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BIRDS OF MONTECRISTO NATIONAL PARK, EL SALVADOR

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Resumen. – Aves del Parque Nacional Montecristo, El Salvador. – A través del presente inventario de las aves de la estación reproductora en Parque Nacional Montecristo, se estimó las abundancias relativas de aves de bosque nebuloso, bosque pino-roble y plantaciones de ciprés (*Cupressus lusitanica*). Los métodos utilizados incluyeron búsquedas intensivas de 4 horas diarias, conteos de punto con radio fijo, y capturas con redes de neblina. Hay 233 especies de aves reportadas para el parque y la lista completa podría exceder las 275, dado muestreos incompletos y la distribución regional de la avifauna. El bosque pino-roble era el hábitat más diverso, aunque la densidad de aves era mayor en el bosque nebuloso. Las plantaciones de ciprés eran intermedias en diversidad, pero forman el hábitat con las densidades menores de aves y tienen menos especies residentes. Diez especies de aves en El Salvador están restringidas al Parque Nacional Montecristo, y cinco de estas al bosque nebuloso. Los 52% de las aves del parque están amenazadas en El Salvador que incluye 22% que están en peligro al nivel nacional. De 18 aves restringidas al norte de Centro-américa y reportadas en El Salvador, 15 habitan Montecristo, y tres no se encuentran en otro lugar del país. Comparado a un bosque nebuloso de mayor extensión en Chiapas, México (El Triunfo), el bosque nebuloso de Montecristo tiene ~ 90% de las especies residentes, y tiene tres especies no reportadas en El Triunfo. Se reportan cinco especies de aves nuevas para la lista nacional de las aves de El Salvador.

Abstract. – An inventory of the breeding season birds of Montecristo National Park (El Salvador) estimated relative abundances of birds in cloud forest, pine-oak forest, and Mexican cypress (*Cupressus lusitanica*) plantations. Methods included intensive searches (4 hours per day), fixed-radius point counts, and mist-netting. A list of 233 bird species was compiled for the park, and the actual species list may be higher than 275, given incomplete sampling and regional bird distributions. Pine-oak forest was by far the most diverse habitat, although bird density was highest in cloud forest. Cypress plantations had intermediate diversity, but lowest bird density, and fewer resident species than the other habitats. Many species at the park are habitat specialists restricted to cloud forest or pine-oak forest. Ten bird species in El Salvador are restricted to Montecristo National Park, and five of these to the cloud forest. Fifty-two percent (118 species) of the park's bird species are threatened in El Salvador, including 22% (53 species) that are endangered at the national level. Of 18 regionally-endemic birds (restricted to northern Central America) reported from El Salvador, 15 are reported from Montecristo, and three are not found anywhere else in El Salvador. Compared to the larger El Triunfo cloud forest in Chiapas, Mexico, Montecristo's cloud forest has about 90% as many resident species, and includes three species not reported at El Triunfo. Five new species of birds are reported for the El Salvador national bird list.
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Key words: Birds, communities, density, cloud forest, conservation, cypress plantation, inventory, pine-oak forest, El Salvador.

INTRODUCTION

Montecristo National Park protects the most extensive cloud forest in El Salvador, as well as montane pine-oak forest. The park is currently the only Salvadoran protected area in the ancient mountains of the Sierra Madre of northern Central America. Montecristo and adjoining areas in El Salvador, Guatemala, and Honduras form the proposed La Fraternidad Biosphere Reserve (Herrera *et al.* 1998). The park is home to numerous species of fauna and flora not known to occur anywhere else in El Salvador (Daugherty 1973, Reyna Vásquez 1979, Thurber *et al.* 1987, Owen & Jones 1993, Schuster *et al.* 2000). A number of species and subspecies were first described to science from collections made at the park (Hincks 1953, Fryxell 1980, Hidalgo 1983, de la Maza E. & de la Maza E. 1984, Schuster 1989, Zamudio 1997, Anderson & Ashe 2000).

Cloud forest is a specialized habitat with many endemic species – organisms uniquely adapted to cloud forest that cannot live in any other habitat. Many of the bird species with ranges geographically restricted to northern Central America are cloud forest endemics (Hernández-Baños *et al.* 1995, Long 1995). Detailed information on the distribution of these species is not available because site inventories of birds are available for very few Northern Central American cloud forests. There are more than 50 separate cloud forests in the biogeographic region of Northern Central America, which includes Chiapas (Mexico), Guatemala, Honduras, El Salvador, and Nicaragua. Currently, only one site inventory of cloud forest birds from this region is widely available, for the El Triunfo cloud forest in Chiapas (Parker *et al.* 1976, Gómez de Silva G. *et al.* 1999).

Several ornithological studies have been carried out at Montecristo National Park, although none can be characterized as an inventory, and none estimated relative abundances of different species. Steinbacher (1956, 1958) collected 25 bird species at areas within or adjacent to today's Montecristo park. Peter Hamel (unpubl. report) observed 77 other species in the park in 1974. Thurber (1978) documented 11 more species with photographs. Hellebuyck (1983) collected two new species for El Salvador from the park. Pullen (1983) studied the Highland Guan (*Penelopina nigra*), but did not report additional species. Sixteen additional species were reported by Thurber *et al.* (1987) for the park. In 1990, Néstor Herrera and Wilfredo Rodríguez (pers. com.) noted a single new species, bringing the bird list to 132. I visited Montecristo briefly in 1991, 1995, and 1996, recording 35 species not previously reported from the park and a few new records for El Salvador (Komar 2001). In 1996, Juan Pablo Domínguez compiled an unpublished park bird list, including 38 new species encountered mostly in the tropical semi-deciduous forest zone (Domínguez, pers. com.). Visitors to the park continued to record new species in unpublished field notes. In 1995 and 1997, Néstor Herrera found six; during 1997–1999 Ricardo Ibarra recorded three; and in June 1998, Wilfredo Rodríguez, Karla Pérez, Néstor Herrera, Roberto Rivera, and Ricardo Ibarra added four. In February–March 1999, Wilfredo Rodríguez, Ricardo Ibarra, and Roberto Rivera found nine more species for the park's bird list.

Prior to the present study, 227 species of birds had been recorded in the park. Many of these species had not been reported from any other site in El Salvador. The lack of a published list and relative abundance information for the park's birds, and a desire to understand the conservation importance of Montecristo National Park, motivated this iventory. As a result, the park bird list is now at 233 species, and relative abundance estimates are available for birds in three major habitats

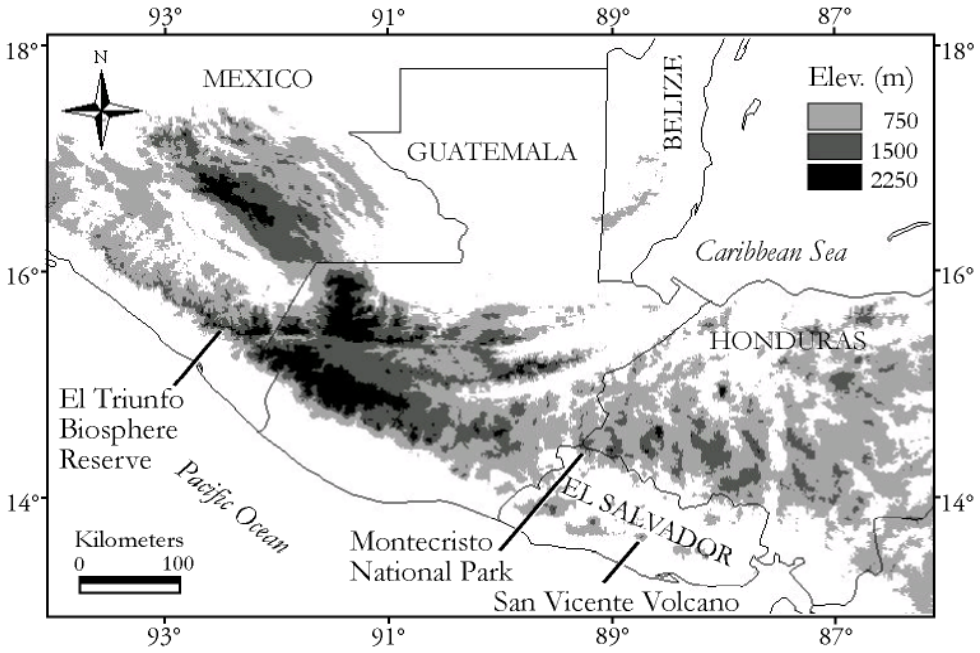

FIG. 1. Montecristo National Park is located near the intersection of El Salvador, Honduras, and Guatemala.

within the park. This information permits an analysis of the conservation importance of the park and its habitats.

STUDY AREA

Parque Nacional Montecristo is a 2000-ha protected area in the Department of Santa Ana, northwest El Salvador (Fig. 1) that protects an altitudinal transect from 800 m to 2418 m above sea level. Cloud forest occupies all of the area between 2000 and 2350 m. Above 2350 m, the forest is replaced by a shrub (or elfin forest) community. Moving downslope, the forest transitions to humid pine-oak forest in the zone between 1900 m and 1000 m. Below 1000 m, disturbed tropical semi-deciduous forest and agricultural plots dominate the landscape but these were not surveyed. A 300-ha Mexican cypress (*Cupressus lusitanica*) plantation occupies most of the zone between 1750 and 2000 m. Several more plantations, mostly ocote pine (*Pinus oocarpa*) and Caribbean pine (*Pinus caribbea*), occupy patches totalling less than 100 ha. Some of these plantations were well-established by 1974, and others were established in the mid-1970s.

