THE COLUMBIA RIVER FOREST RESERVE

Little Quartz Ridge Expedition

A Biological Assessment

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INTRODUCTION

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A Rapid Environmental Assessment in the Little Quartz Ridge area of the Columbia River Forest Reserve was conducted in the month of February 1997. This Forest Reserve encompassed an area, calculated by Global Information System (GIS), of 39,630 hectares (97,894 acres). The Columbia River Forest Reserve includes habitats of broadleaf forest, montane forest, pine savanna, and secondary broadleaf forest (Zisman, 1996). The atea is considered to be mainly subtropical lower montane wet with some subtropical lower montane moist to the west and subtropical wet to the east (Holdridge, 1967). Terrestrial and aerial reconnaissance of similar terrain in adjacent countries indicates that this is one of the few large continuous tracts of relatively undisturbed evergreen forest left in Central America (Parker et aI., 1993).

To facilitate better timber management, the Columbia River Forest Reserve and a section of the Maya Mountains Forest Reserve were consolidated into one Forest Reserve (Columbia River Forest Reserve), now with an area of 60,000 hectares (148,357 acres). This consolidation was officially gazetted by the Minister of Natural Resources in Statutory Instrument No. 115 of November 1997.

The Columbia River Forest Reserve lies approximately at Latitude 16° 20'N and Longitude 89° 58' W (see map 1, p.90). The terrain within the reserve varies from 300-1,000 meters above sea level. Rainfall figures are unknown bur assumed to average over 2,540 mm (100 inches) per year (Hartshorn et aI, 1984), bur due to the complex topography, figures are likely to vary greatly between one location and the other.

The geology of the Columbia River Forest Reserve is highly complex bur consists mostly of limestone and associated karst features (see Holl~nd in this volume). A unique feature of the Columbia River Forest Reserve is Little Quartz Ridge, an isolated mounrainous ridge that extends a distance of approximately fifteen kilometers, trending northeast and lying near the northern limit of the karst foothills. The Little Quartz Ridge reaches an elevation of just over 1000 meters. Streams formed on its high summits (> 1000 meters) *Row* inro the surrounding carbonates 300 meters below, penetrating a few kilometers before disappearing in the karst..

Over sixty years ago, men called chicleros, searching the forests of Belize for chicle trees *(Manilkara zapota)* to tap during the rainy season, supposedly gave Little Quartz Ridge its name. This was due to the sharp "fin" of quartz-rich rocks located along the crest of the ridge. Even today, chicleros still "bleed" the chicle trees that are plenriful around the Little Quartz Ridge.

The forests of the Columbia River Forest Reserve were first studied in the *1920's.* L. H. Ower, an Australian geologist, examined the area for mineral resources between 1921-26 (Ower, 1928). When the boundary line between British Honduras and Guatemala was cut between 1920-26, an opportunity for botanical collections was opened, and a Belizean botanist, William A. Schipp, made the first collections there. Subsequently, D.G. Dixon (1955) prepared a geological map of southern British Honduras from fieldwork,

which was carried our from 1950-56, working for several months out of camps located in the vicinity of Quartz Ridge and the Machikilha River. This pioneer work gave rise to the basic understanding of the geology and soils. Emerging from this, were some of the more obvious relarionships between rock-soil-plant communities, and placed on record in the Land Use Survey report (Wright et aI., 1959). Declared a Forest Reserve in June 1954, over twenty years passed before any further inventories or fieldwork were undertaken (Forest Department, 1978). However, by rhis time, most of the primary timbers, cedar *Cedrela odorata,* mahogany *Swietenia macrophylla* and rosewood *Dalbergia stevensonii* had been extracted. The years 1925-1960 were those of maximum timber and chicle extraction within the Columbia River Forest Reserve.

A Critical Habitat Survey conducted by the Belize Center for Environmental Studies (BCES) in 1990 noted that the Columbia River Forest Reserve was in need of an ecological assessment. This led to a first rapid assessment of the area in December of that same year (Matola, 1991). This report created a growing interest in the area for more biological inventories. Some of the more interesting findings during that short field investigation included notation of a great diversity of tree species within the area.

A more detailed Rapid Biological Assessment of the Columbia River Forest Reserve in 1992 yielded several new plant genera and plant families for Belize. Many of the species recorded were only known from a few botanical collections (Parker et aI., 1993).

