Ornithological Field Investigations in Macaya Biosphere Reserve, Haiti, 7-14 February 2004

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Summary: We surveyed the montane forest bird community at two sites in the Macaya Biosphere Reserve, Haiti during 7-14 February 2004. We recorded 37 species of birds among 234 mist net captures, 121 point count detections, and 451 total observations. These included 9 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 the wet montane broadleaf forest at 1825-1915 m elevation. We confirmed Bicknell's Thrush at both sites, capturing 13 individuals, and we documented the first record (5 mist-netted individuals) of Swainson's Warbler 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.

Introduction and Background

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 and Woods 2001, Keith et al. 2003). Its remaining forest cover stands at less than 1.5%, 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 and Woods 2001). The larger of the two parks, Macaya Biosphere Reserve, consists of 5,500 hectares at the core of the Massif de la Hotte and was established by governmental decree in 1983. Its diverse forested habitats, ranging from wet 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 and Ottenwalder 1992). Chronic socioeconomic hardships and political instability have hindered efforts to implement an effective, sustainable conservation plan for Macaya Biosphere Reserve (Sergile and Woods 2001).

Intensive floral and faunal surveys conducted from 1975 through the 1980s by Dr. Charles Woods and associates confirmed the outstanding ecological importance of the Pic Macaya region, documented its unique avian and mammalian fauna, and outlined an explicit stewardship plan (Woods and Ottenwalder 1992, Woods et al. 1992). However, few resources have been available during the past 15 years to either execute this plan (Sergile and Woods 2001) or to conduct follow-up monitoring of ecological conditions within Macaya (F. Sergile and C. Woods, pers. comm.). With growing international realization that little time remains to ensure long-term protection of Macaya, a concrete action plan has begun to take shape. At the heart of this plan is the mobilization of a cadre of conservationists within and outside of Haiti to create a locally-based, self-sustaining nongovernmental organization dedicated to biodiversity conservation. The fledgling Société Audubon Haïti (SAH) is poised to assume the leadership role in this effort. Several prominent, committed Haitians represent the core of SAH. They are building partnerships and momentum, both within the Haitian conservation community and with established conservation groups like BirdLife International, Conservation International, The Nature Conservancy, The Northwoods Institute (former Vermont Leadership Center), the Sociedad Ornitológia de Hispaniola (SOH), the University of Florida, U.S. Fish and Wildlife Service, and the Vermont Institute of Natural Science (VINS). The Haitian Ministry of Environment is fully supportive of this initiative.

All partners agreed that a critical first step in catalyzing this process would be to carry out a coordinated, international field research and training expedition to the Macaya region. After more than a year of planning, and despite numerous funding and political uncertainties, an ornithological field trip to Macaya became reality in early 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 Macaya Biosphere Reserve,, as a means to assess changes since 1989 (the final year of Woods' formal biotic surveys), the immediacy of conservation threats, and needs for a concrete action plan.
2) Targeted surveys for species of conservation concern, such as White-winged Warbler *(Xenoligea montana)*, Gray-crowned Palm-Tanager *(Phaenocophilus poliocephalus)*, Western Chat Tanager *(Calyptophilus tertius)*, and Bicknell's Thrush *(Catharus bicknelli)*.
3) Intensive training of Haitian biologists and local park rangers, as a means to build technical capacity within the Haitian biological community and to generate local interest and conservation commitment.
4) Coordinated distribution of donated field equipment to local guides and park rangers, in order to provide them with the resources necessary to work effectively in remote parts of the park. A collection of used field equipment (sleeping bags, tents, daypacks, flashlights, warm clothing) in good condition was shipped by VINS early in 2004 to Philippe Bayard and distributed to these guides in February.
5) Evaluation of specific protection needs for Macaya Biosphere Reserve and initial development of follow-up strategies to achieve them.

