonax affinis/oberholseri/minimus*. “Winter” visitor (earliest date 7 August). Two records from small gaps in the cloud forest, more often recorded in Campamento El Triunfo. Readily distinguished from Hammond’s Flycatcher by their very drab fall plumage and “whit” call, and from most other *Empidonax* by their relatively narrow beaks (Kaufman 1990, Howell & Webb 1995). One particularly close-up sighting was identified as Pine or Dusky Flycatcher by the long and narrow beak with a flesh lower mandible that had a clear-cut dusky tip.

Black Phoebe *Sayornis nigricans*. A single individual at the edge of the stream that runs through the clearing of Campamento El Triunfo, 20 May (FG).

Dusky-capped Flycatcher *Myiarchus tuberculifer*. Heard only. Three records (at the edge of the clearing on 9 and 12 May; 2500 m along Palo Gordo transect on 16 May).

Sulphur-bellied Flycatcher *Myiodynastes luteiventris*. One pair at Campamento El Triunfo from 31 March to late July. This lowland species is not normally recorded at this elevation in Mexico (Howell & Webb 1995), though it has been recorded up to 2000 m in Costa Rica (Stiles & Skutch 1989).

Scissor-tailed Flycatcher *Tyrannus forficatus*. One record, a single individual at Campamento El Triunfo on 11 May.

Cassin’s Kingbird *Tyrannus vociferans*. One record, a bird obviously on migration seen from the top of Cerro El Triunfo on 25 October.

Rose-throated Becard *Pachyramphus aglaiae*. Found in moderate numbers. Marked decrease in numbers recorded in summer and fall. Perhaps a partial altitudinal migrant. Nesting recorded in March and May.

Solitary Vireo *Vireo cassini*. Found in low numbers at least in March, April, November and December. Absent in summer.

Brown-capped/Warbling Vireo *Vireo leucophrys/gilvus*. Heard only. Two records, 24 March and 28 May.

Chestnut-sided Shrike Vireo *Vireolanius melitophrys*. Scarce. More often recorded in spring.

Black-throated Jay *Cyanolyca pumilo*. Found in moderate numbers in the forest all year. Often encountered in flocks of around eight birds. Immatures seen July and August. Seen feeding on large hairy caterpillars and (once) on *Morus* fruits.

Unicolored Jay *Aphelocoma unicolor*. Found in the forest in low numbers. Usually encountered in groups of 2 or 3 birds. Recorded slightly more frequently in summer than in spring, recorded slightly less frequently in fall.

Violet-green Swallow *Tachycineta thalassina*. Two records from the top of Cerro El Triunfo (single birds on 24 March and 12 May).

Black-capped Swallow *Notiochelidon pileata*. Found year round in small numbers flying over the cloud forest, occasionally perched on snags or flying around earth banks at the edge of the clearing.

Bank Swallow *Riparia riparia*. One record from the top of Cerro El Triunfo, several birds on 12 May among other migrating swallows.

Cliff Swallow *Petrochelidon pyrrhonota*. Few

records, from the top of Cerro El Triunfo and Cerro La Bandera. Small flocks on 14 March and on 12 and 17 May, and a single bird on 26 September. The birds seen on 14 March, at least, had the pale buff foreheads typical of northern breeders.

Barn Swallow *Hirundo rustica*. The only records are of 21 and 8 birds on migration above the top of Cerro El Triunfo on 18 April and 25 October, respectively.

Spotted-breasted Wren *Thryothorus maculipectus*. Heard only, recorded at the same spot on Prusia trail on 1 August, 2 September and 2 October.

Rufous-browed Wren *Troglodytes rufociliatus*. Found in moderate numbers in the forest. Less frequently recorded in summer and fall.

Gray-breasted Wood Wren *Henicorhina leucophrys*. Numerous and very vocal. Marked decrease in fall. Perhaps a partial altitudinal migrant. Nest observed 30 April. Juvenile seen on 6 August.

Brown-backed Solitaire *Myadestes occidentalis*. Numerous. Recorded less frequently in summer. Recorded as a partial altitudinal migrant in the Gómez Farías region of Tamaulipas (Arvin 1990). Nests recorded April, May and June on earth banks at the sides of some of the trails. Juveniles and immatures seen June to August. Seen feeding on *Morus* sp., *Citharexylum mocinnii*, *Rhamnus capraefolia* var. *grandifolia* and *Trophis cuspidata*.