While it was clear that the limited fieldwork having occurred in the Columbia River Forest Reserve provided a window into its unique biological resources, what became obvious was the need for further investigations. This was underscored in the Draft Forest Management Plan for the Columbia River Forest Reserve (Bird, 1994). This Management Plan not only attempred to regulate the ongoing logging activities in the Forest Reserve bur also saw a need to base this management on sound scientific footing. One of the recognized needs was for a biological inventory of the area extending from the southeast slopes of the Little Quartz Ridge, east of Union Camp (map 3). The recommendation for this important field investigation was realized during February 1997. With major sponsorship by the National Resource Institute-Forest Planning and Management Project (NRIIFPMP), and with assistance from Conservation International (Cl), a two-week biological assessment was accomplished.

The following reports from field scientists participating in this 1997 expedition further acknowledge the unique and rich biodiversity of the Columbia River Forest Reserve. While, the February 1997 expedition focused on the area immediately south of the Little Quartz Ridge, this current report also includes results from expedirions into other areas of the Columbia River Forest Reserve. The combined information in this document will serve as an important tool for the future conservation strategies and management plans directed towards the forests of the southern Maya Mountains of Belize. Already, the plant species list for the Columbia River Forest Reserve encompasses nearly 1,000 plant species and with that, the Columbia River Forest Reserve and more specifically, the Little Quartz Ridge area is now probably the best floristically investigated area of Belize. Many other data, and specifically those from the entomological and herpetological surveys, indicate how poor our knowledge of this part of Belize still is and how much potential exists to make further discoveries.

The future of the Columbia River Forest Reserve depends on ongoing management by the Belize Forest Department. . Boundaries need to be enforced and it is hoped permanent camps can be established at San Miguel, Gloria Camp and Union Camp to serve as guard posts, research stations, and perhaps ecotourism destinations. Hopefully, hunting can be banned in the vicinity of these camps, alrhough, we are skeptical that a hunting ban could be enforced at the present time. The reality is that the ongoing logging activities facilitate access to hunters (see the section of mammals by Meerman), Based on experience wi th tourists and tourism in southern Belize over the past years, we believe that both Gloria Camp and Union Camp can become significant over-night or 2-3 day destinations for the more adventurous and hardy tourists if they are properly maintained and promoted, and trail access from San Jose is improved. But these destinations will only be attractive if, as suggested in the Parker et al. (1993) report, all hunting in the area is banned (and rigorously enforced) to allow the acclimation of the larger animal species to the presence of non-threatening humans.

Finally we would like to express our hope for more research into the Columbia River Forest Reserve. Knowledge of its resources may be the key to the survival of this unique area.

ACKNOWLEDGMENTS

The 1997 Columbia River Forest Reserve Expeditions were made possible through support by the Forest Planning and Management Project (FPMP), Forest Department, Ministry of Natural Resources, the National Resource Institute (NRI) and Conservation International (Cl).

Outstanding logistical support from British Forces Belize provided the opportunity for the movement of scientists and their specialized field equipment into some of the most remote areas of the sourhern Maya Mountains.

sharon Matola, Director of the Belize Zoo and Tropical Education Cenrer, was not only instrumental in organizing rhe expedition, but together with Martin Meadows and Greg sho, she also scouted the area, cleared trails and established camps prior to the expedition.

The Conservation Division of the Forest Department, Ministry of Natural Resources, provided scientific research permits.

We are also thankful to the friendly, hard-working people of Maya Cent er and San Jose who provided invaluable logistic support and, in addition, helped us during the daily collecting trips. Also, the field team of the Forest Planning and Management Project (FPMP) assisted in collecting data and shared their companionship in the field with us.

Brian Holland, in Punta Gorda, graciously provided space at his home to process the last day's collections and storage of the same while they were awaiting transportation.

Logistic and material support were also provided by the University of Miami, Belize Tropical Forest Studies. Gerrit and Jeany Davidse of the Missouri Botanical Garden kindly and efficiently processed the collections before identification and provided valuable support during the planr idenrification process.

