

## AVIAN DIVERSITY, ABUNDANCE, AND CONSERVATION STATUS IN THE MACAYA BIOSPHERE RESERVE OF HAITI

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**Résumé.** – **Diversité aviaire, abondance et situation de conservation de la Réserve de la Biosphère de Macaya.** – Les oiseaux de deux bosquets de montagnes ont été recensés dans la Réserve de la Biosphère de Macaya, Sud d'Haïti, entre le 7 et le 14 février 2004. Les résultats sont les suivants : 37 espèces, 234 captures au filet, 121 points de comptage et 451 observations. Les 37 espèces correspondent à 9 migrants de l'Amérique du Nord et 28 sédentaires, dont 11 endémiques de l'île d'Haïti (Hispaniola). Les deux bosquets diffèrent nettement tant au niveau de la diversité qu'à celui de la quantité des oiseaux. La forêt mésique de latifoliés sur karst, située à 1175–1250 m d'altitude, présente 2 à 3 fois plus d'espèces que la forêt humide de la tifioliés de montagne à 1825–1915 m. Nous confirmons la présence de la Grive de Bicknell (*Catharus bicknelli*) dans les deux sites par la capture de 13 individus, ainsi que celle de la Paruline de Swainson (*Limnothlypis swainsonii*), signalée pour la première fois en Haïti (5 individus capturés). Nos observations indiquent que la forêt sur karst du morne Cavalier est sérieusement menacée par la perte d'habitats et la fragmentation et nous recommandons que des mesures immédiates de conservation soient prises pour éviter d'autres pertes.

**Resumen.** – **Diversidad, abundancia y estado de conservación de las aves de la Bioreserva del Pico Macaya en Haití.** – Investigamos la comunidad de aves del bosque de montaña en dos puntos diferentes dentro de la Reserva de la Biosfera Pic Macaya en Haití, del 7 al 14 de Febrero del 2004. Identificamos 37 especies de 234 capturas con redes, 121 detecciones usando puntos de conteo y 451 observaciones totales. Entre estas 37 se incluyen nueve especies migratorias Norteamericanas y 28 especies residentes, de las cuales 11 son endémicas de la Hispaniola. Los dos puntos muestreados se diferenciaron significativamente en cuanto a diversidad y abundancia de aves. Con todos los métodos de campo, registramos de 2 a 3 veces más especies e individuos en el bosque latifolio sobre roca cársica (1175–1270 m), que en el bosque húmedo de montaña (1825–1915 m). Confirmamos la presencia del Zorzal de Bicknell (*Catharus bicknelli*) en ambas localidades (13 individuos capturados) y documentamos el primer registro de la Reinita de Swainson (*Limnothlypis swainsonii*) para Haití (cinco individuos capturados). Nuestras observaciones indicaron que el bosque latifolio sobre roca cársica del área de Morne Cavalier esta seriamente amenazado por la pérdida y fragmentación de hábitat; recomendamos medidas inmediatas de conservación para asegurar que no continúe desapareciendo.

**Abstract.** – We surveyed the montane forest bird community at two sites in the Macaya Biosphere Reserve, Haiti during 7 to 14 February 2004. We recorded 37 species of birds among 234 mist-net captures, 121 point count detections, and 451 total observations. These included nine North American

migrant species and 28 permanent resident species, of which 11 were Hispaniolan endemics. The two sites differed markedly in diversity and abundance of birds. All field methods yielded 2–3 times more species and individuals in mesic karst broadleaf forest at 1175–1250 m elevation than in wet montane broadleaf forest at 1825–1915 m elevation. We confirmed Bicknell's Thrush (*Catharus bicknelli*) at both sites, capturing 13 individuals, and we documented the first record (five mist-netted individuals) of Swainson's Warbler (*Limnothlypis swainsonii*) for Haiti. Our observations indicated that karst forest in the Morne Cavalier area is seriously threatened by habitat loss and fragmentation; we recommend immediate conservation measures to ensure that no further loss occurs. *Accepted 3 March 2005.*