Led by scientists and conservation planners from Haiti, the Dominican Republic, and the United States, a team of 11 people arrived by vehicle at Kay Michel, Durand on 7 February 2004. Here we met with the Macaya Guide Association, and we were joined by several local guides and park rangers. Kay Michel served as the group's logistic base of operations until our departure for Port-au-Prince on 15 February (Appendix). The core group consisted of the following 14 participants:

Philippe Bayard, Société Audubon Haïti, President of the Board of Directors
Florence Sergile, Société Audubon Haïti, Technical Coordinator
Jean Denis Chery, Société Audubon Haïti, Field Coordinator
Jean Max Dimitri Norris, Ministry of Environment, Chief of Biodiversity
Paul Judex Edouarzin, Ducks Unlimited Monitoring Program
Jean Vilmond Hilaire, Université Notre Dame d'Haïti, Professor of Botany
Antoine Fresnor Jules, Macaya Biosphere Reserve, Park Ranger and Guide
Reynold Jules, Macaya Biosphere Reserve, Park Ranger and Guide
Jean Simon Despagne, Macaya Biosphere Reserve, Park Ranger and Guide
Eladio Fernandez, Sociedad Ornitológia de Hispaniola, Vice President
Jesus Almonte, Sociedad Ornitológia de Hispaniola, Ornithologist
Chris Rimmer, Vermont Institute of Natural Science, Ornithologist
Jason Townsend, Vermont Institute of Natural Science, Ornithologist
Andrea Townsend, Cornell University, Ornithologist/PhD candidate

Study Areas and Field Methods

Field research and training were conducted at two sites in Macaya Biosphere Reserve (Fig. 1). From 7-11 February we established a field site in the wet karst limestone forest

about 2.5 km north of Kay Michel, at elevations ranging from 1175-1250 m. We named this site "Bois Musicien" (Creole: "Bwa Mizisyen", hereafter "Rak Bwa"; Fig. 2A). Using an established foot and livestock trail through this forest, we operated 16.5 mist nets (12-m x 2.6-m, 36-mm mesh) from dawn to dusk on 8-10 February and from dawn until 0845 EDST on 11 February. Nets were checked hourly and closed at night. We also conducted Bicknell's Thrush surveys of forested areas in 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. All captured birds were processed at a central location (Appendix). Each individual bird was identified, banded, aged, and sexed. A series of morphometric measurements were taken to the nearest 0.1 mm, 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. 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-minute point counts between 0700-0745 EDST on 11 February. Each point was separated by 100-200 m.

We conducted field work at a second site, "Plaine Boeuf" (Creole: "Laplenn Bèf"), located 4.5 linear km east-northeast of Rak Bwa, from 11-14 February (Fig. 2B). 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 1825-1915 m. We operated 21.5 mist nets (12-m x 2.6-m, 36-mm mesh) at Plaine Boeuf from dawn to dusk on 12-13 February and from dawn to 1115 EDST on 14 February. Netting and banding protocols followed those at the Rak Bwa site, with the addition that we collected blood samples from Bicknell's Thrushes for analysis of mercury levels. These were collected in heparinized capillary tubes and stored in vaccutainers. As at Rak Bwa, we recorded all incidental observations of birds encountered during the 3-day visit, and we conducted five unlimited-distance, 10-minute point counts between 0700-0750 EDST on 14 February.

At both sites, we recorded the locations of all net sites, point counts, and Bicknell's Thrush captures (Fig. 2), using a handheld Global Positioning System (GPS) unit. We also conducted detailed vegetation measurements at a randomly-selected Bicknell's Thrush capture location at each site, as a means to characterize habitat occupied by this species.

Results and Discussion

We recorded 37 species of birds among 234 mist net captures, 121 point count detections, and 451 total observations during our eight 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%), while the percentage of migrant individuals captured was higher at Plain Boeuf (27% vs. 19% at Rak Bwa; Table 1). The ratio of migrants to residents was equal at both sites on point count detections, while 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, while 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 4 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 6 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, while Rufous-throated Solitaire *(Myadestes genibarbis)* and Greater Antillean Bullfinch *(Loxigilla violacea)* were among the top 6 at each site. Only one migrant, Black-throated Blue Warbler *(Dendroica caerulescens)*, was among the 6 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.