The cloud forest and pine-oak forests are contiguous with similar forests outside park boundaries. The size of the contiguous patch of cloud forest is roughly 2500 ha, of which approx. 825 ha is in El Salvador, with the remainder in adjoining Honduras and Guatemala (Reyna Vásquez 1979). Only about 300 ha of cloud forest are within park boundaries. I estimate a total patch size of 15,000 ha for pine-oak and pine forest, with about 1000 ha within park boundaries. Two shaded coffee plantations occupy 45 ha within the park,

between 900 and 1450 m, and a similar area is occupied by other anthropogenic activities, such as agricultural plots and human habitations, mostly below 1200 m. The two villages and scattered habitations within the park have a combined population of 704 (unpubl. data, Montecristo National Park, 1998). Tropical semi-deciduous forest occupies about 200 ha in the lowest part of the park.

The cloud forest tree community includes at least 177 tree species and eight tree fern species (Reyna Vásquez 1979). Abundant canopy trees (20–40 m tall) include *Quercus aaata*, *Symplocos culminicola*, *Magnolia hondurensis*, *Cornus disciflora*, and *Brunellia mexicana* (Heriberto Lima, pers. com.). Abundant middle canopy species (5–20 m tall) include trees of the families Araliaceae and Myrtaceae, as well as *Hedyosmum mexicanum* and *Saurauia* sp., and the tree fern *Alsophila salvinii* (Reyna Vásquez 1979). The shrub forest above 2350 m has a canopy of about 6 m, comprised of six species of the family Ericaceae (Reyna Vásquez 1979). The dominant trees in the pine-oak forest are *Pinus oocarpa*, *Quercus eschineris*, *Quercus tristis*, *Diphysa robinioides*, and *Perymenium grande* (Heriberto Lima, pers. com.). There are patches of mostly pine, and also mostly oak where both of the *Quercus* spp. dominate. In the shrubby underbrush, a species of *Agave* with leaves up to 2 m long is common.

The base of operations for field work was the Cabaña Científica (1900 m, 14°23'N, 89°22'W), a four-room log cabin at Los Planes de Montecristo ("Los Planes"), a recreational area with picnic areas, campgrounds, and extensive flower gardens. Around Los Planes, windbreaks and older plantations of Mexican cypress were probably planted well before 1950.

METHODS

Relative abundances of birds were estimated during June and July 1999, using three sampling methods: intensive searches with standardized durations, fixed-radius point counts, and mist-netting. I also recorded birds casually in the area of Los Planes de Montecristo on 15–17 June, 22–23 June, 27 June, 20–21 July, and 27 July. I observed birds near the park entrance, altitude 800 m, briefly while entering or leaving the park. Documentary photographs are on-line at http://nhm.ku.edu/komar and have been deposited at the Academy of Natural Sciences in Philadelphia, Pennsylvania (accession numbers v06/40/001–020).

Intensive searches. I conducted 4 h (06:00 to 10:00 CST) surveys on seven days in cloud forest (during 16–26 June 1999), five days in humid pine-oak forest (during 22–31 July 1999), and four days in plantations of Mexican cypress (during 20–29 July 1999). Surveys consisted of walking slowly through the habitat, mostly along trails or roads but also off trails, and stopping frequently for periods of 10 min. Only in cloud forest did I visit some areas twice. All birds heard and seen were noted, unless flying over and not evidently using the habitat. The dawn chorus began at 05:05; sunrise was at 05:30. Sampling began after the dawn chorus had subsided, to avoid bias in detection probability caused by increased singing during the chorus.

To avoid considering migrant or vagrant species as part of the community of breeding birds, I defined members of the breeding communities as those that regularly breed or are presumed to breed in their respective habitats, and refer to such species as "core" species. Species detected casually and only outside of intensive searches were conservatively considered non-core species, for comparison purposes. All species detected by the intensive searches were assumed to be core species, since even species detected only once were also observed during casual observa-

tions or mist-netting, and did not appear to be vagrants I conservatively considered additional species reported by earlier studies (mostly opportunistic observations) to be non-core species, except when nesting was reported.

Standardized point counts. I estimated densities of bird populations as an index of relative abundance, using the fixed-radius point count method (Hutto *et al.* 1986). Points were located at 100 m intervals along transects chosen arbitrarily so as to be representative of the major part of each habitat sampled, and visited during the intensive searches described above. Thus the data collected at points form part of the data for intensive searches. I visited points once, and recorded all birds seen or heard within a 25 m radius during 10 minutes. The point count method assumes that all birds detected were present at a single moment in time, and therefore species recorded as a result of moving into the count circle during the count inflate density estimates. This bias can be reduced by using shorter count durations, but low detectability in tropical forests due to infrequent singing (author's unpubl. data) necessitate longer durations. Ten-minute durations have been used widely in the tropics. These biases cause density estimates (or other measures of relative abundance) to be overestimated in some species and underestimated in others.

For density estimates, I assumed that a single individual recorded at a point represented a breeding pair, and that additional individuals recorded were members of the same pair or family unit, a conservative assumption. Thus the units for density are pairs ha^{-1}, and the estimated density of a given species in a given habitat is the number of counts (points) where the species was detected in the given habitat, divided by the sum of the areas surveyed. The estimated density for all birds in a given habitat is the sum of individual densities. The circle surveyed around each point (radius 25 m) measures 0.196 ha. I visited 51 points in cloud forest (10.0 ha), 52 points in pine-oak forest (10.192 ha), and 39 points in cypress plantations (7.644 ha). The statistical significance of differences in densities was calculated for species recorded at four or more points, using the presence-absence data for each point, and 3 × 1 contingency tables (chi-square test). Apparent differences in estimated density should be interpreted with caution, because they may reflect differences in detectability and not density. Because different habitats were sampled at slightly different times of year, detectability of birds may have differed among habitats (Komar 1995).

Captures with mist nets. Field assistants and I captured under-story birds with mist nets in cloud forest, pine-oak forest, and cypress plantation, using 9–12 nets per day, opened for 6.5 h per day weather permitting, from 05:30 until 12:00. The nets measured 12 × 2.5 m, with 36 mm mesh. Nets were placed in lines along narrow roads and trails, with breaks of 25 to 50 m between each pair of nets. I combined mist-netting results from February and March, 1999 (W. Rodríguez, unpubl. data) with those from June and July 1999, to present relative capture frequencies for all birds (very few migratory birds were captured during the earlier period when Nearctic migrants were present). In cloud forest, nets were operated for 716 net-h during 18–19 February (100 net-h), 4 and 10–11 March (154 net-h), and 16–18 and 23–26 June (462 net-h). In pine-oak forest, nets were operated for 597 net-h during 11–12 February (82 net-h), 22 and 27 June (132 net-h), and 20, 22–23, and 27–30 July (383 net-h). Distribution of mist-netting effort in pine-oak forest was biased towards the upper ele-

TABLE 1. Mean number of birds detected per 4-h observation periods and captured per mist-netting hour, by habitat.

Species	Cloud forest		Pine-oak forest		Cypress plantations	
	Detected (n = 7)[1]	Captured (n = 716)[2]	Detected (n = 5)[1]	Captured (n = 597)[2]	Detected (n = 4)[1]	Captured (n = 216)[2]
Thicket Tinamou (*Crypturellus cinnamomeus*)			0.6			
Black Vulture (*Coragyps atratus*)			1.0			
Turkey Vulture (*Cathartes aura*)			0.6			
Zone-tailed Hawk (*Buteo albonotatus*)			0.2			
Red-tailed Hawk (*Buteo jamaicensis*)			0.2			
Barred Forest-Falcon (*Micrastur ruficollis*)	0.1	0.003	0.2			
American Kestrel (*Falco sparverius tropicalis*)			0.6			
Highland Guan (*Penelopina nigra*)	0.7		1.0		0.3	
Singing Quail (*Dactylortyx thoracicus*)	0.1		1.4		0.8	
Red-billed Pigeon (*Columba flavirostris*)			0.2			
Band-tailed Pigeon (*Columba fasciata*)	1.7		1.0		1.0	
White-tipped Dove (*Leptotila verreauxi*)			2.8	0.002		
White-faced Quail-Dove (*Geotrygon albifacies*)	2.1	0.001			0.8	
Squirrel Cuckoo (*Piaya cayana*)			1.4		0.3	
Fulvous Owl (*Strix fulvescens*)	0.1					
Chestnut-collared Swift (*Streptoprocne rutila*)			0.6			
Lesser Swallow-tailed Swift (*Panyptila cayennensis*)			0.4			
Violet Sabrewing (*Campylopterus hemileucurus*)		0.001	0.2		0.3	
Green Violet-ear (*Colibri thalassinus*)			0.2	0.005		0.005
White-eared Hummingbird (*Hylocharis leucotis*)			1.4	0.012		0.005
Azure-crowned Hummingbird (*Amazilia cyanocephala*)			1.0	0.018		
Berylline Hummingbird (*Amazilia beryllina*)				0.002		
Green-throated Mountain-gem (*Lampornis viridipallens*)	0.4	0.013	0.6	0.007		0.009
Amethyst-throated Hummingbird (*Lampornis amethystinus*)	1.7	0.029		0.010	0.3	0.014
Garnet-throated Hummingbird (*Lamprolaima rhami*)	1.3	0.006				
Magnificent Hummingbird (*Eugenes fulgens*)						0.005
Sparkling-tailed Hummingbird (*Tilmatura dupontii*)			0.2			

TABLE 1. Continued.