**Key words:** Haiti, Macaya Biosphere Reserve, avifauna, Hispaniolan endemic birds.

## INTRODUCTION

Haiti is widely acknowledged to be one of the world's most densely populated, environmentally degraded, and ecologically threatened countries (Stattersfield *et al.* 1998, Sergile & Woods 2001, Keith *et al.* 2003). Its remaining forest cover stands at less than 1.5% of the original extent, and most of this occurs in only two blocks, the Massif de la Hotte and the Massif de la Selle (Paryski *et al.* 1989). Both areas, despite being formally protected as national parks, face intense and unrelenting pressures from a variety of human sources (Sergile & Woods 2001). The larger of the two parks, Macaya Biosphere Reserve, consists of 5500 ha at the core of the Massif de la Hotte and was established by governmental decree in 1983. Its diverse forested habitats, ranging from mesic limestone forest at lower elevations to a complex mosaic of pine and cloud forest at upper elevations, may support the highest levels of endemism found on Hispaniola. The park's remnant forests are also among the island's most endangered, as deforestation has steadily encroached on Macaya's last remote areas (Woods & Ottenwalder 1992). Chronic socioeconomic hardships and political instability have hindered efforts to implement an effective, sustainable conservation plan for Macaya Biosphere Reserve (Sergile & Woods 2001).

Intensive floral and faunal surveys conducted from 1975 through the 1980s by Charles Woods and associates confirmed the

outstanding ecological importance of the Macaya region, documented its unique avian and mammalian fauna, and outlined an explicit stewardship plan (Woods & Ottenwalder 1992, Woods *et al.* 1992). However, few resources have been available to either execute this plan (Sergile & Woods 2001) or to conduct follow-up monitoring of ecological conditions within Macaya (F. Sergile & C. Woods pers. com.). With growing international realization that time is dwindling to ensure long-term protection of Macaya, a concrete action plan has begun to take shape. As a first step in catalyzing this process, we coordinated a field expedition to the Macaya region in February of 2004. With an ultimate goal of promoting long-term conservation of Macaya Biosphere Reserve, the expedition had several discrete, shorter-term objectives: (1) documentation of the avifauna and specific habitat conditions within the reserve, (2) targeted surveys for species of identified conservation concern, and (3) evaluation of specific protection needs for Macaya Biosphere Reserve and initial development of follow-up strategies to achieve them. We report our results in this paper.

## STUDY AREAS AND METHODS

Field research was conducted at two sites in Macaya Biosphere Reserve of southwestern Haiti. From 7 to 11 February 2004, we established a field site in mesic karst limestone forest in the Morne Cavalier area about 2.5 km

TABLE 1. Birds mist-netted and observed in Macaya Biosphere Reserve, Haiti, 8 to 14 February 2004.

Species	Number					
	Mist-netted		In point counts		Total detected <sup>a</sup>	
	Rak Bwa	Plaine Boeuf	Rak Bwa	Plaine Boeuf	Rak Bwa	Plaine Boeuf
Sharp-shinned Hawk ( <i>Accipiter striatus</i> )	–	–	–	–	1	–
Red-tailed Hawk ( <i>Buteo jamaicensis</i> )	–	–	–	–	4	1
American Kestrel ( <i>Falco sparverius</i> )	–	–	–	–	1	–
Scaly-naped Pigeon ( <i>Patagioenis squamosa</i> )	–	–	–	–	1	–
Plain Pigeon ( <i>Patagioenis inornata</i> )	–	–	3	–	3	–
Zenaida Dove ( <i>Zenaida aurita</i> )	–	–	1	–	1	–
Mourning Dove ( <i>Zenaida macroura</i> )	–	–	–	–	2	–
Hispaniolan Lizard-Cuckoo ( <i>Saurotberia longirostris</i> )	–	–	–	–	3	–
Antillean Mango ( <i>Anthracoceros dominicus</i> )	–	–	–	–	3	–
Hispaniolan Emerald ( <i>Cblorostilbon swainsonii</i> )	10 <sup>b</sup>	3 <sup>b</sup>	8	2	25	10
Hispaniolan Trogon ( <i>Priotelus roseigaster</i> )	–	–	6	–	12	–
Narrow-billed Tody ( <i>Todus angustirostris</i> )	8 <sup>c</sup>	3 <sup>c</sup>	3	3	15	14
Antillean Piculet ( <i>Nesocites micromegas</i> )	–	–	–	–	6	–
Hispaniolan Woodpecker ( <i>Melanerpes striatus</i> )	–	–	10	1	12	7
Greater Antillean Elaenia ( <i>Elaenia fallax</i> )	1	–	4	–	6	1
Golden Swallow ( <i>Tachycineta euchrysea</i> )	–	–	2	–	11	2
Rufous-throated Solitaire ( <i>Myadestes genibarbis</i> )	21	4	13	1	30	10
Bicknell's Thrush ( <i>Catharus bicknelli</i> )	3 <sup>d</sup>	10 <sup>d</sup>	–	–	4	10
Red-legged Thrush ( <i>Turdus plumbeus</i> )	11	2	4	–	12	5
Cape May Warbler ( <i>Dendroica tigrina</i> )	2	–	–	–	3	–
Black-throated Blue Warbler ( <i>Dendroica caerulescens</i> )	14	9	3	4	12	18
Black-and-white Warbler ( <i>Mniotilta varia</i> )	1	–	–	–	–	–
American Redstart ( <i>Setophaga ruticilla</i> )	4	–	–	–	5	–
Worm-eating Warbler ( <i>Helminthos vermivorus</i> )	1	–	–	–	–	–
Swainson's Warbler ( <i>Limothlypis swainsonii</i> )	3	2	–	–	–	2
Ovenbird ( <i>Seiurus aurocapillus</i> )	5	1	1	–	4	1
Common Yellowthroat ( <i>Geothlypis trichas</i> )	1	–	1	–	2	–
White-winged Warbler ( <i>Xenoligea montana</i> )	10	–	8	–	25	–
Bananaquit ( <i>Coereba flaveola</i> )	20	–	5	–	30	–
Antillean Euphonia ( <i>Euphonia musica</i> )	–	–	–	–	6	–
Hispaniolan Spindalis ( <i>Spindalis dominicensis</i> )	22	8	9	10	30	25
Gray-crowned Palm-Tanager ( <i>Phaenicophilus poliocephalus</i> )	10	7	5	–	15	14
Western Chat-Tanager ( <i>Calyptophilus tertius</i> )	3	6	–	5	6	22
Black-faced Grassquit ( <i>Tiaris bicolor</i> )	4	–	–	–	2	–
Yellow-faced Grassquit ( <i>Tiaris olivaceus</i> )	–	–	–	–	2	–
Greater Antillean Bullfinch ( <i>Loxigilla violacea</i> )	20	4	5	–	4	1
Hispaniolan Crossbill ( <i>Loxia megalaga</i> )	–	–	–	–	–	10
Total number of individuals	174	60	91	25	298	153
Total number of species	21	13	18	6	33	17
Total number of mist-net-hours <sup>e</sup>	556.75	515.25	–	–	–	–