Remarks on the Geology of the Columbia River Forest Reserve

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Introduction

Despite a long record of commercial logging in the Columbia River Forest Reserve dating back to at least the *1940s,* very little is known about the geology of the area. This contribution is based upon a review of relevam published work and a visit by the author in 1993 to the Columbia River Forest Reserve with the Forestry Management Project Team. Because of the dearth of geological information, this report attempts only to provide a basic description of the geology of the Columbia River Forest Reserve and how it relates to the landforms presem.

Columbia River Forest Reserve

The Columbia River Forest Reserve is located in southern Belize along the southeastern margin of the Maya Moumains. The reserve covers an area of 600 square kilometers and encompasses several geologically distinct, and in several instances, physically complex areas. These include the 1000 m high and 10 km long topographic feature known as Little Quartz Ridge and a large area of deeply karstified limestone bedrock. These physical habitats have evolved through geological processes over the last 65 million years. An understanding of the geology of the Columbia River Forest Reserve is important, not only for the management of the reserve but also for an understanding of the distribution of microclimates, the developmem of its soils, drainage, and ultimately, the evolution of the diverse communities that inhabit the Columbia River Forest Reserve.

Previous work

The geology of mainland Belize remains poorly known in detail. The cominemal margin of Belize and the Yucatan is a complex of upfaulted blocks (horsts) and downfaulted basins (grabens). The origin of this complex is related to the developmem of the still active Caribbean-North American plate boundary. For a comprehensive review of the literature on the origin of the Caribbean sea floor and continental margin adjacem to Belize see Pindell (1994) and Burkart (1994).

The earliest detailed geological observations made in Belize were those by Sapper (1889). His work was followed by Ower (1928) who published the firsr geological map of Belize and also a north-south geological cross-section through the Columbia River Forest Reserve, including Little Quartz Ridge. The cross section shows the bedrock of the Columbia River Forest Reserve to be composed oflate Paleozoic (Carboniferous-Permian) sedimemary rocks overlain by late Mesozoic (Cretaceous) limestones. His interpretation was confirmed by Dixon (1955) who described the geology of the region in some detail and also noted the occurrence of feldspar porphyry with quartz phenocrysts in the northernmost end of Little Quartz Riage. Dixon (ibid.) also recognized the extensive quartz veining in the Carboniferous and Permian sedimemary rocks around Little Quartz Ridge, hence the name "Quartz Ridge." Bateson & Hall (1976) further refined our knowledge of the geology of the Maya Mountains which lie adjacent to the Columbia River Forest Reserve and also revised Dixon's stratigraphy of the Carboniferous-Permian sequences present in southern Belize and within the Columbia River Forest Reserve. A more recem study by Sanchez-Barreda (1990) deals with the petroleum geology of southern Belize and is relevant to areas lying immediately east of the Columbia River Forest Reserve.

Geological processes forming the Columbia River Forest Reserve landscape

Two major geological processes have been acrive (and still are) in the formation of landforms within the Columbia River Forest Reserve-tectonic movements (faulting) and karstification (solution of limestone). The effects of these forces, however, are constantly being modified by erosion of bedrock and soils and by the deposirion of erosion products. Sediments are also being transported into the Columbia River Forest Reserve from the Maya Mountains.

Tectonics

The Columbia River Forest Reserve is situated on and adjacent to rhe sourhern margin of rhe Maya Mountains. The Maya Mountains represent an uplifred faulr block of pre-Cretaceous basemen t rocks with a partial cover of late Cretaceous limestones preserved mainly in the southwestern portion of the mountains (Dixon, 1955; Bateson & Hall, 1976). Several major faults have affected the Columbia River Forest Reserve; one is a NE-SW trending fault, termed here the Bladen River Fault, which defines the southeastern margin of the Maya Mountains. The other is the NW-SE trending Southern Boundary Fault Zone (Bateson & Hall, 1976) that forms the sourhern margin of the Maya Mountains and also includes the Little Quartz Ridge fault block. The Bladen River Fault appears to cut the Columbia River Forest Reserve and thus may be younger. Both faults are probably related to lateral movements of the Caribbean plate along the North America plare boundary demarcated by the Belize barrier reef escarpment (Lara, 1993; Pindell, 1994 and references therein).