Ruddy-capped Nightingale Thrush *Catharus frantzii*. Numerous. Regularly recorded all the way to the top of Cerro El Triunfo. Strongly marked decrease in the number of fall records. Song never heard in summer (calls only). Probably a partial altitudinal migrant. Juvenile recorded late June. Usually forages

on the ground or in low undergrowth, occasionally higher (especially at midstory fruiting trees) but once observed foraging for insects around 25 m up in the top branches of a tree (21 June).

Spotted Nightingale Thrush *Catharus dryas*. Numerous. Most frequently recorded in summer, strongly marked decrease in the number of records in fall. Perhaps a partial altitudinal migrant. Recorded very rarely (only twice) above 2200 m on Cerro El Triunfo. Recorded feeding on fruits of *Citharexylum mocinnii*.

Hermit Thrush *Catharus guttatus*. Three records of single birds on 6 and 7 March and 16 April. Silent and most probably underrecorded.

Swainson's Thrush *Catharus ustulatus*. Spring transient (recorded late March to May) in moderate numbers. Sings often. Seen feeding on fruits of *Citharexylum mocinni*.

Black Thrush (Robin) *Turdus infuscatus*. Found in moderate numbers. Sings from at least March to May (males in both adult and immature plumages). Juveniles seen in May. Only two summer records (singing 23 June, male seen 29 July) and no fall record. Altitudinal migrant, as has been observed in Guatemala (Skutch 1967). As observed in Guatemala (Skutch 1967), its songs are easy to recognize as they include short snatches of song of different species, including its own, one after another, usually with a burry quality. Species imitated at El Triunfo include *Dactylortyx thoracicus*, *Piaya cayana*, *Melanerpes formicivorus*, *Platyrinchus cancrominus*, *Myiarchus tuberculifer*, Social Flycatcher *Myiozetetes similis*, *Thryothorus maculipectus*, *Catharus ustulatus*, *Cycularhis gujanensis*, *Chlorophonia occipitalis*, *Piranga bidentata*, and *Coccothraustes abeillei*. *Myiozetetes similis* and *Cycularhis gujanensis* are lowland species not recorded in the upper cloud forest and

another two or three species are also typical of the lowlands and are very rare found in the cloud forest; their songs may have been learned during the robins' migrations outside of the upper cloud forest. Recorded feeding on fruits of *Morus* sp., *Citharexylum mocinnii* and *Rhamnus capraefolia* var. *grandifolia*. Juvenile seen on 7 May.

Mountain Thrush (Robin) *Turdus plebejus*. Found locally in the survey area. Sings from at least late March to May in the upper parts of the cloud forest (the only later date heard singing was 23 June). Much less frequently recorded in summer and even less in fall, although nonsinging individuals sometimes seen on fruiting trees in the lower areas of the upper cloud forest in those seasons (when never recorded in the upper parts of the study area), implying altitudinal migration. Recorded feeding on fruits of *Citharexylum mocinnii*, *Rhamnus capraefolia* var. *grandifolia*, "flor de San Juan" and *Trophis cuspidata*.

Clay-colored Thrush (Robin) *Turdus grayi*. Concentrated in the Campamento El Triunfo clearing and only four records from the cloud forest, mostly March to June (also heard singing 6 August). Juvenile observed on 21 June.

White-throated Thrush (Robin) *Turdus assimilis lecauchen*. Four records from the forest (on Prusia and Cipresal transects) and one record at Campamento El Triunfo, all in fall. Whereas some of the other thrushes of this genus migrate downslope in summer and fall, this species seems to migrate upslope. Recorded feeding on fruits of *Trophis cuspidata*.

Rufous-collared Thrush (Robin) *Turdus rufitorques*. Few records, all from the clearing of Campamento El Triunfo. Single birds on 31 March and 15 December and four immature

birds on 1 to 5 August.

Blue-and-white Mockingbird *Melanotis hypoleucus*. Mostly recorded in the clearing of Campamento El Triunfo and edge, and two records from a single brushy hillside in the cloud forest on Cipresal transect (1 May, 11 December).

Cedar Waxwing *Bombycilla cedrorum*. Two records of a flock at Campamento El Triunfo and one of a flock on Malacatal transect, all in spring.