TABLE 1. Continuation.

Species	Number					
	Mist-netted		In point counts		Total detected <sup>a</sup>	
	Rak Bwa	Plaine Boeuf	Rak Bwa	Plaine Boeuf	Rak Bwa	Plaine Boeuf
Number of birds/100 net-hours <sup>f</sup>	30.53	9.51	–	–	–	–
Number of birds/point count x 100	–	–	18.2	4.2	–	–
% migrant species	43	31	17	17	18	24
Number of species/number of individuals	9/32	4/13	3/5	1/4	6/30	4/31
% resident species	57	69	83	83	82	76
Number of species/number of individuals	12/138	9/37	15/86	5/21	27/268	13/122

<sup>a</sup>Excludes mist-netted birds and those recorded during point counts, although some of these individuals were likely encountered at other times and are thus included in these totals.

<sup>b</sup>Tail-clipped, not banded.

<sup>c</sup>Includes individuals mist-netted with vocal playback lures (2 at Rak Bwa, 2 at Plaine Boeuf).

<sup>d</sup>Includes individuals mist-netted with vocal playback lures (2 at Rak Bwa, 9 at Plaine Boeuf).

<sup>e</sup>Excludes nets used with vocal playbacks outside standardized netting area.

<sup>f</sup>Excludes four Narrow-billed Todies and 11 Bicknell's Thrushes netted with vocal playbacks.

north of Kay Michel, at elevations ranging from 1175 to 1250 m. We named this site “Rak Bwa” (18°19.45'N, 74°1.48'W). Using established trails through this forest, we operated 16.5 mist-nets (6-m and 12-m x 2.6-m, 36-mm mesh) from dawn to dusk from 8 to 10 February, and from dawn until 08:45 h EST on 11 February. Nets were checked hourly and closed at night. We also conducted surveys of Bicknell's Thrush (*Catharus bicknelli*) in forested areas within a 1–2 km radius from our main study site, by broadcasting vocal playbacks of recorded calls to elicit thrush responses. We attempted to capture each thrush encountered, using vocal playback lures and 6- or 12-m mist-nets. Captured individuals of all species were processed at a central location. Each bird was identified, banded, aged, and sexed. A series of morphometric measurements were taken with dial calipers and standard wing rules to the nearest 0.01 mm (0.5 mm for wing chord and tail length), and weight was recorded to the nearest 0.1 g. We collected 50–150 µl of blood

from most individuals by brachial venipuncture, and we stored samples in plastic vials with 1.0 ml Queen's lysis buffer; these are archived at the Cornell Laboratory of Ornithology's Molecular Genetics Laboratory. In addition to mist-netting, we recorded all incidental observations of birds encountered during the 4-day visit, and we conducted five unlimited-distance 10-min point counts from 07:00–07:45 on 11 February. Each point was separated by 100–200 m.