Selected Species Accounts

Golden Swallow *(Petrochelidon 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. 2004). 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 "Near Threatened" globally (Stattersfield et al. 1998). Woods and 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. 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 (Fig. 2). 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 3 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 (Figure 2). The dense understory that characterized the wet broadleaf-dominated forest at Plain Boeuf was structurally similar to montane forests in the Dominican Republic that support the highest known densities of wintering 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 and Ottenwalder 1983, 1986), and at that time still considered Gray-cheeked Thrush *(Catharus minimus)*, were very likely of this species, but no vocal or morphometric data were obtained. Of the 13 birds we captured, 3 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, while 13 of 18 (72%) birds from mid-elevation, moderately disturbed forests in the Cordillera Septentrional were female (unpubl. data). 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. Analyses of our Macaya blood samples will contribute important information to the question of whether habitat segregation exists on Hispaniola.

Black-throated Blue Warbler *(Dendroica caerulescens)* – 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 5 Swainson's Warblers (3 at Rak Bwa, 2 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., 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 and Almonte 2001, unpubl. data).

The confirmation of this species in two forest types of 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 3-8 individuals in both single- and mixed-species flocks. We were surprised not to detect White-winged Warblers at Plaine Boeuf, as Woods and Ottenwalder (1983) reported several sightings of the species between 1650-1900 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 (Appendix) 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 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 5 of 6 measurements than mist-netted *C. tertius* 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 and Ottenwalder (1992) and Keith et al.

(2003), systematics of the Chat-Tanager 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* sampled throughout Hispaniola, should help elucidate systematic relationships within the genus. Woods and 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 3 occasions at Plaine Boeuf, in areas with large emergent pines. Two flocks estimated at 4-6 birds were heard flying overhead, while a group of 5 birds was observed feeding in the canopy of a pine. This species was not documented in Massif de La Hotte until 1984 (Woods and 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, however, as the mixed broadleaf-pine forest of Plaine Boeuf was outside our primary study area. Woods and 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 and Ottenwalder (1983) during January of 1983 in the Formon area between 1200-1950 m elevation: Hispaniolan Parrot *(Amazona ventralis)*, Vervain Hummingbird *(Mellisuga minima)*, Broad-billed Tody *(Todus subulatus)*, Greater Antillean Pewee *(Contopus caribaeus)*, and Pine Warbler *(Dendroica pinus)*. The presumed 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 Tody 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 2 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 and 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. 2004). Woods and 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 and 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 can not be certain that we conducted field work in any of the sites surveyed by Woods et al. in the 1970s and 1980s. 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 and Ottenwalder [1992]) and wet montane broadleaf forest ("Mature Hardwood Forest" or "Cloud Forest" of Woods and 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 will more closely compare our 2004 data with those of Woods et al. in coming months. 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 lack access to quantitative data from previous surveys and so can make only qualitative comparisons. 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

Without prior firsthand experience in Macaya Biosphere Reserve, we have little historical context for evaluating habitat changes that have occurred in the past 10-15 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 the Morne Cavalier area or within its viewshed. Our field observations indicated that the karst limestone forest at Rak Bwa was very 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 (Appendix), 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 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 much less seriously threatened than those in the Morne Cavalier area. While numerous small groups of local inhabitants passed through Plaine Boeuf during our 3 days there, we observed little evidence of largescale 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. Along a spur trail that extended west from our northernmost nets (Fig. 2B), we noted more than a dozen stumps of very large (> 1 m diameter) pines that appeared to have been cut within recent weeks (Appendix). 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 is not ceased. 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. The protection of mature pines throughout Macaya Biosphere Reserve should be a high priority.