Gray Silky *Ptilogonys cinereus*. Found in moderate numbers in the forest but infrequently recorded, more often in spring. Only one record each in September, October and November and two records in December. Probably a partial altitudinal migrant, as has been observed in the Valley of Mexico (Howell & Webb 1995: 40-41). Recorded feeding on fruits of *Citharexylum mocinnii*.

Blue-winged Warbler *Vermivora pinus*. One record, at the edge of the clearing of Campamento El Triunfo, 24 October.

Tennessee Warbler *Vermivora peregrina*. Scarce transient. Recorded in fall only (after 25 October), although has been seen in spring in the lower cloud forest.

Nashville Warbler *Vermivora ruficapilla*. One fall record from the cloud forest (two or three birds, 26 October) and one spring record from the clearing in Campamento El Triunfo (single bird on 25 March).

Crescent-chested Warbler *Vermivora superciliosa*. Found in moderate numbers in the forest. Much less frequently recorded in summer and fall, partly due to absence of song in those seasons. Probably a partial altitudinal migrant, as observed also in the Gómez

Fariás region, Tamaulipas (Arvin 1990), and in the Valley of Mexico (Howell & Webb 1995: 41). Nest found on 24 May.

Yellow-rumped Warbler *Dendroica coronata auduboni*. Fall transient. Flying over the forest on migration and one record of a single bird in the clearing.

Townsend's Warbler *Dendroica townsendi*. Probably found in moderate numbers but underrecorded. Recorded from September to March only (and unidentified *Dendroica* warblers, perhaps this species, heard in September and early October).

Black-throated Green Warbler *Dendroica virens*. Spring and fall, only three records.

Hermit Warbler *Dendroica occidentalis*. One record, a bird in a mixed flock on 6 December.

Black-and-white Warbler *Mniotilta varia*. Scarce. Records in spring and fall.

Worm-eating Warbler *Helmitheros vermivorus*. One record (6 December).

Ovenbird *Seiurus aurocapillus*. One record (26 October).

Louisiana Waterthrush *Seiurus motacilla*. Found in low numbers along streams in the forest and at the clearing. Latest spring record: 9 March. Earliest fall record: 28 July (the first day spent in the region that month, so perhaps present from earlier in July).

McGillivray's Warbler *Oporornis tolmiei*. Recorded a few times in March, in brushy areas, especially at the clearing of Campamento El Triunfo.

Wilson's Warbler *Wilsonia pusilla*. Numerous

winter visitor. Latest spring record: 30 April. Earliest fall record: 26 August. Several individuals in song: 2 October.

Canada Warbler *Wilsonia canadensis*. Two records: one at Campamento El Triunfo on 22 September, the other in the forest on 1 October.

Slate-throated Redstart *Myioborus miniatus*. Numerous, much less frequently recorded in summer and even less in fall. Probably a partial altitudinal migrant as has also been observed in the Valley of Mexico (Howell & Webb 1995: 41).

Golden-browed Warbler *Basileuterus belli*. Numerous resident, recorded more often in summer. A nest observed on 29 April. Birds in the ephemeral juvenile plumage observed on three occasions (22 June, 27 June and 30 July). In the first two occasions, single juveniles were observed being attended by a pair of adults indicating high infant mortality, as the species is reported to lay 2-4 eggs (Howell & Webb 1995). In the latter date, a pair of juveniles seen attended by a pair of adults.

Blue-hooded Euphonia *Euphonia elegantissima*. Found in moderate numbers. Recorded less often in summer and still less often in fall. Probably a partial altitudinal migrant, as has been observed in the Gómez Fariás region of Tamaulipas (Arvin 1990). Recorded feeding on mistletoe berries (Loranthaceae).

Blue-crowned Chlorophonia *Chlorophonia occipitalis*. Found in moderate numbers, but recorded much less frequently in summer. Probably a partial altitudinal migrant, as has been observed in the Los Tuxtlas region of Veracruz (Howell & Webb 1995: 40).

Summer Tanager *Piranga rubra*. Two records

(18 March, 6 December).