We conducted field work at a second site, “Plaine Boeuf” (18°21.07'N, 73°59.42'W), 4.5 linear km east-northeast of Rak Bwa, from 11 to 14 February. This site was characterized by wet montane broadleaf-dominated forest, with scattered large emergent pines (*Pinus occidentalis*) and dense thickets of climbing bamboo (*Arthrostylidium haitiense*), at elevations from 1825 to 1915 m. We operated 21.5 mist-nets (6-m and 12-m x 2.6-m, 36-mm mesh) at Plaine Boeuf from dawn to dusk on 12 and 13 February, and from dawn to 11:15 h on 14 February. Netting and banding protocols fol-

lowed those at the Rak Bwa site. As at Rak Bwa, we recorded all incidental observations of birds encountered during the 3-day visit, and we conducted five unlimited-distance 10-min point counts from 07:00 to 07:50 h on 14 February.

## RESULTS AND DISCUSSION

We recorded 37 species of birds among 234 mist-net captures, 121 point count detections, and 451 total observations during our 8 days of field work in Macaya Biosphere Reserve (Table 1). These included 9 North American migrant species and 28 permanent resident species, of which 11 were Hispaniolan endemics. The Rak Bwa and Plaine Boeuf sites differed markedly in diversity and abundance of birds. Overall, we captured or observed more than twice the number of species at Rak Bwa (36) as at Plaine Boeuf (16); 15 species were recorded at both sites (Table 1). Mist-net capture rates and point count detection rates were more than three times higher at Rak Bwa than at Plaine Boeuf (Table 1). Overall detections of individual birds at Rak Bwa were nearly twice those at Plaine Boeuf.

The proportion of migrant to resident species captured in mist-nets was higher at Rak Bwa (43%) than at Plaine Boeuf (31%), whereas the percentage of migrant individuals captured was higher at Plaine Boeuf (27% vs 19% at Rak Bwa; Table 1). The ratio of migrants to residents was equal at both sites on point count detections, although a higher percentage of migrants was detected via general observations at Plaine Boeuf. Three migrant species were detected only through mist-netting at Rak Bwa, whereas all mist-netted resident species were also detected visually or aurally. At Plaine Boeuf, all mist-netted species were also detected by point counts and/or general observations. Fourteen species at Rak Bwa and four species at Plaine Boeuf were detected only by point counts or

general observations. All field methods recorded a higher proportion of endemic species and individuals at Plaine Boeuf than at Rak Bwa.

Six species accounted for 64% of all passive mist-net captures at Rak Bwa, while the six most numerically abundant species at Plaine Boeuf accounted for 78% of captures (Table 1). Hispaniolan Spindalis (*Spindalis dominicensis*) was the most-frequently captured species at both sites, whereas Rufous-throated Solitaire (*Myadestes genibarbis*) and Greater Antillean Bullfinch (*Loxigilla violacea*) were among the top six at each site. Only one migrant, Black-throated Blue Warbler (*Dendroica caerulescens*), was among the six most abundant species in mist-net captures at the two sites. Abundance was more evenly spread among point count detections and overall observations, with some species rarely, if at all, detected through mist-netting, while others were rarely encountered outside mist-net captures. Although we recognize the limitations of mist net data to quantify the relative abundance of birds within or between habitats (e.g., Remson and Good 1996), we believe that our three sampling methods combined enable reliable, if crude, population assessments at these two sites.

### Selected species accounts

Four species of global conservation concern (Stattersfield *et al.* 1998, Woods & Ottenwalder 1992), and four species for which we provide new or significant information in Haiti, are discussed below.