Field Training

We trained our Haitian professional colleagues, as well as the Macaya Biosphere Reserve guides and rangers, in all aspects of our field work, particularly mist-netting and banding. Whenever possible, we relayed information on bird identification and biology, and several participants practiced techniques of bird handling and mist net extraction (Appendix). We engaged in regular discussions of conservation issues related to Macaya Biosphere Reserve, and we solicited input from all participants. A total of 7 Haitians received hands-on field training, while others observed without directly participating. We believe that our training exercises were an invaluable component of the trip.

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 must be carefully revisited, and that strong local coordination must be marshaled to ensure its implementation. A significant investment of human and financial resources will be necessary to achieve this. A committed network of Haitian conservationists, led by the Société Audubon Haïti and the Ministry of Environment, must work in tandem with international cooperators to collectively bring about long-term, sustainable conservation of Macaya Biosphere Reserve.

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. The following specific actions should be given serious consideration:

a) Accurate park boundary surveys must be conducted in the Morne Cavalier area, and boundaries must be clearly delineated. If significant areas of karst broadleaf forest are found to lie outside current park boundaries, these must be immediately expanded to include all or nearly all intact forest patches.
b) The forest patch that we named Rak Bwa should be specially designated as a core ecological reserve that is completely off-limits to human activities involving habitat alteration. This area has outstanding potential for biological research and monitoring, as well as for environmental education and ecotourism. This tract of forest appears to be isolated from other similar patches, and we believe that it should be physically protected by means of a barrier to exclude livestock and to discourage farming. We advocate that a fence with informational/warning signs be erected around at least 100 hectares of Rak Bwa, as an immediate stop-gap measure to prevent further habitat loss.
c) A management plan specific to karst broadleaf forests and surrounding agricultural areas must be developed and implemented. This should include delineation and mapping of all current habitat patches through GIS analyses, consolidation and connectivity of existing fragments through actual or potential habitat corridors, natural or human-aided regeneration of disturbed areas, and concerted education of local residents as to the importance of this habitat type.
d) A small educational facility should be developed in Rak Bwa. This could serve as a resource for local residents, as a destination for ecotourism groups that visit Macaya, and as a base of operations for future field research operations. It should be linked to educational displays and other information that need to be developed at Caye Michel. Such a facility might be constructed near our banding site in the clearing midway along the main foot trail on which we operated our mist nets (Fig. 2A). This trail could become an established nature trail, with interpretive signs and designated observation sites.

2) A long-term avian monitoring and research program should be designed and implemented in Macaya Biosphere Reserve. The scope of such a program should also include other wildlife and plants. We recommend that Rak Bwa be designated as one site within a network of monitoring sites. It offers numerous opportunities, due to its proximity to Kay Michel, its logistic accessibility, its diverse avifauna, and its status as a relatively intact patch of karst broadleaf forest.
3) Kay Michel must 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. A large wall map depicting Macaya's boundaries, topography, primary trails, and major habitats types should be prominently featured. Pocket versions of this map should be available to visitors.

4) A program of training and certification of park guides and rangers should be instituted. There are several outstanding candidates for these positions, and their regular involvement in park activities will help ensure their commitment to Macaya's conservation. They must be properly equipped and educated.