Stripe-backed Tanager *Piranga bidentata*. Found in low numbers. Recorded very rarely in summer and fall (not recorded in transects in those seasons). Altitudinal migrant, as has been observed in the Gómez Farías region of Tamaulipas (Arvin 1990). Seen feeding on *Morus* sp., *Urera caracasana* (Urticaceae) and *Citharexylum mocinnii*.

Common Bush Tanager *Chlorospingus ophthalmicus*. Numerous resident. Almost always found in flocks of around 10 to several dozen individuals, thus it forms larger flocks than are usually recorded in Costa Rica (Skutch 1967; Stiles & Skutch 1989), where a different subspecies (or sister species?) is found. Large flocks are usually spread out over a large area and flock size is therefore often difficult to judge except under special circumstances. At least 40 or 50 individuals can sometimes be counted in flocks that move rapidly across the edge of a treefall gap or through a fruiting tree. However, on occasional transects HGdS would be surrounded by a flock of this species, never losing sight or sound of them for up to 1 km of trail. Such flocks may contain over 200 individuals (HGdS). Immatures seen frequently in August. Seen feeding on *Conostegia volcanalis*, *Trema micrantha* (Ulmaceae), *Morus* sp., *Citharexylum mocinnii* and *Rhamnus capraefolia* var. *grandifolia*. Juveniles observed July and August.

Yellow-throated Brushfinch *Atlapetes gutturalis*. Found in the forest in low numbers, though very rarely recorded (most records in spring); more often recorded in the second-growth at the edge at Campamento El Triunfo or in treefall gaps in the forest. Probably underrecorded because the species sings mostly before 07:00 h.

Chestnut-capped Brushfinch *Atlapetes brunnei-*

nucha. Numerous. Much less frequently recorded in summer and even less in fall. Perhaps an altitudinal migrant. Single juveniles seen in different parts of the forest on 26 June, 29 July, 4 August, 22 August, 23 August and 31 August. Observed feeding on fruits of *Citharexylum mocinnii*.

Cinamon Flowerpiercer *Diglossa baritula*. Found in moderate numbers. Recorded much less often in fall.

Lincoln's Sparrow *Melospiza lincolni*. Recorded spring and fall at Campamento El Triunfo.

Rufous-collared Sparrow *Zonotrichia capensis*. Only two records from the forest but numerous at Campamento El Triunfo. Juveniles seen late June, July and August.

Yellow Grosbeak *Pheucticus chrysopeplus*. Recorded in the forest occasionally and in small numbers but numerous at the Campamento El Triunfo clearing. Much less frequently recorded in summer and fall. This species is not normally found in cloud forest or at this elevation. Although at Campamento El Triunfo this species can be heard singing at all times of day, it was very rarely heard singing in the forest (single silent or calling birds only; HGdS). Breeding may occur only at Campamento El Triunfo, and birds recorded in the forest may be individuals that occasionally range away from this clearing searching for food (HGdS). Nesting recorded in May and June.

Rose-breasted Grosbeak *Pheucticus ludovicianus*. Two records (19 April at Campamento El Triunfo and 11 December, in the forest).

Blue Grosbeak *Guiraca caerulea*. Three birds seen at Campamento El Triunfo on 19 April

are the only record.

Indigo Bunting *Passerina cyanea*. One record, a bird obviously on migration flew in from the west and perched briefly on the top of Cerro El Triunfo on 25 October.

Melodious Blackbird *Dives dives*. At least two pairs live in Campamento El Triunfo.

Great-tailed Grackle *Quiscalus mexicanus*. The only record is a single female seen at Campamento El Triunfo on 12 March (a day with much mist and especially wind, perhaps having to do with the bird's accidental occurrence).

Red-eyed Cowbird *Molothrus aeneus*. Three records at Campamento El Triunfo in spring, including one sighting of a male displaying to two females. The first record occurred at the same time as the accidental record of the previous species.

Orchard Oriole *Icterus spurius*. One record of a female in the forest (29 March) and one of a bird at Campamento El Triunfo (7 August).

Hooded Grosbeak *Coccothraustes abeillei*. Found in the forest in low numbers, less frequently recorded in summer and still less in spring. A pair was once observed nibbling on bits of bromeliad leaves torn from the plant. Recorded visiting fruiting *Citharexylum mocinnii* and *Rhamnus capraeifolia* var. *grandifolia*.