*Golden Swallow* (*Tachycineta euchrysea*). We recorded a maximum of 11 individuals of this species over cleared areas within and surrounding the Rak Bwa site. One pair repeatedly visited a large standing dead tree near our banding site and entered a cavity about 8 m off the ground, as if prospecting for a nest site. We observed no behavior that indicated

actual or imminent breeding, however, and Golden Swallows are not known to breed before April (Latta *et al.* in press). We also observed a pair of swallows high overhead on several occasions at Plaine Boeuf. The status of this species is not well known in Haiti, but it is believed to have declined sharply (Keith *et al.* 2003) and is considered globally “near threatened” (Stattersfield *et al.* 1998). Woods & Ottenwalder (1986) reported Golden Swallows almost exclusively at higher elevations (c. 1900 m) in Macaya. Our limited observations suggest that the species may regularly inhabit lower elevation karst forest habitats. Nesting habitat for this species is suspected to be limited (Latta *et al.* in press), thus making a nest-box program advisable. A coordinated program of nest-box placement in the Morne Cavalier area might enhance breeding opportunities for Golden Swallows and provide educational benefits for local residents and visitors.

*Bicknell's Thrush* (*Catharus bicknelli*). We detected a total of 14 Bicknell's Thrushes in Macaya Biosphere Reserve and captured 12 of these. An additional bird was passively mist-netted. Thrush densities were considerably higher and more uniform at Plaine Boeuf than at Rak Bwa, where birds were patchily distributed and relatively low in abundance. The many clearings and small foot trails at Rak Bwa enabled us to survey a much larger area than at Plaine Boeuf, yet we detected only three vocalizing birds, all near forested edges of recently cleared agricultural plots. Steep terrain, extremely dense vegetation, and a limited network of foot trails restricted our survey coverage at Plaine Boeuf, where we encountered and captured 10 vocalizing thrushes. The dense understory that characterized the wet broadleaf-dominated forest at Plaine Boeuf was structurally similar to montane forests in the Dominican Republic that support the highest known densities of win-

tering Bicknell's Thrush (Rimmer *et al.* 2001). The lower elevation, more fragmented karst forest at Rak Bwa had a patchy understory, and its suitability for this species appeared more variable.

The 13 handheld records we obtained represent the first conclusive documentation of Bicknell's Thrush in Macaya Biosphere Reserve. Two individuals observed at 1900 m on the ridge of Formon in January of 1983 [Woods & Ottenwalder 1983, 1986; at that time still considered Gray-cheeked Thrush (*Catharus minimus*)] were likely of this species, but no vocal or morphometric data were obtained. Of the 13 birds we captured, three were yearlings and 10 were older ( $\geq 2$ -year old) individuals. Sex determination of each bird awaits laboratory analysis of blood samples. Our preliminary data from the Dominican Republic since 1999 indicate that habitat segregation of sex, and possibly age, classes of Bicknell's Thrush occurs on Hispaniola. Thirty-three of 40 (83%) known-sex individuals from montane forests in Sierra de Bahoruco and 9 of 10 (90%) in cloud forests of the Cordillera Central were male, whereas 13 of 18 (72%) birds from mid-elevation, moderately disturbed forests in the Cordillera Septentrional were female (Rimmer unpubl). These findings suggest that males and females occupy different habitats, which may have important consequences for overwinter survivorship and maintenance of good body condition prior to spring migration. Sex- and age-related habitat segregation may have profound implications for long-term conservation of Bicknell's Thrush, if preferred winter habitats are limiting. It appears that the 13 individuals we captured in Macaya conform to the general pattern of older males occupying “optimal” montane forest habitats, as most were  $\geq 2$  years old and had wing lengths in excess of 90 mm (Rimmer *et al.* 2001).

*Black-throated Blue Warbler* (*Dendroica caerulescens*)

scens). This species far outnumbered any other migrant in mist-net captures, point count detections, and overall detections at both sites (Table 1). Females predominated over males, as in other montane broadleaf forest habitats of Hispaniola (Keith *et al.* 2003, Latta *et al.* 2003), accounting for 87% of all mist-net captures (13 of 14 birds at Rak Bwa, 7 of 9 birds at Plaine Boeuf).

*Swainson's Warbler* (*Limnothlypis swainsonii*). We mist-netted five Swainson's Warblers (three at Rak Bwa, two at Plaine Boeuf), providing the first documentation of this species' occurrence in Haiti. Surprisingly, intensive surveys in Macaya throughout the 1980s by Woods *et al.* (1992), combining censusing and mist-netting, did not detect Swainson's Warblers. The species was only recently discovered in the Dominican Republic, where six individuals have been mist-netted and banded since 1997 in montane broadleaf forests at 1400 m elevation in Sierra de Bahoruco (Rimmer & Almonte 2001, Rimmer unpubl.). The confirmation of this species in Macaya Biosphere Reserve, where it ranked third in overall abundance among mist-netted migrants (Table 1), suggests that Swainson's Warbler may be a regular winter resident of Massif de la Hotte. Questions remain whether its recent discovery on Hispaniola represents a winter range expansion and/or increases in local abundance, and whether surveys in the 1980s simply missed detecting this retiring species.