Species	Cloud forest		Pine-oak forest		Cypress plantations	
	Detected (n = 7)[1]	Captured (n = 716)[2]	Detected (n = 5)[1]	Captured (n = 597)[2]	Detected (n = 4)[1]	Captured (n = 216)[2]
Violaceous Trogon (*Trogon violaceus*)			0.4			
Collared Trogon (*Trogon collaris*)	1.1		2.4		1.8	
Resplendent Quetzal (*Pharomachrus mocinno*)	1.4					
Blue-throated Motmot (*Aspatha gularis*)	2.4		1.0	0.002	1.0	0.005
Blue-crowned Motmot (*Momotus momota*)			2.2			
Emerald Toucanet (*Aulacorhynchus prasinus*)	2.1		1.8			
Acorn Woodpecker (*Melanerpes formicivorus*)			2.0	0.002		
Golden-fronted Woodpecker (*Melanerpes aurifrons*)			0.4			
Golden-olive Woodpecker (*Piculus rubiginosus*)	0.3		3.6		1.5	
Northern Flicker (*Colaptes auratus*)			2.4		0.5	
Scaly-throated Foliage-gleaner (*Anabacerthia variegaticeps*)	0.4					
Ruddy Foliage-gleaner (*Automolus rubiginosus*)	0.9					
Tawny-throated Leaftosser (*Sclerurus mexicanus*)	0.7					
Ruddy Woodcreeper (*Dendrocincla homochroa*)		0.001				
Ivory-billed Woodcreeper (*Xiphorhynchus flavigaster*)			3.8		0.5	
Spot-crowned Woodcreeper (*Lepidocolaptes affinis*)	2.7	0.004	2.0		2.5	
Barred Antshrike (*Thamnophilus doliatus*)			0.2			
Mountain Elaenia (*Elaenia frantzii*)	5.6		0.4	0.012	9.5	
Yellow-olive Flycatcher (*Tolmomyias sulphurescens*)			0.4			
Greater Pewee (*Contopus pertinax*)			3.2			
Yellowish Flycatcher (*Empidonax flavescens*)	9.6	0.007	2.2	0.008	1.0	0.005
Dusky-capped Flycatcher (*Myiarchus tuberculifer*)			3.4			
Boat-billed Flycatcher (*Megarynchus pitangua*)			0.4			
Brown-capped Vireo (*Vireo leucophrys*)	2.1		0.4			
Rufous-browed Peppershrike (*Cyclarhis gujanensis*)			2.4			

TABLE 1. Continued.

Species	Cloud forest		Pine-oak forest		Cypress plantations	
	Detected (n = 7)[1]	Captured (n = 716)[2]	Detected (n = 5)[1]	Captured (n = 597)[2]	Detected (n = 4)[1]	Captured (n = 216)[2]
Bushy-crested Jay (*Cyanocorax melanocyaneus*)			11.8	0.002	8.0	
Black-throated Jay (*Cyanolyca pumilo*)	0.4					
Unicolored Jay (*Aphelocoma unicolor*)	0.3					
Black-capped Swallow (*Notiochelidon pileata*)	0.1	0.003	6.4			
Brown Creeper (*Certhia americana*)			0.6			
Band-backed Wren (*Campylorhynchus zonatus*)			1.0			
Rufous-and-white Wren (*Thryothorus rufalbus)*			1.8			
Plain Wren (*Thryothorus modestus*)			6.2	0.003	1.5	0.005
House Wren (*Troglodytes aedon*)			1.8		1.3	0.009
Rufous-browed Wren (*Troglodytes rufociliatus*)	7.7					
Gray-breasted Wood-Wren (*Henicorhina leucophrys*)	10.3	0.013				
Eastern Bluebird (*Sialia sialis*)			1.0			
Brown-backed Solitaire (*Myadestes occidentalis)*			10.0	0.02	11.5	0.005
Slate-colored Solitaire (*Myadestes unicolor*)	17.9	0.015		0.008	1.8	
Orange-billed Nightingale-Thrush (*Catharus aurantiirostris*)			3.0		0.8	0.005
Ruddy-capped Nightingale-Thrush (*Catharus frantzii*)	9.7	0.053	0.4	0.007	2.3	0.046
Spotted Nightingale-Thrush (*Catharus dryas*)	7.1	0.025		0.002	1.5	
Swainson's Thrush (*Catharus ustulatus*)*				0.007		0.005
Black Robin (*Turdus infuscatus*)	8.3		0.2	0.003	10.0	0.005
Mountain Robin (*Turdus plebejus*)	0.7	0.003				
Clay-colored Robin (*Turdus grayi*)			1.4			
Rufous-collared Robin (*Turdus rufitorques*)					6.3	
Blue-and-white Mockingbird (*Melanotis hypoleucus*)			0.4		1.3	
Olive Warbler (*Peucedramus taeniatus*)			1.4		0.5	
Crescent-chested Warbler (*Parula superciliosa*)	0.7		3.2		2.8	
Black-throated Green Warbler (*Dendroica virens*)*				0.002		
Grace's Warbler (*Dendroica graciae*)			3.6			
Ovenbird (*Seiurus aurocapillus*)*				0.003		0.009

TABLE 1. Continued.

Species	Cloud forest		Pine-oak forest		Cypress plantations	
	Detected (n = 7)[1]	Captured (n = 716)[2]	Detected (n = 5)[1]	Captured (n = 597)[2]	Detected (n = 4)[1]	Captured (n = 216)[2]
MacGillivray's Warbler (*Oporornis tolmiei*)*						0.009
Wilson's Warbler (*Wilsonia pusilla*)*				0.003		0.019
Painted Redstart (*Myioborus pictus*)			2.0			
Slate-throated Redstart (*Myioborus miniatus*)		0.001	4.8	0.008	2.3	0.005
Rufous-capped Warbler (*Basileuterus rufifrons*)			1.0	0.002		
Golden-browed Warbler (*Basileuterus belli*)	5.0	0.054				0.009
Common Bush-Tanager (*Chlorospingus ophthalmicus*)	21.1	0.029		0.028	1.5	0.023
Flame-colored Tanager (*Piranga bidentata*)	0.3		7.6		7.0	
Slaty Finch (*Haplospiza rustica*)		0.001				
Cinnamon-bellied Flower-piercer (*Diglossa baritula*)	0.6					
White-naped Brush-Finch (*Atlapetes albinucha*)		0.001	0.4	0.007	0.5	0.009
Chestnut-capped Brush-Finch (*Buarremon brunneinucha*)	4.1	0.022	2.2	0.018	4.0	0.037
Rose-breasted Grosbeak (*Pheucticus ludovicianus*)*		0.001				
Black-vented Oriole (*Icterus wagleri*)					0.8	
Yellow-backed Oriole (*Icterus chrysater*)			6.0	0.003		
Black-headed Siskin (*Carduelis notata*)			2.8	0.002		
Lesser Goldfinch (*Carduelis psaltria*)			0.8			
Hooded Grosbeak (*Coccothraustes abeillei*)			0.6		2.8	
Subtotal identified	132.3		133.2		89.8	
Unidentified	9.6		11.2		5.5	
Total	141.9	0.289	144.4	0.208	95.3	0.245

*Nearctic migrant, captured in February or March.
[1]n = number of 4-h observation periods.
[2]n = number of mist-netting hours.

vations, where the forest begins a transition toward cloud forest. In cypress plantation, nets were operated for 216 net-h (4 February, 50 net-h; 12 March, 40 net-h; 15 June, 60 net-h; and 21 July, 66 net-h). The selection of net sites in cypress plantation was biased toward sites with extensive undergrowth, frequently at the edge of a plantation, or in narrow borders between plantations. However, the major part of these plantations had minimal undergrowth not conducive to mist-netting. Since the netting sites were not typical of the

TABLE 2. Bird species diversity by habitat at Montecristo National Park.

	Pine-oak forest	Cloud forest	Cypress plantation	Tropical semi-deciduous forest
Total species	166	73	57	87
Species richness with equal effort (16 h observed)	64	34	35	N/A
Core resident species	70	43	35	N/A
Abundant residents[1]	6	10	6	N/A
Common residents[2]	35	11	17	N/A
Uncommon residents[3]	29	14	12	N/A
Rare residents[4]	N/A[5]	8	N/A	N/A
Regional endemic resident species	10	9	6	2

[1]Abundant: average individuals detected per observation period (4 h) = ≥ 5.
[2]Common: average ≥ 1 and < 5.
[3]Uncommon: average ≥ 0.2 and < 1.
[4]Rare: average < 0.2.
[5]No species in pine-oak forest or cypress plantation could be classified as rare because of fewer than six sampling periods.

overall habitat, results of mist-netting in cypress plantations should not be considered as .representative of the understory bird community in that habitat.

RESULTS

The breeding season inventory recorded 115 species of birds. Intensive searches provided relative abundance information for more species (88) than other methods. Mist-netting revealed secretive species that may have been more common than observations indicated but captured only 38 species (Table 1), of which one – Slaty Finch (*Haplospiza rustica*) – was never otherwise detected, and two others – Berylline Hummingbird (*Amazilia beryllina*) and Magnificent Hummingbird (*Eugenes fulgens*) – were only detected casually. Twenty-four species were only detected during casual observations. Six species were recorded for the first time in the park, and the park bird list, including species reported from a variety of earlier sources (cited earlier), now reaches 233 (Komar 2000).

Species diversity in three habitats, and completeness of the inventory. Pine-oak forest was the most species-rich habitat, followed by tropical semi-deciduous forest, then cloud forest, then cypress plantation (Table 2). Six of seven popular diversity indices (Magurran 1988) concurred that pine-oak forest was more diverse than cloud forest and cypress plantation. The tropical semi-deciduous forest, not included in this study, will not be treated further in this paper. Bird abundances for cloud forest, pine-oak forest, and cypress plantation are given in Table 1.