Karstijication

The late Cretaceous limestones within the Columbia River Forest Reserve, like limestones within the Chiquibul Forest Reserve immediately north of the Columbia River Fotest Reserve, are intensely karsrified. This process has taken place throughout much of rhe Tertiary (65 million years) following uplift of rhis part of southern Belize in the early Tertiary. Karstification has modified the sutface topography of the limestone bedrock, creating typical" cockpit" landscapes; it has also formed vast subsurface cave systems, sinkholes and other collapse structures within the Columbia River Forest Reserve. Indeed, the cave systems in sourhwestern Belize are recognized as being amongst the largest in the world (Miller, 1996). The large-scale solurion of limestone has also yielded immense quantities of insoluble clay minerals that have been deposited in caves and on the surface. The Cretaceous limestones reach a thickness of several thousand meters away from the uplifted Maya Mountains (Sanchez-Barreda, 1990, and unpublished oil well dara). Due to erosion and solmion effects, (map 2) one can expect thickness of these limestones to be much less in the Columbia River Foresr Reserve.

Areas comprising the Columbia River Forest Reserve

Field work and a study of the topogtaphic map of the Columbia River Forest Reserve, shows that it comprises a complex of discrete landscapes, each with their own geologic history and development. Thus, the Columbia River Forest Reserve can be divided into the following sub-areas:

1. Little Quartz Ridge
2. Burgos Plain
3. Southern Karst Plateau
4. Sourhern Toledo Plain

Little Quartz Ridge

Little Quartz Ridge is the most prominent topographic feature within the Columbia River Forest Reserve. Rising more than 1040 meters amsl, Little Quartz Ridge is a sourheast dipping tilted fault block with a NE-SW trending elongate ridge. It is 10 km long and 2-3 km wide at its widest point with a steep escarpment on its west flank.. The fault block was formed along strike-slip movement of the Bladen River Fault in the late Tertiary.

Ourcrops of the Carboniferous-Permian rocks, mainly shales, occur in the southern end of Little Quartz Ridge in gullies where they are intensely folded, sheared and cut by quartz veins. Cretaceous limestones, preserved on the lower eastern slope of Little Quartz Ridge ate massive to thickly bedded, often recrystallised and karstified. Limestones appear to be absent along the crest of Little Quartz Ridge, probably due to intense dissolution and erosion. The bedrock surface on the western part of the crest (seen by the author) appears to be mainly composed of deeply weathered shales and siltstones, p"obably of Carboniferous-Permian age. The steep northern escarpment of Little Quartz Ridge has given rise to a series of small alluvial fans. These fans are composed of highly weathered, shales and other sedimentary rocks of presumCld Carboniferous- Permian age transported out onto the Burgos Plain (see below) by seasonal creeks flowing down the escarpment. It is likely that small alluvial fans are also being deposited along the southern margin of Little Quartz Ridge. Little Quartz Ridge is an area of net etosion; i.e. there is no deposition of sediments taking place on the ridge.

Burgos Plain

The Burgos Plain lies north of Little Quartz Ridge and takes its name from an old logging camp. It is approximately 40 square kilometers in area and roughly rectangular in outline. Compared to surrounding areas the Burgos Plain is relatively flat except for isolated, conical karst towers that punctuate the plain. Some of the towers are 50-60 meters high and several hundred meters in diameter at their base and contain numerous caves. The Burgos Plain is drained by a few meandering creeks, one of which flows into a sinkhole near the northwestern corner of Little Quartz Ridge. Creeks flowing into the Burgos Plain from the surrounding uplifted areas remain mostly on the periphery.

Down faulted relative to adjacent highlands, the Burgos Plain appears to have formed as a graben. To the north and east it is bordered by the Maya Mountains and to the south by the uplifted western escarpment of Little Quartz Ridge. To the west the plain is abruptly bordered by limestone hills. Unconsolidated fine-grained sediments with some poorly sorted coarser clasts of limestone, claystone and siltstones blanket the floor of the plain. Close to Little Quartz Ridge these sediments are derived from alluvial fans developed along Little Quartz Ridge's western escarpment. Further north on the plain these sediments are mainly clays and limestone clasts of varying size that appear to be derived from the karstification (solution) of the limestones underlying the entire plain. As there are few streams transporting sediments away from the plain, the Burgos Plain appears to be an area of net sedimentation, apart from the ongoing karstification of limestones.