*White-winged Warbler* (*Xenoligea montana*). We found White-winged Warblers only at the Rak Bwa site, where the species ranked fourth among point count detections, fifth in overall detections, and seventh among mist-net captures. Birds were encountered in groups of three to eight individuals in both single- and mixed-species flocks. We were surprised not to detect White-winged Warblers at Plaine Boeuf, because Woods & Ottenwalder (1983)

reported several sightings of the species between 1650 and 1900 m elevation on the ridge of Pic Formon, in wet broadleaf forest presumably similar to that at Plaine Boeuf. Considered Haiti's most endangered bird species by Woods *et al.* (1992) and assigned a global status of "vulnerable" by Birdlife International (Stattersfield *et al.* 1998), the current Haitian distribution of White-winged Warblers appears to be restricted to Massif de La Hotte. Our limited observations suggest that the species' stronghold in Macaya is karst limestone broadleaf forest, which we believe to be the most threatened habitat type in the park. More focused research and monitoring are needed to clarify the Haitian population and conservation status of White-winged Warbler, arguably among Hispaniola's least-known endemic species. The recovery plan outlined by Woods *et al.* (1992) provides a practical and relevant model on which virtually no action has been taken to date.

*Gray-crowned Palm-Tanager* (*Phaenicophilus poliocephalus*). This was among the most common species at both sites, although its relative abundance was higher at Plaine Boeuf, where it ranked third among mist-net captures and fourth among total detections (Table 1). We observed Gray-crowned Palm-Tanagers either in pairs or as single birds, occasionally in association with mixed-species flocks at Rak Bwa. This is the only full species with its range effectively confined to Haiti (Keith *et al.* 2003); few reliable records have been obtained from the Dominican Republic, and all of these have been recorded very close to the Haitian border. Gray-crowned Palm-Tanagers are habitat generalists and appear to be locally common in Macaya Biosphere Reserve, as noted by Woods *et al.* (1992) in the 1980s.

*Western Chat-Tanager* (*Calyptophilus tertius*). We encountered this species at both sites, but

TABLE 2. Morphometrics of mist-netted Western Chat-Tanagers (*Calyptophilus tertius*) in Macaya Biosphere Reserve, Haiti (February 2004) and in Sierra de Bahoruco, Dominican Republic (January and February, 2001 to 2003). Measurements were recorded to nearest 0.01 mm, weight to nearest 0.1 g. Only weight differed significantly ( $P < 0.001$ ) between the two populations.

	Macaya			Sierra de Bahoruco		
	n	Mean $\pm$ SD	Range	n	Mean $\pm$ SD	Range
Wing chord <sup>a</sup>	9	93.7 $\pm$ 4.44	88.5–101.5	21	91.2 $\pm$ 5.88	80.0–102.5
Tail length <sup>b</sup>	9	96.5 $\pm$ 5.99	88.0–108.5	19	99.3 $\pm$ 7.04	88.5–110.0
Tarsus length <sup>c</sup>	8	36.2 $\pm$ 2.17	32.2–39.7	18	35.0 $\pm$ 2.01	32.1–39.8
Bill length <sup>d</sup>	9	15.9 $\pm$ 2.12	12.2–17.8	19	15.2 $\pm$ 0.83	13.6–17.0
Weight <sup>e</sup>	9	56.6 $\pm$ 4.86	51.1–63.2	18	49.2 $\pm$ 4.86	40.2–55.3

<sup>a</sup>Measured from bend of wing (carpal joint) to tip of longest primary.

<sup>b</sup>Measured from base of feathering to tip of longest rectrix.

<sup>c</sup>Measured from “bend” of toes to outside of tibia adjacent to intertarsal joint.

<sup>d</sup>Measured from anterior edge of nares to bill tip.