The species accumulation curves for the intensive search method and mist-net captures nearly reached asymptotes for the inventory work in cloud forest, suggesting that the inventory for that habitat is relatively complete (Fig. 2). The accumulation curves for pine-oak forest and cypress plantation were still rising at he end of field work, however, indicating that the inventories for these habitats are still far from complete (Fig. 2).

The fixed-radius point counts permitted estimates of density, as an index of relative

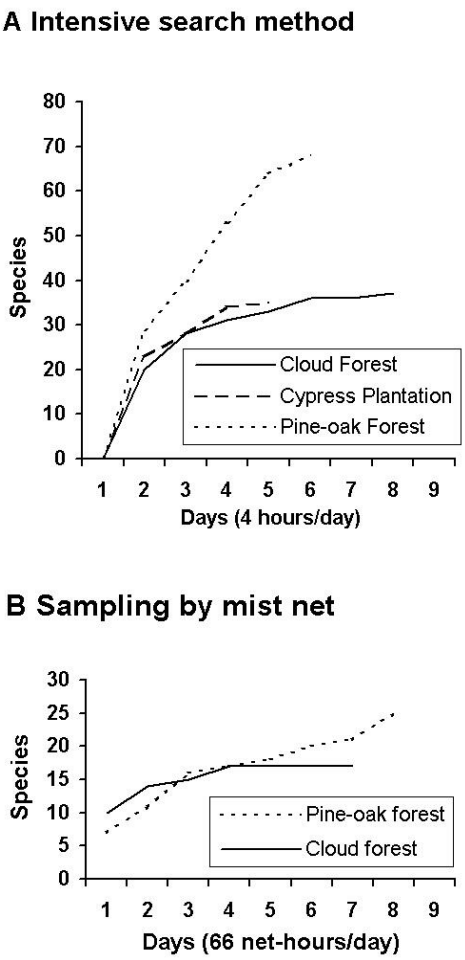

FIG. 2. Accumulation curves for the bird inventory at Montecristo National Park, El Salvador, in 1999 show that (A) the intensive search method detected most species in cloud forest, but sampling was incomplete in cypress plantations and in pine-oak forest; (B) mist-net sampling of birds was relatively complete in cloud forest, and incomplete in pine-oak forest.

abundance, for species that were relatively common. I compared estimated densities among habitatst for 26 species that were detected within the fixed radius at four or more points (Table 3). Seventeen species showed statistically significant differences. Eleven species were more abundant in cloud forest; five species were more abundant in pine-oak forest. One species, Black Robin (*Turdus infuscatus*), was abundant in cloud forest and cypress plantations (no significant difference between those two habitats), while being virtually absent in pine-oak forest. The density estimates may be biased by differences in song behavior and detectability related to time of year (Komar 1995) and to habitat. Sampling of cloud forest was completed in June, while sampling of the other two habitats was completed one month later. June sampling would be expected to increase the overall bird density estimates because of more frequent song activity.

Intensive searching was statistically less powerful than fixed-radius point counts, given smaller sample sizes, but detected far more birds and more species. Some species, probably among the rarest encountered, were only observed outside of standardized sampling. I summarize such observations in Table 4.

The most frequently detected species (recorded more than five times per 4 h observation) in each major habitat's bird community (Table 1) are presented here in order of frequency of detection. For cloud forest they were: Common Bush-Tanager (*Chlorospingus ophthalmicus*), Slate-colored Solitaire (*Myadestes unicolor*), Gray-breasted Wood-Wren (*Henicorhina leucophrys*), Ruddy-capped Nightingale-Thrush (*Catharus frantzii*), Yellowish Flycatcher (*Empidonax flavescens*), Black Robin, Rufous-browed Wren (*Troglodytes rufociliatus*), Spotted Nightingale-Thrush (*Catharus dryas*), Mountain Elaenia (*Elaenia frantzii*), and Golden-browed Warbler (*Basileuterus belli*). For pine-oak forest they were: Bushy-crested Jay (*Cyanocorax melanocyaneus*), Brown-backed Solitaire (*Myadestes occidentalis*), Flame-colored Tanager (*Piranga bidentata*), Black-capped Swallow (*Notiochelidon*

TABLE 3. Estimates of densities (pairs ha^{-1}) of birds at Montecristo National Park, El Salvador, as an index of relative abundance. The number of points (PTS) with detections is assumed to be equivalent to the number of pairs per total area sampled. Species detected at < 4 points are not presented. Significantly different densities are indicated by *. N represents the number of points used to estimate densities in each habitat. English names are given in Table 1.

Species	Cloud forest (n = 51)		Pine-oak forest (n = 52)		Cypress plantation (n = 39)		χ^2	*P*
	PTS	Density ± SD	PTS	Density ± SD	PTS	Density ± SD		
Hylocharis leucotis			4	0.39 ± 0.03			7.124	0.028*
Lampornis viridipallens	1	0.10 ± 0.01	3	0.29 ± 0.02			2.923	0.232
Lampornis amethystinus	6	0.60 ± 0.03			1	0.13 ± 0.02	8.246	0.016*
Lamprolaima rhami	4	0.40 ± 0.03					7.344	0.025*
Colaptes auratus			3	0.29 ± 0.02	1	0.13 ± 0.02	3.143	0.208
Lepidocolaptes affinis	4	0.40 ± 0.03	3	0.29 ± 0.02	2	0.26 ± 0.03	0.319	0.853
Elaenia frantzii	14	1.40 ± 0.05			8	1.05 ± 0.05	15.85	0.001*
Empidonax flavescens	16	1.60 ± 0.05	4	0.39 ± 0.03			20.75	0.001*
Vireo leucophrys	3	0.30 ± 0.02	2	0.20 ± 0.02			2.277	0.320
Cyanocorax melanocyaneus			8	0.78 ± 0.04	2	0.26 ± 0.03	9.61	0.008*
Notiochelidon pileata			7	0.69 ± 0.03			12.74	0.002*
Troglodytes rufociliatus	11	1.10 ± 0.04					21.28	0.001*
Henicorhina leucophrys	9	0.90 ± 0.04					17.15	0.001*
Myadestes occidentalis			5	0.49 ± 0.03	3	0.39 ± 0.04	4.906	0.086
Myadestes unicolor	24	2.40 ± 0.05					51.53	0.001*
Catharus frantzii	14	1.40 ± 0.05			1	0.13 ± 0.02	24.18	0.001*
Catharus dryas	9	0.90 ± 0.04			1	0.13 ± 0.02	13.9	0.001*
Turdus infuscatus	8	0.80 ± 0.04			8	1.05 ± 0.05	9.81	0.007*
Peucedramus taeniatus			4	0.39 ± 0.03	1	0.13 ± 0.02	4.63	0.099
Parula superciliosa	3	0.30 ± 0.02	3	0.29 ± 0.02	2	0.26 ± 0.03	0.026	0.987
Myioborus miniatus			8	0.78 ± 0.04	2	0.26 ± 0.03	9.61	0.008*
Basileuterus belli	8	0.80 ± 0.04					15.13	0.001*
Chlorospingus ophthalmicus	37	3.70 ± 0.05			1	0.13 ± 0.02	85.21	0.001*
Piranga bidentata			2	0.20 ± 0.02	3	0.39 ± 0.04	2.349	0.309
Buarremon brunneinucha	4	0.40 ± 0.03	3	0.29 ± 0.02	4	0.52 ± 0.04	0.319	0.853
Icterus chrysater			5	0.49 ± 0.03			8.97	0.011*

pileata), Plain Wren (*Thryothorus modestus*), and Yellow-backed Oriole (*Icterus chrysater*). For cypress plantations, they were: Brown-backed Solitaire, Black Robin, Mountain Elaenia, Bushy-crested Jay, Flame-colored Tanager, and Rufous-collared Robin (*Turdus rufitorques*).

Species accounts. The following section includes natural history observations, movements derived from netting recaptures, and new species reported for El Salvador. Abundance information contained in tables and appendices is not repeated here. A complete list of all species recorded at Montecristo National Park is given elsewhere (Komar 2000). I report movements (or lack thereof) for White-naped Brush-Finch (*Atlapetes albinucha*), Golden-browed Warbler, Ruddy-capped Nightingale-Thrush, Spotted Nightingale-Thrush, Plain Wren, and Brown-backed

TABLE 4. Species observed during casual observations in 1999, but not during standardized sampling.