Southern Karst Plateau

Occurring immediately south and west of Little Quartz Ridge, the Southern Karst Plateau is an exceedingly complex, karstified Cretaceous limestone terrain. It is characterized by steep walled, sharply meandering valleys that are often more than 120 meters deep, and numerous large sinkholes (individual sinkholes can be as wide as 0.5 km in diameter and more than 200 meters deep). The Southern Karst Plateau is bordered to the north by Little Quartz Ridge and to the east, south and west by the Southern Toledo Foothills. The Southern Karst Plateau is mainly drained by ephemeral streams and creeks that often appear to flow into sinkholes and fissures.

Southern Toledo Foothills

The Southern Toledo Foothills can be characterized as dissected, anticlinal hills formed of Cretaceous limestones, often karstified, and with a Tertiary clastic sediment cover that increases southward. Onlap of the Tertiary Toledo Formation on Cretaceous limestones (Sanchez-Barreda 1991; Prasada Rao & Ramanathan, 1988) can be clearly seen on the road near the village of San Jose. The Southern Toledo Foothills forms the southern and western part of the Columbia River Forest Reserve and may be faulted bounded to the Southern Karst Plateau in parts, especially the area north and northeast of San Jose. The transition from the Southern Karst Plateau to the Southern Toledo Foothills in the western part of the Columbia River Forest Reserve is gradual, and a distinct boundary between the two areas is often difficult to draw.

The Tertiary Toledo Formation sediments likely once covered much of the area, including the Southern Karst Plateau, but have subsequently been eroded from the Southern Toledo Foothills following uplift of the area along faults in the late Tertiary. Like the Southern Karst Plateau, the Southern Toledo Foothills are an area of net erosion. Creeks flowing into tributaries of the Rio Grande and Moho Rivers largely drain the area. However, drainage into sinks in the ubiquitously karstified Cretaceous limestone is common.

Summary and conclusions

The Columbia River Forest Reserve extends from the faulted southern margin of the Maya Mountains onto the upper foothills of the coastal plain of southern Belize. Geologically, the Columbia River Forest Reserve comprises four physically and structurally distinct landscapes. The landscapes of the Columbia River Forest Reserve have evolved through two primary geologic processes, faulting and karstification, with substantial modification of the landforms by erosion and, to a lesser extent, by sedimentation. In terms of their physical (topographical) complexity, one can rank the landscapes as follows:

In decreasing physical complexity

1. Southern Karstified Plateau
2. Southern Toledo Foothills
3. Little Quartz Ridge
4. Burgos Plain

Movements along major faults formed the Little Quartz Ridge tilted fault block and the Burgos Plain graben. Uplift along zones of faults also is likely to have played a role in the development of the other landscapes, the Southern Karst Plateau and the Southern Toledo Foothills. Intense karstification and erosion have modified the Cretaceous limestones to create a landscape of extremely complex valleys and ridges

with numerous sinkholes and extensive cave systems. These various geological processes were likely active throughout much of the Tertiary (65 million years) and are ongoing.

The bedrock geology of the entire Columbia River Forest Reserve is composed of Carboniferous-Permian sedimentary rocks, predominantly shales, siltstones and sandstones, overlain by massive to thickly bedded Creraceous limestones except on the crest of Little Quartz Ridge. No rocks of Triassic, Jurassic and Lower Cretaceous age have been recorded. The maximum thickness of the Cretaceous limestones within the Columbia River Forest Reserve is not known, however, sinkholes reveal a minimum thickness of at least 200 meters. In the southernmost part of the Columbia River Forest Reserve, Cretaceous limestones are partly overlain by the Tertiary Toledo Formation composed of clastic (turbidite) rocks. Southwards away from the Columbia River Forest Reserve the Toledo Formation thickens as the Cretaceous dips easrwards.

Rapid Vegetation Assessment at Little Quartz Ridge

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Methods

Four temporary plots representing two different vegetation types were surveyed by the joint Forest Department and Forest Planning & Management team (K. Shawe, N. Rosado, A. Howe, R. Leopoldo, and H. Mai). The location of the four plots is shown on map 1.0. Plot 1 was placed in vegetation type MPFOV (Montane Palm Forest over Volcanics-Iremonger & Brokaw, 1995) at the top of the Little Quarrz Ridge (1,030 m). Plots 2, 3 and 4 were placed in BHFLR/(Broadleaf Hill Forests over Limestone in Rolling or Flat Terrain-Iremonger & Brokaw, 1995) near Camps 2, 3 and 1, respectively (map 3 of site locations).