<sup>e</sup>Measured with digital Ohaus HS-20 scale.

its relative abundance was markedly higher in the dense broadleaf forest at Plaine Boeuf, where it ranked second among total detections and third among mist-net captures (Table 1). Several birds at both sites were heard singing at dawn, and most appeared to occupy discrete territories. Handheld birds were darker-plumaged, with more distinctly chestnut-brown tails, and were larger in five of six measurements than mist-netted individuals of this species from Sierra de Bahoruco in the Dominican Republic (Table 2). Comparison of measurements between birds from the two ranges revealed that only weight differed significantly (Table 2; Mann-Whitney U-tests,  $P < 0.001$  for all tests; SYSTAT Version 5.2.1). As noted by Woods & Ottenwalder (1992) and Keith *et al.* (2003), systematics of the *Calyptophilus* complex are not fully resolved and need further study. Analysis of blood samples from our mist-netted birds in Macaya, and comparison of results with those from *Calyptophilus* individuals sampled throughout Hispaniola, should help elucidate systematic relationships within the genus. Woods & Ottenwalder (1983, 1992) also

found Western Chat-Tanagers at all elevations sampled in the 1980s, and they considered it among the most endangered birds in Haiti. Birdlife International designates the *Calyptophilus* complex as globally “vulnerable” (Stattersfield *et al.* 1998). Our limited observations suggest that the species is locally common, especially in higher elevation forests, and we believe its status in Macaya may be more secure than those of species that are more restricted to the broadleaf karst forests.

*Hispaniolan Crossbill* (*Loxia megaplaga*). We observed small flocks of crossbills on three occasions at Plaine Boeuf, in areas with large emergent pines. Two flocks estimated at four to six birds were heard flying overhead, and a group of five birds was observed feeding in the canopy of a pine. This species was not documented in Massif de La Hotte until 1984 (Woods & Ottenwalder 1992), and its persistence 20 years later suggests the existence of an established breeding population. Our observations reveal little about the status of Hispaniolan Crossbills, because the



mixed broadleaf-pine forest of Plaine Boeuf was outside our primary study area. Woods & Ottenwalder (1992) considered the species to be endangered in Haiti, although there are no reliable estimates of its abundance. A recovery plan for the Hispaniolan Crossbill has been outlined by Woods *et al.* (1992), with primary goals of preventing further loss of mature pine forest habitat and determining the species' current population status.

#### Comparison with previous studies

Several species recorded by Charles Woods and his associates during the late 1970s and 1980s in Macaya Biosphere Reserve were notably absent during our surveys. We did not detect any of the following resident species, all of which were reported by Woods & Ottenwalder (1983) during January of 1983 in the Formon area between 1200 and 1950 m elevation: Hispaniolan Parrot (*Amazona ventralis*), Vervain Hummingbird (*Mellisuga minima*), Broad-billed Tody (*Todus subulatus*), Greater Antillean Pewee (*Contopus caribaenus*), and Pine Warbler (*Dendroica pinus*). The absence of these species may have been due simply to our failing to detect them or because we did not visit areas in which they currently occur. The absence of Broad-billed Todies was unsurprising, as the species rarely occurs above 1070 m. We conducted systematic playback surveys for Broad-billed Todies at both Rak Bwa and Plaine Boeuf, but recorded none. We did, however, detect two individuals during an opportunistic survey in a small coffee plantation at 145 m elevation on the access road. We also documented sympatry with Narrow-billed Tody (*Todus angustirostris*) at this site.

The absence of Hispaniolan Parrots was especially striking, as Woods & Ottenwalder (1992) reported flocks of up to 80 birds in the Massif de La Hotte during 1975 and described the species as "common in ... small flocks" in

karst forests on the Plain of Formon in the early and mid-1980s. This species is typically noisy and conspicuous, and we believe it is unlikely that we failed to detect birds that may have been present. An island-wide decline has been documented since the 1930s, with many local extirpations (Keith *et al.* 2003, Latta *et al.* in press). Woods & Ottenwalder (1992) considered Hispaniolan Parrots rare and endangered in Massif de La Hotte, and they may now be extirpated in Parc National La Visite (Davalos & Brooks 2001). Focused surveys should be conducted to investigate the status of this species in Macaya Biosphere Reserve.

The limited timeframe and geographic scope of our surveys preclude any rigorous comparison between our findings and those of earlier studies. We cannot be certain that we conducted fieldwork in exactly the same sites surveyed by Woods *et al.* in the 1970s and 1980s, nor is it likely that the sampling methods we used were strictly comparable to theirs. However, it is clear that we visited the same habitat types, specifically mesic karst limestone forest ["mature broadleaved forest" and "fragmented broadleaved forest" of Woods & Ottenwalder (1992)] and wet montane broadleaf forest ["mature hardwood forest" or "cloud forest" of Woods & Ottenwalder (1992)]. Our results therefore provide broad context for evaluating changes in patterns of avian distribution and abundance during the 15+ years since Charles Woods' last published surveys. We are currently unable to detect evidence of any dramatic declines or increases in avian populations of Macaya, and it appears that the overall status of most common resident species has changed little, with the possible exception of Hispaniolan Parrot. However, we emphasize that comparisons of our and previous surveys are purely qualitative, rather than quantitative, in nature. We believe that our most noteworthy findings include the relatively high abundance of White-

winged Warblers in karst broadleaf forests at Rak Bwa, confirmation that Bicknell's Thrush is a regular inhabitant of broadleaf forests at both middle and high elevations, and documentation of wintering Swainson's Warblers.