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

	Rak Bwa			Plaine Boeuf		
Species	**# Mist-netted**	**# in Point Counts**	**Total # Detected[a]**	**# Mist-netted**	**# in Point Counts**	**Total # Detected[a]**
Sharp-shinned Hawk *(Accipiter striatus)*			1			
Red-tailed Hawk *(Buteo jamaicensis)*			4			1
American Kestrel *(Falco sparverius)*			1			
Scaly-naped Pigeon *(Columba squamosa)*			1			
Plain Pigeon *(Columba inornata)*		3	3			
Zenaida Dove *(Zenaida aurita)*		1	1			
Mourning Dove *(Zenaida macroura)*			2			
Hispaniolan Lizard-Cuckoo *(Saurotheria longirostris)*			3			
Antillean Mango *(Anthracothorax dominicus)*			3			
Hispaniolan Emerald *(Chlorostilbon swainsonii)*	10[b]	8	25	3[b]	2	10
Hispaniolan Trogon *(Priotelus roseigaster)*		6	12			
Narrow-billed Tody *(Todus angustrostris)*	8[c]	3	15	3[c]	3	14
Antillean Piculet *(Nesoctites micromegas)*			6			
Hispaniolan Woodpecker *(Melanerpes striatus)*		10	12	1		7
Greater Antillean Elaenia *(Elaenia fallax)*	1	4	6			1
Golden Swallow *(Petrochelidon euchrysea)*		2	11			2
Rufous-throated Solitaire *(Myadestes genibarbis)*	21	13	30	4	1	10
Bicknell's Thrush *(Catharus bicknelli)*	3[d]		4	10[d]		10
Red-legged Thrush *(Turdus plumbeus)*	11	4	12	2		5
Cape May Warbler *(Dendroica tigrina)*	2		3			
Black-throated Blue Warbler *(Dendroica caerulescens)*	14	3	12	9	4	18
Black-and-white Warbler *(Mnioltilta varia)*	1					
American Redstart *(Setophaga ruticilla)*	4		5			

	Rak Bwa			Plaine Boeuf		
Species	**# Mist-netted**	**# in Point Counts**	**Total # Detected[a]**	**# Mist-netted**	**# in Point Counts**	**Total # Detected[a]**
Worm-eating Warbler *(Helmintheros vermivorus)*	1					
Swainson's Warbler *(Limnothlypis swainsonii)*	3			2		2
Ovenbird *(Seiurus aurocapillus)*	5	1	4	1		1
Common Yellowthroat *(Geothlypis trichas)*	1	1	2			
White-winged Warbler *(Xenoligea montana)*	10	8	25			
Bananaquit *(Coereba flaveola)*	20	5	30			
Antillean Euphonia *(Euphonia musica)*			6			
Hispaniolan Spindalis *(Spindalis dominicensis)*	22	9	30	8	10	25
Gray-crowned Palm-Tanager *(Phaenicophilus poliocephalus)*	10	5	15	7		14
Western Chat-Tanager *(Calyptophilus tertius)*	3		6	6	5	22
Black-faced Grassquit *(Tiaris bicolor)*	4		2			
Yellow-faced Grassquit *(Tiaris olivicea)*			2			
Greater Antillean Bullfinch *(Loxigilla violacea)*	20	5	4	4		1
Hispaniolan Crossbill *(Loxia megaplaga)*						10
Total # of individuals	174	91	298	60	25	153
Total # of species	21	18	33	13	6	17
Total # mist net-hours[e]	556.75			515.25		
# birds/100 net-hours[f]	30.53			9.51		
# birds/point count x 100		18.2			4.2	
% migrant species (# species/# individuals)	43 (9/32)	17 (3/5)	18 (6/30)	31 (4/13)	17 (1/4)	24 (4/31)
% resident species (# species/# individuals)	57 (12/138)	83 (15/86)	82 (27/268)	69 (9/36)	83 (5/21)	76 (13/122)
% endemic species (# species/# individuals)	29 (6/58)	39 (7/49)	30 (10/149)	46 (6/26)	67 (4/20)	41 (7/102)

[a] 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.

[b] Hispaniolan Emeralds tail-clipped, not banded.

[c] Includes individuals mist-netted with vocal playback lures (2 at Rak Bwa, 2 at Plaine Boeuf).

[d] Includes individuals mist-netted with vocal playback lures (2 at Rak Bwa, 9 at Plaine Boeuf).

[e] Excludes nets used with vocal playbacks outside standardized netting area.

[f] Excludes 4 Narrow-billed Todies and 11 Bicknell's Thrushes netted with vocal playbacks.