A 200 m transect was set up at each site by running a tape measure for 50 m in each direction of the compass. The transect was then surveyed in two different width bands-a) 4 m, representing a total transect area of 0.08 ha, and b) 10 m, representing a total transect area of 0.2 ha. Within the 4 m band, all seedlings, saplings and ttees were recorded. Foliage closure (verticallayering), canopy closure and soil pH were assessed at 10 In intervals along the transect.. The degree of vertical layering or foliage closure was assessed by recording the number of individual 1 m segments of a 15 m height pole that were intersected by branches, twigs or leaves. Canopy closure was estimated as the percentage closure using a spherical densitometer (Lemmon, 1957). One reading was taken with the densitometer at each 10 m point along the transect, with four additional readings being taken at a distance of 2 m from the transect point in each direction of the compass. Soil pH was measured every 10 m using a Kelway soil acidity and moisture tester, model HB-2.

Within the 10 m width band, the number of dead trees was recorded in three classes - standing, fallen, or tree stump, The occurrence of interesting life forms (such as yams, terrestrial bromeliads, erc.) was alsp assessed for each site. The dara gathered from both width bands was then used to assess the characteristics of each site in the context of a wider survey of selected vegetation types being conducted by FPMP..

Results

A total of 9,890 plant specimens were recorded. Of these, 21 specimens were unknown, and the remainder were found to represent 218 species in 66 plant families (see Appendix A for list of species by site). The most species-rich site was plot 2 (near Camp 2), with a total of 118 species. An assessment of the sp~cies composition at each of the four plots sampled shows that, as expected, plot 1 on top of the Little Quartz Ridge was the most distinct site, with 39 species (44% of the total) being only found in that plot (Table 1. Plot 4 (near Camp 1) was the least distinct, having only 9 species (10% of the total) thar were restricted to the plot). As only four sites were sampled, these statistics cannot be interpreted meaningfulJy. They do, however, provide an indication of the generallevel of variability within BHFLRF, and of the distinct nature of MPFOV..

It is interesting to note that nationally, the BHFLRF vegetation type as defined by Iremonger-Brokaw, is treated as three different vegetation types and seven subtypes (3, 3a, 3b, 4, 4a, 4b and 6a) in the Wright system. As parr of the wider survey of vegetation types, a total of 16 sites have been sampled within BHFLRF, representing all three differ-

ent vegetation types in the Wtight system, and four of the sub types (3a, 4, 4a and 6a). A cluster analysis based on all 16 sites surveyed by FPMP within BHFLRF, including those plots sampled at the base of the Little Quartz Ridge, suggests that this vegetation type is in fact highly variable.

Wright's vegetation map of Belize was based on very detailed ground truthing, but there is clearly an anomaly in the Little Quartz Ridge area. Despite the clear differences observed on the ground, the map shows Wright's vegetation type 12 as covering both rhe ridge top and the area below the south-western end of the ridge. According to Wright's vegetation map, plots 1, 2 and 4 are all classified as vegetation type 12, while plot 3 is classified as vegetation type 12a. Plots 2, 3 & 4 might have been expected to have fallen within Wright's vegetation type 4a, given the designation of the area along the southern base of the Little Quartz Ridge as BHFLRF under the Iremonger-Brokaw system.

The analysis carried out on the larger FPMP dataset for BHFLRF and five other vegeration types, including MPFOV,, shows that plot 1 on top of the ridge is distinct from all other sites surveyed (Shawe, 1998). The analysis also shows that plots 2, 3 and 4 are similar to the 13 other BHFLRF sites sampled in the wider survey. The dendro-grams produced by a cluster analysis on the BHFLRF dataset, using a range of different clustering algorirhms, consistently separate all sixteen BHFLRF sites surveyed into two main clusters, one containing sites in Wright's vegetation types 3a and 4a, the other containing sites in Wright's vegeration types 4 and 6a. Plots 2, 3 and 4 in the Little Quartz Ridge area are all grouped within the cluster containing the 3a and 4a sites. It is suggested therefore that the vegetation map produced by Wright should be amended for this area, and that plots 2, 3 and 4 should more correctly be classified as vegetation type 4a in the Wright System. The separation of Wright's sub types 4 and 4a into different clusters is intriguing and suggests that further field work is needed in order to assess this vegetation type properly.