#### Habitat assessment

Lacking prior firsthand experience in Macaya Biosphere Reserve, we have little historical context for evaluating habitat changes that have occurred in the past 10 to 15 years. Florence Sergile, a core member of Woods' field teams in the 1980s, had last visited Macaya in 1995. Her overall impression upon returning with us in February of 2004 was that little further drastic loss of habitat had occurred in Morne Cavalier or areas within its view. Our field observations indicated that the karst limestone forest at Rak Bwa was limited in extent, heavily fragmented, and seriously threatened by subsistence agriculture. We were unable to accurately estimate the size of the habitat patch at Rak Bwa, or to determine the extent of this forest type in the Morne Cavalier area. However, karst forests appear to be rapidly shrinking as they are cleared for crop production and grazing. We observed numerous recent clearings in all directions from Rak Bwa, as well as many older cleared areas that were actively cultivated or grazed, and some that appeared to be fallow. We saw little evidence of regeneration of karst forests, and we suspect that this habitat type does not recover easily from disturbance. These mature broadleaf forests support Macaya's highest avian and floristic diversity (Woods *et al.* 1992), yet they are completely unprotected. Their proximity and relative accessibility to the human population in Macaya Biosphere Reserve's vicinity, and the fact that many are outside the park's poorly-defined and uncontrolled boundaries, have contributed to a crisis situation. Immediate and stringent measures must be implemented to prevent

further loss of karst forests and to ensure their persistence.

The forests in the vicinity of Plaine Boeuf appear to be less seriously threatened than those in the Morne Cavalier area. Although numerous small groups of local inhabitants passed through Plaine Boeuf during our three days there, we observed little evidence of large scale habitat loss, and no agriculture on the ridge itself. The primary threat to the wet broadleaf forest at these elevations is removal of emergent pines, apparently for lumber. Along a spur trail that extended west from our northernmost nets, we noted more than a dozen stumps of large (> 1 m diameter) pines that appeared to have been cut within recent weeks. Because pines were not numerous in this area, and we noted few trees in younger age classes, we believe that the forest composition and dynamics will be significantly altered if cutting of mature emergent trees does not cease. These overstory *Pinus occidentalis* are the primary producers of cones and seeds in the species, and they likely provide essential local habitat for Hispaniolan Crossbills. They may also perform important ecological functions such as shading and moisture retention.

#### Conservation and management recommendations

The comprehensive stewardship plan outlined by Woods *et al.* (1992) details concrete actions that are no less urgent and relevant today than they were 12 years ago. We believe that this plan should be carefully revisited, and that strong local coordination must be marshaled to ensure its implementation. A substantial investment of human and financial resources will be necessary to achieve this. We fully support the recommendations proposed by Woods *et al.* (1992), and we add or reiterate only the following:

- 1) Immediate and forceful measures must be

taken to protect karst broadleaf forests in the Morne Cavalier area, and wherever else they occur. As suggested by Woods *et al.* (1992), this likely includes the entire extent of mesic broadleaf forest between Sous Bois (Portal Formon) and Morne Cavalier. Further loss and fragmentation of these forests are not sustainable, and we believe they constitute the single most important habitat type within Macaya Biosphere Reserve. They are certainly its most endangered. Specific actions should include accurate delineation of park boundaries in the Morne Cavalier area, special designation of a core ecological area that is completely off-limits to human-caused habitat alteration, and creation and implementation of a management plan specific to karst broadleaf forests and surrounding agricultural areas.

- 2) Protection of mature pines throughout Macaya Biosphere Reserve should be a high priority. Removal of such trees must be prevented.
- 3) A long-term avian monitoring and research program should be designed and implemented in Macaya Biosphere Reserve.
- 4) Kay Michel should be further developed as the Park's headquarters and educational center. Infrastructure and security of the building must be upgraded, a park supervisor should be stationed there, and educational displays should be constructed.
- 5) A program of training and certification of local park guides and rangers should be instituted. The regular involvement of such individuals in park activities will help ensure their commitment to Macaya's conservation. Proper equipment and educational training will be essential components of such a program. Only through locally-

based initiatives can the long-term ecological integrity of Macaya Biosphere Reserve be maintained.

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