Habitats	Species	Dates	Notes
Cloud forest	Black Vulture (*Coragyps atratus*)	26 June	Flying over
Pine-oak forest	King Vulture (*Sarcoramphus papa*)	23 July	Adult flying over, 1500 m
	Solitary Eagle (*Harpyhaliaetus solitarius*)	29 July	Observed by R. Ibarra
	Short-tailed Hawk (*Buteo brachyurus*)	24 June	Los Planes
	Collared Forest-Falcon (*Micrastur semitorquatus*)	24 June	Los Planes
	Buffy-crowned Wood-Partridge (*Dendrortyx leucophrys*)	29 July	Observed by R. Ibarra
	White-faced Quail-Dove (*Geotrygon albifacies*)	23 June; 21, 23 July	
	Mottled Owl (*Ciccaba virgata*)	15-16, 23-24 June	Los Planes
	Chestnut-collared Swift (*Streptoprocne rutila*)	23 and 27 July	Flocks of 10 and 20 birds
	Vaux's Swift (*Chaetura vauxi*)	16 June	Los Planes
	Amethyst-throated Hummingbird (*Lampornis amethystinus*)	21 July	Los Planes
	Turquoise-browed Motmot (*Eumomota superciliosa*)	30 July	In coffee plantation (R. Ibarra)
	Tufted Flycatcher (*Mitrephanes phaeocercus*)	22 July	Observed by R. Ibarra and W. Rodríguez
	Social Flycatcher (*Myiozetetes similis*)	30 July	Around 1450 m
	Black-and-white Warbler (*Mniotilta varia*)	29 July	Observed by R. Ibarra
	Bar-winged Oriole (*Icterus maculialatus*)	30 July	In coffee plantation (R. Ibarra)
	Yellow-billed Cacique (*Amblycercus holosericeus*)	16 June	
Cypress plantation	Zone-tailed Hawk (*Buteo albonotatus*)	30 July	Flying over
	Chestnut-collared Swift (*Streptoprocne rutila*)	30 July	Flying over
	Vaux's Swift (*Chaetura vauxi*)	30 July	Flying over
	Azure-crowned Hummingbird (*Amazilia cyanocephala*)	28-29 July	Foraging in cypress tree, 1900 m
	Blue-crowned Chlorophonia (*Chlorophonia occipitalis*)	22 June	Flock of 7 at Los Planes
Tropical semi-deciduous forest	Great Kiskadee (*Pitangus sulphuratus*)	26 July	Park entrance
	White-throated Magpie-Jay (*Calocitta formosa*)	26 July	Park entrance
	Rufous-naped Wren (*Campylorhynchus rufinucha*)	26 July	Park entrance
	Scrub Euphonia (*Euphonia affinis*)	26 July	Park entrance
	Grayish Saltator (*Saltator coerulescens*)	26 July	Park entrance
	Black-headed Saltator (*Saltator atriceps*)	26 July	Park entrance
	Melodious Blackbird (*Dives dives*)	26 July	Park entrance
Non-forested areas	White-winged Dove (*Zenaida asiatica*)	15-16, 27 June	Los Planes
	Yellow-faced Grassquit (*Tiaris olivacea*)	15, 22, 27 June	Los Planes

Solitaire. I present breeding information for 26 species. Breeding was reported elsewhere for Collared Trogon (*Trogon collaris*) and Resplendent Quetzal (*Pharomachrus mocinno*, Thurber *et al.* 1987), Slate-throated Redstart (*Myioborus miniatus*, Thurber 1978), and Black-vented Oriole (*Icterus wagleri*, Komar *et al.* 2000). "Reproductive condition" refers to developed brood patches and/or swollen cloacal protuberances. Taxonomy follows the American Ornithologists' Union (1998). New species reported for El Salvador, with respect to the list published by Komar (1998), are indicated with an asterisk (*).

King Vulture (Sarcoramphus papa). An adult flew across the park on 23 July, in the pine-oak zone between 1450–1550 m. Park guards occasionally see the "Rey Zope" but say it does not nest in the park.

Solitary Eagle (Harpyhaliaetus solitarius). W. Rodríguez and R. Ibarra (unpubl. data) observed a pair calling and taking turns landing on 12 February 1999 and again on 19 March in pine-oak forest between 1200–1300 m. They thought the birds may have been breeding, but could not confirm a nest. R. Ibarra observed one nearby on 29 July, flying low over pine-oak forest at 1490 m.

Highland Guan (Penelopina nigra). Park guards regularly encounter this species from about 1200 m (near the village of Las Majaditas) upwards into the cloud forest. The *Penelopina* vocalized frequently throughout June and July. A nest was found in March 1999 in cloud forest, in a tree known locally as Chemís (Juan José Aldana, pers. com.). On 17 June a family group included the adults and one young male that appeared full-grown but was brown with some black feathers. On 21 July, I found a female sitting on a nest at about 1910 m, in a patch of very old cypress trees that were natural (E. Ramos, pers. com.). The nest tree was 20 m from a small (25 m across) marshy pond. A brook that fed the pond ran almost directly below the nest. The female did not leave the nest during our visit. The nest was in a cypress tree, on a horizontal branch, 3 m from its terminus and 4.5 m from the trunk, 10 m above the ground. The tree itself was only about 15 m tall, but its base was right next to a much larger cypress tree about 35 m tall. The understory of the forest was dense with shrubbery less than 2 m high, and a middle stratus of trees 8–12 m tall. The nest was ~60 cm in diameter and ~40 cm deep, made of fine cypress branches, pine needles, and a large green moss. E. Ramos had encountered three nests of this guan since 1974, twice in forks of branches of large oaks in cloud forest, and once in a tree fern in cloud forest. On 30 July, I saw a female with a ¾ grown juvenile that had blackish wings and a darker tail (male?), in a natural cypress grove at about 1800 m, east of Los Planes.

Band-tailed Pigeon (Columba fasciata). A nest was being built in a tall cypress tree adjacent to the Cabaña Científica (1900 m) on 21–22 June. On 25 June, one or more pigeons were making long circular flights, presumably as part of courtship, above the cloud forest (2300 m). I found broken egg shells, confirmed of this species by E. Ramos, in cypress plantation on 21 July at 1880 m. A pigeon was singing from the tree above.

Berylline Hummingbird (Amazilia beryllina). N. Herrera (pers. com.) found a nest of this species at Los Planes in April 1997.

Green-throated Mountain-gem (Lampornis viridipallens). The lowest encounter of this species was at 1450 m, on 30 July in open pine forest.

Amethyst-throated Hummingbird (Lampornis amethystinus). W. Rodríguez observed a male

carrying nest material in its beak on 16 June, in cloud forest.

Garnet-throated Hummingbird (Lamprolaima rhami). A female carried material to a nest in cloud forest, and tightly guarded the site along the edge of the road, harassing me as I walked by, on 17 June. One week later (24 June), the nest was a deep cup of mosses and fine fibers, measuring 9 cm from top to bottom. It hung from roots under an overhanging bank in the road cut.

Magnificent Hummingbird (Eugenes fulgens). A male was seen at Santos Martínez's garden throughout June and July, possibly the same individual that occasionally flew through the flower gardens below the Cabaña Científica. Despite frequent sightings, the species may be rare (captured just once, not recorded during censuses).

**Broad-tailed Hummingbird* (Selasphorus platycercus). Although not recorded during the breeding season inventory, two females were reported by R. Ibarra (unpubl. data) on 19 March 1999, at a small shade coffee plantation near 1300 m. The species was also found on 4 June 1998, by Ibarra and N. Herrera (unpubl. data), at Hotel La Palma, La Palma, Chalatenango.

Blue-throated Motmot (Aspatha gularis). Birds with brood patches were captured in cypress plantation on 15 June, and in pine-oak forest on 22 July. The typical call of this species, heard frequently in those habitats and in cloud forest, is a long series of ringing hoots. On 17 June, one constantly repeated a squirrel-like scolding call. On 28 July, two birds were duetting in pine-oak forest, at about 1650 m.

Acorn Woodpecker (Melanerpes formicivorus). Mist-nets captured a juvenile on 30 July near the fire tower at 1400 m. In the same area on 31 July, R. Ibarra observed a nestling peeking out of a hole 10 m high in a pine tree.

Northern Flicker (Colaptes auratus). Hamel (unpubl. report) observed flickers nesting in a windbreak of mature cypress trees at Los Planes de Montecristo during the summer of 1974. Birds were present in 1999 but nesting was not detected.

**Tawny-throated Leaftosser* (Sclerurus mexicanus). I detected this bird in June, by sight and vocalizations, six times in cloud forest, 2050–2350 m. W. Rodríguez also saw one at the edge between cypress plantation and brushy secondary scrub, about 100 m from cloud forest. The species was first detected at Montecristo (and in El Salvador) on 11 June 1998, when one flew into a mist net in the cloud forest (Herrera *et al.* 1998), and R. Rivera (pers. com.) photographed one at night roosting on the road bank.

Spot-crowned Woodcreeper (Lepidocolaptes affinis). On 23 June, an adult with receding brood patch and a juvenile with a not-yet fully-grown bill (presumably a mother with her young) were captured in the same net, in cloud forest (photo v06/40/004).

Mountain Elaenia (Elaenia frantzii). Females with brood patches were caught in the upper pine-oak forest (1930 m) on 20 July.

Yellowish Flycatcher (Empidonax flavescens). An adult with brood patch was captured in pine-oak forest (1900 m) on 22 June.

Bushy-crested Jay (Cyanocorax melanocyaneus). At Los Planes, a family group had five recently-fledged juveniles on 15 June. One adult had three white head feathers. The largest group observed was 22 birds in cypress trees below the Cabaña Científica on 29 July.

Black-capped Swallow (Notiochelidon pileata). Nest holes were present in the road cut throughout the upper parts of the pine-oak zone of the park. Swallows flew into nest holes on 18 June at 1750 m, and on 28 July at 1825 m. A pair was nesting in the road cut in cloud forest, around 2250 m. We captured the pair on 16 June; one had a brood patch. Thurber *et al.* (1987) reported nesting in the park in May and June, 1973. Swallows were common around 1500 m during July. On 22 July, an aggregation of 20 perched in an old pine tree near km 16. During the non-breeding season, swallows probably wander to lower elevations. I noted six below 900 m on 20 February 1991, inside the park.

Band-backed Wren (Campylorhynchus zonatus). On 15 June, a family group at Los Planes included four birds in adult plumage and one fledged juvenile. On 20 July, a group in the same place included four juveniles. W. Rodríguez and R. Ibarra saw an adult carry mosses to a nest on 22 July, at the edge of the orchid garden parking lot. On 30 July, I noted the domed nest was built over a fork on the lowest branch of a Mexican cypress, 4.5 m above the ground, 1.5 m in from the tip of the horizontal branch, and 6 m out from the trunk. The nest shape was somewhat flattened and oval (longer than wide), with the entrance in the middle of the narrow end, measuring approx. 20 cm × 15 cm × 10 cm ($l \times w \times h$).