MPFOV, rhe vegetation type on the top of the ridge itself, is totally protected in Belize but has not been described in the literature to date (see the provisional species list in Appendix A). The two most abundant taxa in plot 1 at the top of the ridge wete *Chamaedorea* sp. and *Euteipe precatoria,* which together represent 57% of all individuals sampled. The most interesting feature of the plot was the small number of *Colpothrinax cookii* individuals (2% of the total sampled), which contributed over a third (approximately 36%) of the total basal area recorded for the plor. This biogeographically interesting species is a canopy emergent to approximately 30 m. A total of 84 species were identified in the plot (not including epiphytes and bryophytes). Ferns were a particularly characteristic component of the species assemblage with four species *(Danaea elliptica, Lindsaea* sp., *Polybotrya* sp. and an unknown tree fern species) having more than 30 individuals in the area sampled (0.08ha). The tree ferns form the most characteristic component of the fern flora with 66 individuals being recorded, compared to a total of only 184 trees. Epiphytes were particularly abundant in this plot, with the Bromeliaceae being the most abundant group. Epiphytes in the Bromeliaceae were present on 152 out of 184 trees recorded within the plot. Being more exposed on top of the tidge, this plot also had a large number of dead trees.

On average for the three BHFLRF plots (plots 2, 3 & 4), 80.6% of the individuals were represented by just 14.3 % of the species. The number of individuals recorded in each of the four plots ranged from 1,929 in plor 1 011 top of Little Quartz Ridge to 3,762 in plot 3 near Camp 3 (table 1). The large number of individuals recorded at plot 3 is explained by the amount of regenerarion occurring at this site. The total basal area of trees and vines also varied significantly between plots, with plot 2 near Camp 2 having the largest total basal area (42.91 m^2 ha,l), This plot, which is in an area of relatively undisturbed fotest, also had a very high number of dead fallen trees. Plot 2 has emerged as the most species rich and distinct of all the 16 sites surveyed to date within BHFLRF by FPMP.

Each pf the sites surveyed on the wider FPMP survey has been ranked in order of importance for three attributes: conservation importance, the diversity of useful raxa, and overall structural diversity. Each species encountered was given a score for conservation importance and for uses importance. Structural diversity was scored differently by taking account of the structural data acquired for each site (foliage closure, canopy closure, dead t!;ees, interesting life forms, frequency of major epiphyte groups). Details of how the overall site scores and species scores were calculated are described in Shawe (1998). No statistically significant differences between rhe scores for foljage closure were detected for the sites surveyed. The overall importance score for structural diversity at plm 2, however, proved to be the highest of any site sampled in the wider FPMP survey. The high overall structural score for this plot appears to be mostly due to the contribution made to the total basal area of the site by three specimens of *Terminalia amazonia,* Together these represent 73.05% of the total (tree) basal area for the plot (table 2).

The overall importance score for uses was based on rhe number of known local and regional use categories for each species recorded and the frequency of these species at each site. Plot 1 (MPFOV) had the lowest overall uses score of all the sites included in the wider survey, and is also interesting in that the total conservation score for the plot is abour average for all the sites surveyed, despite only having 5 species which warranted a conservation score. This average score is mostly due to the abundance of jusr rwo species: *Euterpe precatoria* (frequency 158) and *Co/pothrirtCIX cookii* (frequency 34). These rwo species also made a significant contribution to the relatively high structural score for this plot..

Plot 3 (near Camp 3) which had very low numbers of trees and saplings, had the largest proportion of seedlings, with 81% of all the individuals recorded being seedlings. The amount of regeneration occurring may account for the distorted distribution of individuals among species, with 88% of the individuals at this site belonging to just 18 species. The relatively low degree of canopy closure and the correspondingly high variance in foliage closure at this plot are probably also significant factors. The most likely explanation for the amount of regeneration occurring is that the plot that had 51 individuals of *Martilkam zapota* was near an abandoned chiclero camp and has probably been disturbed in the recent past..