DISCUSSION

As occurs in Neotropical cloud forests in general (Stotz *et al.* 1996: 70), few species of Neotropical-Nearctic migrants were recorded regularly and in numbers in the El Triunfo upper cloud forest. Only *Wilsonia pusilla* was numerous, and only *Dendroica townsendi*, and as a transient *Catharus ustulatus*, were judged to

be found in moderate numbers. *Vireo cassini* and *Contopus sordidulus* were found in low numbers. *Mniotilta varia*, *Seiurus motacilla* and, as a transient, *Vermivora peregrina* were judged to be scarce. Other species seemed to fly over the forest, rarely stopping, and/or mainly visit the man-made clearing.

Four species recorded in this study were not mapped in the Sierra Madre de Chiapas region in Howell & Webb (1995): *Catharus guttatus* (also recorded in El Triunfo by Parker *et al.* 1976), *Vermivora pinus*, *V. superciliosa* *Dives dives*. The first two are rare migrants or vagrants, but the last two are residents.

Some of the Table 2 species, such as *Sarcophamphus papa*, *Spizaetus tyrannus*, *S. ornatus*, *Columba flavirostris*, *Aratinga holochlora*, *Amazilia candida*, *Myiodynastes luteiventris*, *Thryothorus maculipectus*, *Turdus grayi*, *Helminthos vermivorus*, *Pheucticus chrysopheplus* and *Dives dives*, and a few of the Table 1 species, namely *Micrastur ruficollis*, *Paphosia helenae*, *Rhychoyclus brevirostris*, and *Platyrinchus cancrominus* were recorded above their habitual altitudinal range. Some of these species were found only or mostly in the man-made clearing of Campamento El Triunfo (see Annotated List), implying that habitat perturbation benefits certain non-cloud forest species. Most of these species, as well as some other Table 1 species, are usually found in tropical rainforests or rainforest edge, and their presence in El Triunfo may be due to the nearness of such habitats (within around 3 km as the crow flies) owing to the abruptness of the Sierra Madre de Chiapas.

One of these species, *Aratinga holochlora*, seemed to fly over the area regularly to and from the Pacific lowlands to the south, and the Central Valley of Chiapas to the north. The populations in these two regions are generally thought to be isolated from each other and are sometimes treated as separate species. On the other hand, Howell & Webb (1995) mention that the two "separate" Chiapas populations resemble each other more in their

flight calls and some bill measurements than do other populations of the complex. Our observation of regular flights over the Sierra Madre de Chiapas suggests that these two “separate” populations could in fact be interbreeding.

A similar situation occurs with the *Asturina nitida*. This species is usually found in the lowlands, but the single record at our study area suggest that a 2000+ m mountain range is not high enough to isolate populations.

Altitudinal migration seems to be very common in El Triunfo (see Annotated List). One special case is that of lowland or mid-elevation hummingbirds such as *Abeillia abeillei*, *Papfusia helena*, *Amazilia candida*, *Amazilia beryllina* and *Tilmatura dupontii*, which seemed to appear or become more abundant in the upper cloud forest at the same time as the flowering in late September to early December (with peak flowering in November) of *Sechium compositum* (specimen identified by R. Lira of the Instituto de Biología; species until recently known as *Abzolia composita*). This plant is normally found from 200 to 1500 m (Dieterle 1975); probably its seasonal flowering at higher elevation in El Triunfo attracts a guild of hummingbirds usually found at low or mid-elevations.

El Triunfo also appears to be a good place to observe long-distance latitudinal migration (Table 2 species) although the cloud forest itself is poor in migrant species. In particular, large numbers of migrants (raptors, swallows, wood-warblers and smaller numbers of flycatchers and buntings) can be seen from the summit of Cerro El Triunfo as they fly westward in spring and eastward in late summer and fall along the backbone of the Sierra Madre de Chiapas, usually high above the forest. These migrations, along with the fact that a few individuals occasionally stop briefly at the summit of Cerro El Triunfo or elsewhere (especially in the clearing at Campamento El Triunfo), account for

the large number of Table 2 species recorded in the study area. These migrations can be easily distinguished from other kinds of movements in that several birds, often belonging to different families, can be observed flying along the same path and in the same direction. Specific dates on which such migrations were observed from Cerro El Triunfo are 18 April, 12 May, 31 August and 25 October, but they undoubtedly occurred much more often (the few records are due to the fact that much more time was spent under the canopy of the forest than at suitable lookouts). Further observation of this phenomenon is worthwhile.