Plain Wren (Thryothorus modestus). One banded in 1996 by J. P. Domínguez (yellow leg band number 282) was recaptured (near the Cabaña Científica) on 20 July 1999.

Rufous-browed Wren (Troglodytes rufociliatus). This species was much less frequently detected at Montecristo than at the Santa Ana Volcano cloud forest (unpubl. data). In Montecristo, the species lives among epiphytes (I observed one singing from 18 m above ground). The forest floor niche, where the species was abundant on the Santa Ana volcano, appeared to be occupied exclusively at Montecristo by the Gray-breasted Wood-Wren, a species absent from the volcano.

Gray-breasted Wood-Wren (Henicorhina leucophrys). On 17 June, in cloud forest, I observed a nest with young, in tangled branches 4 m above the road, but just 1.5 m from the hillside. The same day, an adult with brood patch was captured. Thurber *et al.* (1987) reported finding nests in the cloud forest during May and June, 1974 and 1975, and determined that one pair's territory measured approximately 32 × 20 m, and was bounded by three other territories. If that territory size was typical, it suggests a density of 15.6 pairs ha^{-1}, much higher than the estimate of 0.9 ± 0.04 pairs ha^{-1} generated by point-count data (Table 3). If the wrens vocalized infrequently during my survey, then detection probability would have been low, and the resulting density estimate could be far below the true density.

**Brown Creeper* (Certhia americana). One was singing on 30 July in open pine woods at 1450 m on the top of a ridge about 300 m north of the fire tower. I photographed one (Photo v06/40/007) and heard two at the same place on 31 July. Three park guards with 25 years' experience in the park were not previously familiar with the species. The habitat was an open grove of pine trees about 25 m tall and > 40 years old. Although reported for El Salvador by Thurber *et al.* (1987), the location of that 1973 record now pertains to Honduras.

Eastern Bluebird (Sialia sialis). In 1974, P. Hamel (unpubl. report) observed adults with fledged young near 1400 m, in open pine woods. W. Rodríguez (unpubl. data) found a pair nesting in almost the same place in 1998.

Birds were present in 1999, although nesting was not detected.

Brown-backed Solitaire (Myadestes occidentalis). This species was an abundant nester in the earthen road cut throughout the pine-oak and cypress forest zone. The lower distribution limit, according to park guards, is around 900 m. On 23 June, three nests had three eggs and another had two nestlings. On 21 July, a nest constructed of only dry pine needles contained one egg. Another that day, constructed of mosses and dried earth, contained two nestlings. On 29 July, a nest 1.3 m above the road in the bank had three eggs, and another nest with two eggs was found in the wall of a house, about 2 m above the ground. Both nests contained mostly pine needles. In pine-oak forest, we captured a female with brood patch on 22 July and a local juvenile on 23 July 1999. Two captured at Los Planes de Montecristo on 3 March 1999 were recaptured there in June 1999. I observed skylarking on one occasion (23 June 1999).

Slate-colored Solitaire (Myadestes unicolor). Adults in reproductive condition were captured on 23–25 June in cloud forest and on 20 and 27 July in the uppermost pine-oak forest (1930 m), in the zone of transition to cloud forest. Thurber (1978) reported a nest at Hacienda Montecristo on 4 May 1973. A local juvenile was captured on 25 June in cloud forest. On one occasion I observed an adult skylarking to about 8 m above the canopy (16 June). The bird flew straight up and down, singing on the way up.

Ruddy-capped Nightingale-Thrush (Catharus frantzii). Adults in reproductive condition were captured on 15–25 June (cypress plantation and cloud forest) and 21 July (cypress plantation). A recently-fledged juvenile was captured in cloud forest on 18 June. A presumed floater captured near El Trifinio on 16 June was captured about 1000 m away on 18 June. Another banded in 1996 (yellow plastic leg band number 130) by J. P. Domínguez was recaptured in nearly the same place on 23 June 1999.

Spotted Nightingale-Thrush (Catharus dryas). This species was nearly absent above 2100 m, abundant in the lower cloud forest (below 2100 m), and uncommon in upper pine-oak forest down to 1750 m. One captured on 11 March was recaptured on 24 June, having moved a few hundred meters. A presumed floater captured on 17 June was recaptured on 23 June more than 500 m away. Adults in reproductive condition were captured in cloud forest on 16–26 June. A local juvenile was captured in pine-oak forest (1930 m) on 27 July. Thurber *et al.* (1987) reported an adult with brood patch collected 15 August 1975. In El Salvador, this species has only been documented from Montecristo, but R. Ibarra (pers. com.) saw one – possibly a vagrant – at Volcán de San Vicente on 18 April 1998.

Black Robin (Turdus infuscatus). On 17 June, a female in the cloud forest was carrying food. A female with brood patch was captured on 27 July in pine-oak forest. The lowest observation of this species was one singing from a cypress plantation at about 1660 m on 23 July.

Clay-colored Robin (Turdus grayi). A nest was found at Los Planes, at 1900 m on 18 June, in a windbreak of mature cypress. A fledged juvenile was observed on 22 July. Hamel (unpubl. report) reported a nest in the same location in 1974.

Rufous-collared Robin (Turdus rufitorques). Juveniles with spotted plumage were observed near Los Planes on 15 and 22 June,

and on 20 July. On 27 June, a female visited a cypress near the Cabaña Científica with food several times, indicating a nest. Hamel (unpubl. report) found a nest in the same place in 1974.

Blue-and-white Mockingbird (Melanotis hypoleucus). On 15 June, a family group at Los Planes had two juveniles, identified by dark gray plumage with dull whitish streaks on the dark underparts and a white malar streak. I also noted breeding at Los Planes on 12 August 1995, when I found a fledgling about one day out of the nest.

Crescent-chested Warbler (Parula superciliosa). On 23 July, a flock in undergrowth of pine-oak woodland (1750 m) included at least 15 of these warblers, with many immatures begging food from females, and small numbers of Spot-crowned Woodcreeper, Mountain Elaenia, Greater Pewee (*Contopus pertinax*), Dusky-capped Flycatcher (*Myiarchus tuberculifer*), Brown-capped Vireo (*Vireo leucophrys*), Grace's Warbler (*Dendroica graciae*), and Slate-throated Redstart. The lowest Crescent-chested Warbler recorded was observed by R. Ibarra at an oak grove around 1550 m on 28 July.

**Tropical Parula* (Parula pitiayumi). Although not observed during the inventory, W. Rodríguez (pers. com.) observed three in Montecristo's cloud forest on 11 June 1998. It was first reported for El Salvador on 5 June 1998, when N. Herrera (unpubl. data) observed two at 2045 m in thickets along the road to Cerro El Pital, department of Chalatenango. R. Ibarra (unpubl. data) found another at La Montañona, Chalatenango, 11 November 1999.

Golden-browed Warbler (Basileuterus belli). Adults in reproductive condition and local juveniles were captured in cloud forest on 16–24 June. Two adults banded in March 1999 were recaptured in June 1999. One was in almost the same place, the other had moved several hundred meters.

Common Bush-Tanager (Chlorospingus ophthalmicus). In cloud forest on 16 June, an adult was feeding a fledged juvenile and another juvenile was captured in mist nets. Adults in reproductive condition were captured in cloud forest on 16–26 June, in upper pine-oak forest on 22 June, 20 and 27 July, and in cypress plantation on 15 June and 21 July. Local juveniles were captured on 22 June and 27 July in upper pine-oak forest.

**Scarlet Tanager* (Piranga olivacea). This Nearctic migrant was observed twice by R. Rivera (W. Rodríguez, pers. com.) between 12 and 15 April 1999, one near the park headquarters and the other near the village of Las Majaditas. It has not been reported previously in El Salvador.

White-winged Tanager (Piranga leucoptera). Although not recorded during this study, N. Herrera (pers. com.) recorded a nest at Los Planes in April 1997.

Blue-crowned Chlorophonia (Chlorophonia occipitalis). Usually considered a cloud forest species, the chlorophonia may be more common in the upper pine-oak forest around Los Planes than in the cloud forest. I did not find it in cloud forest, but Thurber *et al.* (1987) stated that it was "rarely seen in the cloud forest at Montecristo."

Slaty Finch (Haplospiza rustica). This species was detected just once, a male not in breeding condition, captured in a mist net (photo v06/40/005) at about 2120 m in cloud forest on 23 June. Although two were collected at Montecristo in 1975 (in July and November),

neither was reported in breeding condition (Thurber *et al.* 1987).

White-naped Brush-Finch (Atlapetes albinucha). Adults in reproductive condition and a juvenile were captured in pine-oak forest on 20–22 July. A bird marked with a colored leg band on 4 February at Los Planes was observed there again on 15 June, although it was not recaptured.

Chestnut-capped Brush-Finch (Buarremon brunneinucha). Adults in reproductive condition were captured on 15–25 June (cloud forest, pine-oak forest, and cypress plantation). Local juveniles were captured in pine-oak forest on 27 July. Thurber (1978) reported a nest at Hacienda Montecristo on 3 May 1973, containing a day-old chick.

Bar-winged Oriole (Icterus maculialatus). R. Ibarra observed an adult male on 30 July, at the edge of pine-oak forest and shaded coffee plantation at 1450 m. Two were observed on 10 June 1998 at the same locality (W. Rodríguez, unpubl. data), and N. Herrera observed one on 26 April 1995 in the park (Sector La Joya; pers. com.). These are the first records of this regional endemic species in El Salvador's northern cordillera. The species is not known from Honduras.