Table 2. Morphometrics of mist-netted *Calyptophilus tertius* in Macaya Biosphere Reserve, Haiti (February 2004) and in Sierra de Bahoruco, Dominican Republic (January and February, 2001-2003).

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

[a] Measured from bend of wing (carpal joint) to tip of longest primary (mm).
[b] Measured from base of feathering to tip of longest rectrix (mm).
[c] Measured from "bend" of toes to outside of tibia adjacent to intertarsal joint (mm).
[d] Measured from anterior edge of nares to bill tip (mm).
[e] Measured with digital Ohaus HS-20 scale (g).

Figure 1. Map of Hispaniola showing major mountain ranges and Macaya Biosphere Reserve, Haiti.

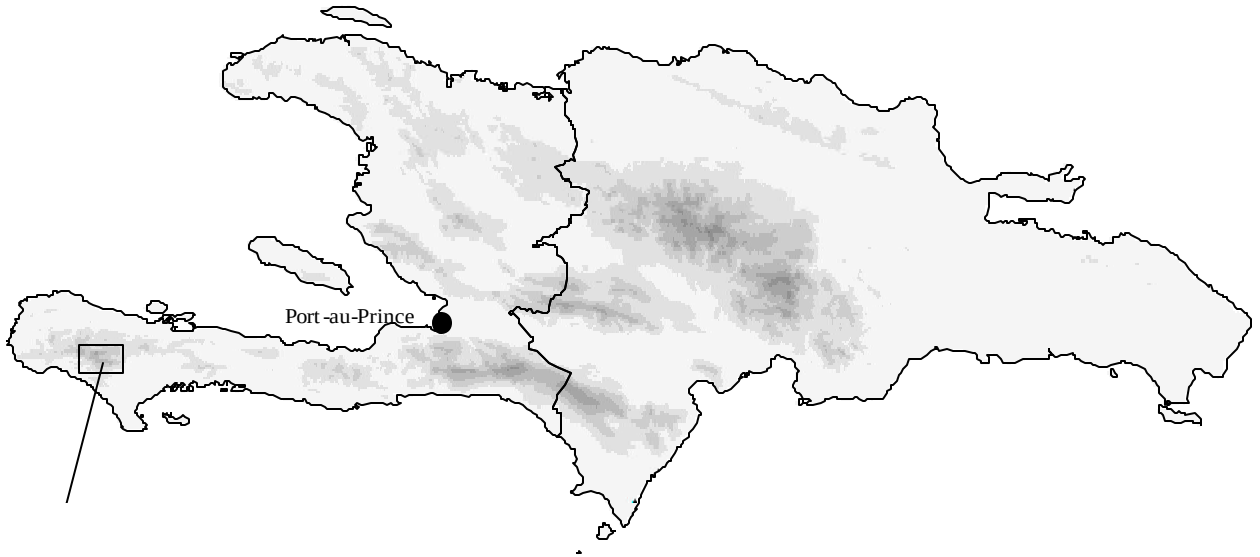
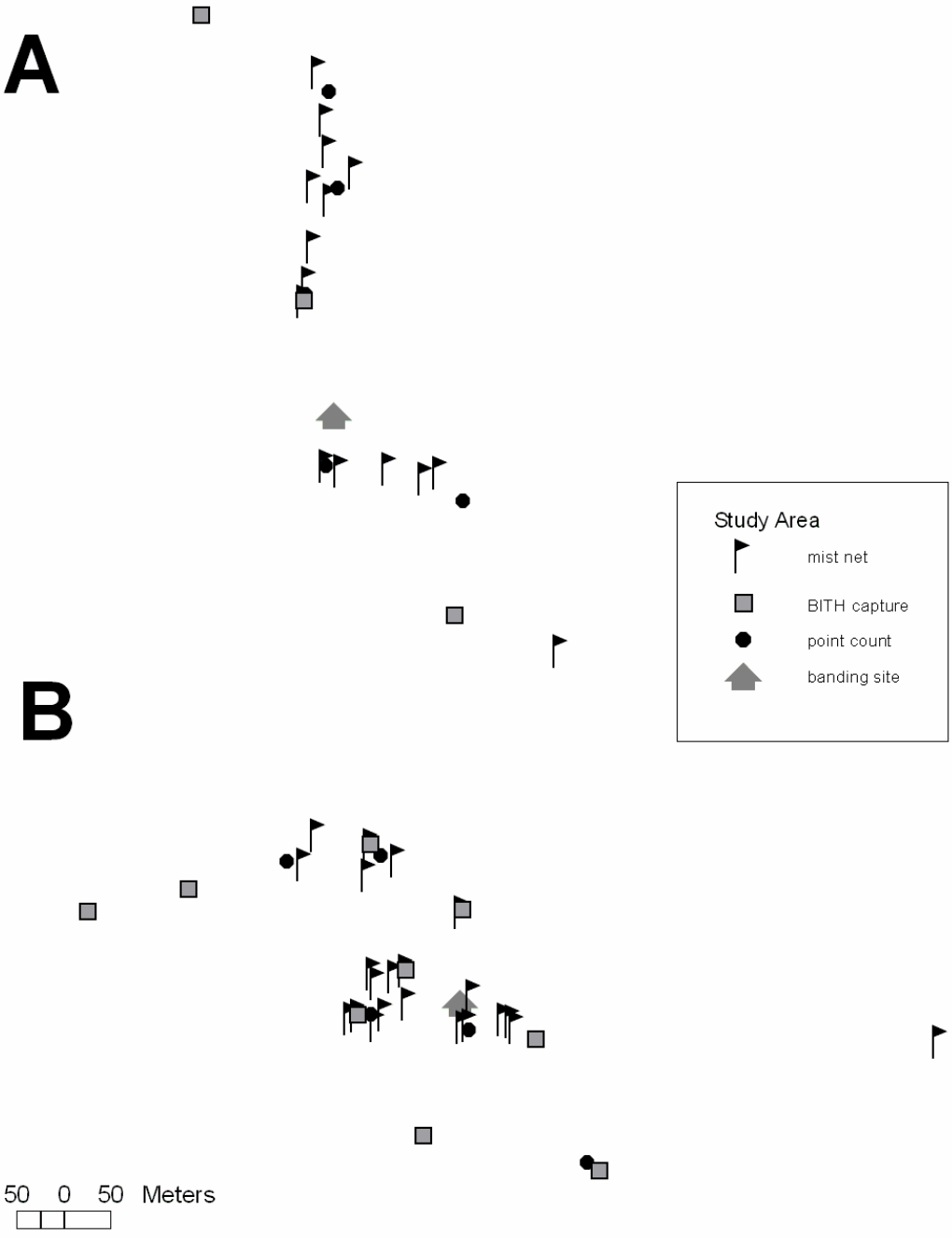


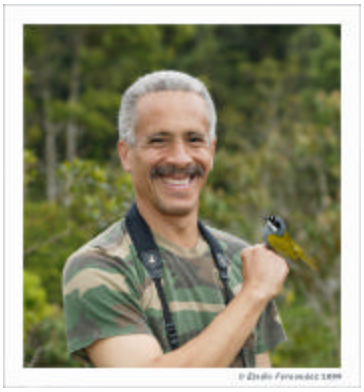
Figure 2. Schematic diagram of Rak Bwa (A) and Plaine Boeuf (B) study sites, Macaya Biosphere Reserve, February 2004.



Appendix:

Banding site at Rak Bwa

Field Team at Kay Michel



Philippe Bayard and Gray-crowned Palm-Tanager

Paul Judex Eduardzin with Red-legged Thrush

Clearing near Rak Bwa study site

Recently cut pine at Plaine Boeuf

Forest interior at Rak Bwa study site