The occurrence of one or very few individuals of bird species that were normally found at other elevations and habitats, such as *Ardea alba*, *Bubulcus ibis*, *Asturina nitida*, *Zenaida macroura*, *Columba flavirostris*, *Crotophaga sulcirostris*, *Chloroceryle americana*, *Thamnophilus doliatus*, *Sayornis nigricans*, *Tyrannus forficatus*, *Molothrus aeneus* and *Quiscalus mexicanus*, reveal the existence of occasional long-range dispersal of a kind that is usually not detected in traditional studies of population dynamics (Koenig *et al.* 1996). This reveals how an apparent geographic barrier such as the Sierra Madre de Chiapas may not constitute a true barrier to dispersal, especially over evolutionary time scales. It may also reveal the way in which certain species are capable of colonizing an isolated patch of suitable habitat in the long term. It is only a matter of degree between the occasional occurrence of *Crotophaga sulcirostris* and *Molothrus aeneus*, for example; the successful breeding of a pair of *Columba flavirostris*; and the establishment of a population of *Turdus grayi*, *Pheucticus chrysopleus* and *Dives dives* at Campamento El Triunfo, outside of their normal habitat and elevation. It is interesting that most records of these “accidental” species are temporally clumped. For example, *Quiscalus mexicanus* and the first observation of *Molothrus aeneus*

were on the same date, and *Zenaida macroura* and *Bubulcus ibis* were recorded for the first time within a few days of each other.

Ant swarms are less frequent in the highlands of the Neotropics than in the lowlands, where most studies of ant-following birds have been made. Ant swarms were observed, infrequently, during all months of the study, and at least seasonally were attended by insect-eating birds. The birds most often seen following ants are *Henicorbina leucophrys* (Troglodytidae), *Catharus frantzii* (Turdidae) and *Atlapetes brunneinucha* (Emberizidae), but many other species can be involved, including *Automolus rubiginosus* (Furnariidae), *Grallaria guatemalensis* (Formicariidae), *Catharus dryas* (Turdidae), *Empidonax flavescens* (Tyrannidae), *Turdus plebejus* (Turdidae), *Chlorospingus ophthalmicus* (Thraupidae) and *Wilsonia pusilla* (Parulidae). Formicariidae, Turdidae and Troglodytidae were considered “fairly regular” ant-followers by Willis & Oniki (1978), whereas Thraupidae and Parulidae were considered “occasional” and Furnariidae and Tyrannidae “rare”. Emberizidae was not even listed, although it was recorded by Sutton (1951).

The number of species recorded on only one or two days (28 and 14 species, respectively; see especially Table 2) were used to estimate the number of species expected in the study area that were not recorded in the present survey. The formulas used are incidence-based estimators and are usually based on the numbers of species recorded on one or two quadrats (see Chazdon *et al. in press*). Here we used days instead of quadrats as the indicator of species incidence, owing to the nature of the fieldwork. Based on our data, the estimator of Chao (1987) and the “first-order jackknife” predict that 28 and 27.776 species, respectively, are still to be recorded, whereas the “second-order jackknife” predicts that 41.663 species were not detected yet (see Chazdon *et al. in press* for information on

these species-richness estimators). It is likely that most of the species still to be recorded are rare migrants at Campamento El Triunfo or vagrants (i.e., Table 2 species). However, it is also possible that some regular species were not recorded, such as small owls (*Glaucidium*, *Otus*, *Aegolius*) and nighthawks (*Chordeiles*), whose apparent absence seems unusual. A few species have been reported in this region but were not detected in the present study; these are Maroon-chested Ground-Dove (*Claravis mondetoura*) and Spotted Towhee (*Pipilo maculatus*; formerly considered a subspecies of *P. erythrophthalmus*) (record in Alvarez del Toro 1958 apparently refer to this region), and White-breasted Hawk (*Accipiter [striatus] chionogaster*; rare, less than 3 records), Blackburnian Warbler (*Dendroica fusca*), Northern Waterthrush (*Seiurus noveboracensis*) and Dickcissel (*Spiza americana*). The last three species were recorded mainly in the clearing of Campamento El Triunfo (Parker *et al.* 1976).

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