Black-headed Siskin (Carduelis notata). On 22 June, at Los Planes, a female was feeding a recently-fledged juvenile.

Hooded Grosbeak (Coccothraustes abeillei). This species was observed mostly in cypress plantations around Los Planes de Montecristo. It was also found lower down the slope, including at a cypress plantation around 1700 m (22 July) and in pine forest near the fire tower (1400 m, 31 July). Breeding behavior was first noted on 23 June, when a male and female were observed together at the edge of a cypress plantation at 2000 m. The female was collecting small twigs on a dirt road that separated the cypress trees from the lower edge of cloud forest. The male sat and watched from a nearby bush. On 24 June, near the Cabaña Científica, a pair was accompanied by a begging juvenile, which was fed by the male. On 27 July, nest building was observed at the Cabaña Científica, along the edge of an old (>50 years) cypress plantation. I suspect the pair was preparing to renest. On 29 July, the female was in the final stages of building the nest in a 35 m tall cypress. The nest was a cup of unknown constitution, about the size of a Clay-colored Robin nest [outside dimensions for that species' nest are given as 15.2 × 20.3 cm diameter and 10.2 cm height by Skutch (1960)]. It was nestled on top of the dense and fine outer branches of the lowest major branch of the cypress, 7 m above the ground. The dense foliage around the nest made it impossible to describe the nest more clearly. The nest was about 5 m out from the trunk and 1 m from the outermost limit of foliage. When the female visited the nest, the male perched about 5 m away. The male accompanied the female constantly, but did not directly participate in nest building. The female took the initiative in all 12 flights that I observed. This was true for four visits to the nest (the female would arrive first, followed closely by the male), for the five times I observed the pair leave the nest, and for three times I observed the pair fly among trees while away from the nest. Most grosbeaks detected during surveys were vocalizing; however, males and females collecting nesting material and nest-building were silent.

DISCUSSION

Due to lack of published site lists of birds in El Salvador and Honduras, a recent analysis of montane bird distribution in Mexico and

Central America (Hernández-Baños *et al.* 1995) used regional treatments (Monroe 1968, Thurber *et al.* 1987) to assemble a list of 173 montane forest species resident in interior Honduras and El Salvador, and predicted the presence of 10 additional bird species on geographic grounds. The present study confirms the presence of three species predicted by Hernández-Baños *et al.* (1995) to occur in the region: Blue-and-white Mockingbird (*Melanotis hypoleucus*), Rose-throated Becard (*Pachyramphus aglaiae*), and Rufous-and-white Wren (*Thryothorus rufalbus*). The becard, however, was not found above 1000 m and may not be a "montane" species in this region.

Almost half (46%) of the 233 bird species recorded for Montecristo National Park are montane forest resident species. Also present are species of open habitats and lowland areas, and 49 (21%) migratory visitors that breed in the Nearctic region. Numerous additional open area species, lowland species, and migratory species may occur. Future field work may determine that the overall species richness for the park is perhaps 275–290 species, given incomplete sampling in the park and known regional bird distributions. The most diverse forest area now recognized in El Salvador, El Imposible National Park, is more than twice as large as Montecristo, contains different habitats, and has approx. 277 species of birds (Ramírez Sosa & Komar 1996; W. Rodríguez, unpubl. data).

Threatened and endemic species. Komar (1998) classified 508 Salvadoran bird species for conservation status, finding that 254 species were threatened at the national level, including 117 in danger of extirpation in the short to medium term (due to very reduced numbers or geographic restriction to one or two small or medium-sized populations). Of those threatened species, 119 occur in Montecristo National Park, including 50 endangered species. Two new species discovered recently at the park and not included in the earlier analysis, Brown Creeper and Tawny-throated Leaftosser, meet the criteria for nationally endangered. The Hairy Woodpecker (*Picoides villosus*) and Band-backed Wren, classified as threatened, proved to be rare and probably are endangered. The woodpecker was not recorded, and perhaps is no longer present in the park. Thus, 121 (52%) of the park's birds are threatened and 54 (23%) are endangered.

The two forest corvids, Black-throated Jay (*Cyanolyca pumilo*) and Unicolored Jay (*Aphelocoma unicolor*), are probably among the rarest and most threatened birds in El Salvador, being restricted to cloud forest (in El Salvador) and seen infrequently. Another endangered corvid is the Common Raven (*Corvus corax*), which has not been recorded in the park since 1995 and may now be extirpated in El Salvador. Some of the other "endangered species," such as Amethyst-throated Hummingbird, Gray-breasted Wood-Wren, Slate-colored Solitaire, Spotted Nightingale-Thrush, and Golden-browed Warbler, are abundant in the cloud forest. These species were classified "endangered" because their habitat is endangered in El Salvador. Although these species have just one or two relatively small populations in El Salvador, they may not be threatened on a regional scale.

Ten species of birds in El Salvador are mostly restricted to Montecristo National Park, and are threatened due to reduced habitat (Table 5). Four of these species were once found in and near the cloud forests of Cerro El Pital ("Los Esesmiles" of Dickey & van Rossem 1938) in El Salvador's Chalatenango department, but were not detected there during two weeks of field work in 2001 (author's unpubl. data). Sixteen other species are known in El Salvador only from highland forests at Montecristo and Cerro El Pital. Eighteen species of birds that are endemic to the biogeographic regions of Northern Central

TABLE 5. Ten species of birds restricted in El Salvador to Montecristo National Park.

Species	Habitats (forest types)
Fulvous Owl (*Strix fulvescens*)[1]	Cloud
Blue-throated Motmot (*Aspatha gularis*)[1]	Cloud, pine-oak
Scaly-throated Foliage-gleaner (*Anabacerthia variegaticeps*)	Cloud
Ruddy Foliage-gleaner (*Automolus rubiginosus*)[1]	Cloud
Tawny-throated Leaftosser (*Sclerurus mexicanus*)	Cloud
Belted Flycatcher (*Xenotriccus callizonus*)[2]	Pine-oak
Unicolored Jay (*Aphelocoma unicolor*)[1]	Cloud
Brown Creeper (*Certhia americana*)	Pine-oak
Spotted Nightingale-Thrush (*Catharus dryas*)[3]	Cloud, pine-oak
Hooded Grosbeak (*Coccothraustes abeillei*)	Cloud, pine-oak

[1]Reported from cloud forest on Cerro El Pital, department of Chalatenango, prior to 1943 (Dickey & van Rossem 1938, Marshall 1943) but not recorded there during 2001 (author's unpubl. data).

[2]Found in 1998 in the department of Chalatenango (R. Ibarra, unpubl. data) but status or future there is not certain.

[3]A single Spotted Nightingale-Thrush was reported from the San Vicente Volcano in 1998 (R. Ibarra, unpubl. data); its status there is unknown.

America occur in El Salvador (Komar 1998). All but three are found in Montecristo National Park, and three are apparently restricted in El Salvador to the park (Table 6).

Three habitats. Bird communities of the three forest habitats surveyed differed profoundly. The present study confirms the conservation importance of the Montecristo cloud forest (Daugherty 1973). Nine regionally-endemic bird species are found there, and five bird species in El Salvador are restricted to it. Eight other bird species restricted to cloud forest are also found at Cerro El Pital, 24 km to the east, but lack adequate protection there. At least 11 bird species had significantly higher densities in the cloud forest than in any other habitat in the park. The importance of the cloud forest is apparent, despite relatively low species richness.

The study has also demonstrated the conservation importance of the park's pine-oak forest; its avifauna is largely different from that of the cloud forest. Species richness in pine-oak forest was higher than the other habitats surveyed, and the species accumulation curve was still far from reaching its asymptote (many more species can be expected). Ten regionally-endemic bird species occupy this habitat, and two bird species are known in El Salvador only from this habitat in the park (Table 5). Moreover, three other species restricted (in El Salvador) to Montecristo are residents of pine-oak forests in addition to cloud forest. At least nine bird species were significantly more abundant in pine-oak forest than in cloud forest or cypress plantation.

The artificial tree plantations within the park, such as the extensive Mexican cypress plantations, probably have little conservation value. A number of cloud forest and pine-oak forest bird species, including regionally-endemic and threatened bird species, were found in the cypress plantations, although breeding was noted for very few. A few species were detected more frequently in the plantations, e.g., Mountain Elaenia, Black Robin, Rufous-collared Robin, and Hooded Grosbeak. Nonetheless, higher densities are

TABLE 6. Fifteen of El Salvador's 18 regionally-endemic bird species live in Montecristo National Park. These species are endemic to the Northern Central America biogeographic region (Nicaraguan Depression to the Isthmus of Tehuantepec, Mexico).

Species	Distribution in El Salvador	Status in Montecristo
White-bellied Chachalaca (*Ortalis leucogastra*)	Lowlands	Reported from lower elevations in the park (J. P. Domínguez, pers. com.)
Highland Guan (*Penelopina nigra*)	Montecristo and Cerro El Pital	Common above 1200 m
Ocellated Quail (*Cyrtonyx ocellatus*)	Northern cordillera	Not recorded, but likely to occur in mid-elevation zones
Pacific Parakeet (*Aratinga strenua*)	Volcanic chain and coast	Not recorded
Fulvous Owl (*Strix fulvescens*)	Montecristo only (formerly Cerro El Pital)	Uncommon in cloud forest
Rufous Sabrewing (*Campylopterus rufus*)	Volcanic chain	Not recorded
Green-throated Mountain-gem (*Lampornis viridipallens*)	Santa Ana Volcano, Montecristo, and Cerro El Pital	Common above 1450 m
Slender Sheartail (*Doricha enicura*)	Santa Ana Volcano, Montecristo, and (formerly?) Cerro El Pital	Rare? (not recorded this study)
Wine-throated Hummingbird (*Atthis elliot*i)	Santa Ana Volcano, Montecristo, and Cerro El Pital	Rare? (not recorded this study)
Blue-throated Motmot (*Aspatha gularis*)	Montecristo only (formerly Cerro El Pital)	Common above 1600 m
Belted Flycatcher (*Xenotriccus callizonus*)	Montecristo only	Rare? (not recorded this study)
Bushy-crested Jay (*Cyanocorax melanocyaneus*)	Highlands above 900 m (also reported at sea level in Parque Nacional Deininger)	Common in pine-oak forest; absent or rare in cloud forest
Black-throated Jay (*Cyanolyca pumilo*)	Montecristo and Cerro El Pital	Uncommon or rare in cloud forest
Black-capped Swallow (*Notiochelidon pileata*)	Montecristo and Cerro El Pital	Common above 1400 m
Rufous-browed Wren (*Troglodytes rufociliatus*)	Santa Ana Volcano, Montecristo, and Cerro El Pital	Uncommon, only in cloud forest
Rufous-collared Robin (*Turdus rufitorques*)	Highlands above 1700 m	Common in open areas
Blue-and-white Mockingbird (*Melanotis hypoleucus*)	Highlands above 1600 m, occasional down to 1200 m	Common in young second growth and disturbed areas
Bar-winged Oriole (*Icterus maculialatus*)	Middle elevations, mostly on volcanic chain	Uncommon or rare in coffee plantation at 1400 m

not necessarily evidence of habitat quality (van Horne 1983). The cypress plantations seemed to be a transition zone between cloud forest and pine-oak forest, with bird species representative of both the natural forest habitats.

Species not observed and possibly locally extirpated. Only 115 bird species were detected during the study, out of 233 species reported in the park. Fifty-six species on the park's list are Nearctic migrants or vagrants, thus I detected 65% of 177 resident or potentially resident species. Some of the species not detected may have disappeared from the park in recent years. Of concern are Hairy Woodpecker, Lineated Woodpecker (*Dryocopus lineatus*), and Common Raven. Park guards recall seeing the latter two species regularly up until 1995 and not afterward (Silvestre Carranza, pers. com.). Two species reported breeding in the cloud forest by Thurber *et al.* (1987), Scaled Antpitta (*Grallaria guatimalensis*) and Eye-ringed Flatbill (*Rhynchocyclus brevirostris*), were not detected, although both species maintain populations elsewhere in El Salvador (pers. observ.). Thurber *et al.* (1987) observed "White-breasted" Hawk (*Accipiter striatus chionogaster*), the distinct resident race that is endemic to northern Central America, frequently during 1974 at Los Planes, and I observed one on 13 August 1995; none was recorded in 1999.

Three species previously fairly common around Los Planes but apparently absent during the present study were White-throated Flycatcher (*Empidonax albigularis*) and Buff-breasted Flycatcher (*Empidonax fulvifrons*) (Thurber *et al.* 1987), and Rufous-collared Sparrow (*Zonotrichia capensis*) (pers. observ.). The latter species was present in 1999 at Hacienda Montecristo, just outside the park (W. Rodríguez, pers. com.). All three species prefer open habitat, and could eventually recolonize clearings at Los Planes from habitat outside the park.

Belted Flycatcher (*Xenotriccus callizonus*) is a regional endemic species reported from just a few sites in Chiapas (Mexico), Guatemala, and from Montecristo (Hellebuyck 1983). In June 1998, R. Ibarra (unpubl. data) observed one about 30 km east of the park, near Cerro El Pital, department of Chalatenango. It is perhaps one of the rarest birds in El Salvador. My inability to find this species may have been due to lack of sufficient time spent in its oak-forest habitat, or perhaps I visited when birds were not vocalizing and were most difficult to detect. I was unable to discover if the Montecristo population persists.

I hoped to find the El Salvador Crested (Steller's) Jay (*Cyanocitta stelleri lazula*), a race restricted to highlands of northwestern El Salvador, described from the pine-oak and cloud forests of Cerro El Pital in Chalatenango by van Rossem (Dickey & van Rossem 1938). The persistence of the species in El Salvador is in question.

Comparison with El Triunfo cloud forest. Because cloud forests tend to be geographically isolated, they are home to many endemic and threatened species of birds (Long 1995). It is interesting to consider how widely distributed are bird species ecologically restricted to cloud forests. Unfortunately, bird lists for cloud forests are difficult to find in the literature. Birds of the El Triunfo cloud forest, located about 360 km to the west-northwest in Chiapas, Mexico, in a similar altitudinal range as the cloud forest at Montecristo, were inventoried by Parker *et al.* (1976) and Gómez de Silva *et al.* (1999). I have found no other published cloud forest bird inventories for the biogeographic region of northern Central America (between the Isthmus of Tehuantepec and the Nicaraguan Depression).

The El Triunfo cloud forest studied has an overall extension that is more than twice

that of the patch where Montecristo is located. More area was sampled at El Triunfo (about 1200 ha vs. about 300 ha), sampling was carried out at all times of year, and total observational sampling effort at El Triunfo was greater (302 h vs 28 h). The Montecristo inventory included 716 net-hours of mist-netting understory birds; no mist-netting was reported for El Triunfo. Unequal sampling efforts make comparisons difficult, but because sampling was so extensive at El Triunfo, I assume that it was virtually complete. Given that the Montecristo species accumulation curve had leveled off (for cloud forest only), and that a few rare breeding species had been previously reported, I also assume that sampling at Montecristo was virtually complete. Complete inventories are comparable, even with unequal sampling.

Gómez de Silva *et al.* (1999) reported 80 core species for El Triunfo, including migratory visitors (non-breeders). Twelve non-breeding visitors and two species recorded once or twice should be removed to make the list comparable to the 43 core species reported for Montecristo. The 66 resident species reported for El Triunfo include 12 species present in the pine-oak forests of Montecristo but not recorded in its cloud forest or too rare to be considered core species. These are Black Vulture (*Coragyps atratus*), Red-tailed Hawk (*Buteo jamaicensis*), Squirrel Cuckoo (*Piaya cayana*), Chestnut-collared Swift (*Streptoprocne rutila*), Green Violet-ear (*Colibri thalassinus*), White-eared Hummingbird (*Hylocharis leucotis*), Magnificent Hummingbird, Tufted Flycatcher (*Mitrephanes phaeocercus*), Rose-throated Becard, Brown-backed Solitaire, Slate-throated Redstart, and White-naped Brush-Finch. These species are not cloud forest specialists, and perhaps some should not be considered core species.

The remaining list of 54 core species at El Triunfo includes four species (Wine-throated Hummingbird *Atthis ellioti*, Hairy Woodpecker, Elegant Euphonia *Euphonia elegantissima*, and Blue-crowned Chlorophonia) that have been reported at Montecristo, but were not recorded in the present cloud forest inventory; they may be rare residents at Montecristo, or recently extirpated species. There are 10 species at El Triunfo that are evidently absent at Montecristo (Table 7). The Stub-tailed Spadebill (*Platyrinchus cancrominus*) and White-throated Robin (*Turdus assimilis*) may not actually be core species as they were not recorded during the breeding season (Parker *et al.* 1976, Gómez de Silva *et al.* 1999). Three species at Montecristo were absent at El Triunfo (Table 7). One of these, Brown-capped Vireo, probably occurs at El Triunfo (Gómez de Silva *et al.* 1999). The other two, Mountain Elaenia and Slate-colored Solitaire, are among the most abundant species at Montecristo. The greater diversity (species richness) at El Triunfo may be due to the larger area of cloud forest available, or more extensive adjacent forest.

Conclusions. Although the inventory of the birds of Montecristo National Park is still not complete, I have provided the first relative abundance and reproductive status information for birds in the park and several of its principal habitats. This information permits an interpretation of the importance of the park for the conservation of El Salvador's biodiversity. The present contribution increased the inventory of the park's birds to 233 species, and includes five new species for El Salvador's national bird list. More field work at Montecristo National Park is needed to determine the conservation value of the park's habitats, and the conservation needs of its species. At present, very little is known about movements of threatened bird populations in and around the park. A number of the cloud forest species, such as the Resplendent Quetzal but also many others, may move

TABLE 7. Species found at El Triunfo cloud forest, in Chiapas, Mexico, not recorded for Montecristo, El Salvador, and vice versa.

Species only at Montecristo	Species only at El Triunfo
Mountain Elaenia (*Elaenia frantzii*)	Horned Guan (*Oreophasis derbianus*)
Brown-capped Vireo (*Vireo leucophrys*)	Barred Parakeet (*Bolborhynchus lineola*)
Slate-colored Solitaire (*Myadestes unicolor*)	Emerald-chinned Hummingbird (*Abeillia abeillei*)
	Mountain Trogon (*Trogon mexicanus*)
	Spotted Woodcreeper (*Xiphorhynchus erythropygius*)
	Paltry Tyrannulet (*Zimmerius vilissimus*)
	Stub-tailed Spadebill (*Platyrinchus cancrominus*)
	White-throated Robin (*Turdus assimilis*)
	Gray Silky-flycatcher (*Ptilogonys cinereus*)
	Chestnut-sided Shrike-Vireo (*Vireolanius melitophrys*)

out of the cloud forest to other habitats in or outside the park, as part of annual migrations. For example, at some cloud forests in Mexico, 25% of the species withdraw to lower elevations during the coldest months (Binford 1989). Year-round survey work may be required to adequately describe these movements. Furthermore, at present we have no information on population trends in the park. A long-term monitoring program is needed to determine which species may be declining. The present study may serve as a baseline for such monitoring.

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