The soil at each of the four plots sampled had a similar range of pH, with plot 4 (near Camp 1) being the most variable (pH 4.6-6.2). The mean pH at each plot ranged from 4.93 at plot 3 (near Camp 3) to 5.64 at plot 4 (Table 1).

Conclusions

The fact that so few sites were sampled makes it difficult to draw anything bur general conclusions abour the relative importance of the Little Quartz Ridge area in relation to the rest of the CRFR. The data acquired represent the first quantitative datasets obtained for each of the rwo vegeration types surveyed. These data indicate that the plot surveyed at the top of the Linle Quartz Ridge (MPFOV) represents a very distinctive plant species assemblage. While this vegetation type is probably not under threat due to its limited distribution and the fact that it is totally protected and occurs on inaccessible ridge tops, it is of sufficient importance nationally to warrant continued protection.

AB far as BHFLRF is concerned, plot 2 has emerged as the most species rich and most distinct of the 16 sites surveyed so tiu by FPMP within this vegetation type (13 of which occur in the CRFR). The available maps indicate thar rhe geology of the area surveyed at the base of the ridge is variable. This fact, together with the distinctive nature of plot 2 and the obvious signs of disturbance at some points along the track running from Union Camp to Cabro, suggest that more anention should be paid to monitoring the levels of disturbance in this part of the core area of the CRFR. The plots surveyed also demonstrate the need for more detailed ground truthing of the vegetation classification system produced by Wright et a!. (1959) and Iremonger-Brokaw (1995). The rwo systems differ significantly in their treatment of the area covered by the expedition. The diversity of vegetation types and subtypes shown on the map produced by Wdght probably reflect the complex geology of the area. The Iremonger-Brokaw map, however, provides a clearer general picture of the vegetation of the area. Any subsequent survey work should focus on the area around Esperanza Camp, and should aim to carry our a more detailed survey of MPFOV on the ridge top.

Table 1 Little Quartz Ridge - summary of plot data

	Plot 1	Plot 2	Plot 3	Plot 4
Frequency (recorded in the 4 m wide transect)				
Total no. of individuals	1929	2165	3762	2034
Total no. of species	84	118	98	82
No. species restricted to each plot	39	34	24	9
As a % of total observed	43.8	27.8	24.7	10.9
No. of species with >30 individuals	13	16	18	9
As a % of total no. of species	15.48%	13.56%	18.37%	10.98%
As a % of total no. of individuals	83.41 %	77.69%	88.65%	75.47%
Total no. trees	154	121	86	89
Total no. saplings	606	523	553	562
Total no. seedlings	1005	1332	3050	1138
Other (herbaceous)'	164	189	73	245
Basal Area [m^2ha^{-1}] - recorded in the 4 m wide transect				
Approx. basal area-trees	39.59	42.79	29.38	21.11
Approx. basal area-vines	0.14	0.12	0.20	0.04
Approx. toral basal area	39.73	42.91	29.58	21.15
Epiphyte distribution				
(presence/absence of groups on each tree recorded in the 4 m wide transect				
Aroids	75	21	47	60
Bromeliads	152	50	38	51
Orchids	13	4	2	7
Cacti	0	0	1	2
Ferns	50	14	6	11
Other life forms (recorded in the 10 m wide transect)				
Yams	0	0	1	0
Terrestrial Bromeliaceae	0	0	0	0
Tree Ferns	66	5	0	0
Dead trees (recorded in the 10 m wide transect)				
Standing	44	33:	30	37
Fallen	53	67	34	29
Stumps	III	71	45	52
Termite nests (recorded in the 10 m wide transect)				
Arboreal	0	1	0	0
Terrestrial	1	0	0	0
Soil pH				
Mean soil pH	5.26 (n=15)	5.29 (n=18)	4.93 (n=21)	5.64 (n=21)
Observed range in soil pH	4.8-5.6	4.8-5.6	4.5-5.6	4.6-6.2

Table 2 Species with highest % of total basal area for each plot

Plot No.	Species	% of total basal area for plot
1	Colpothrinax cookii	36.38%
2	Terminalia amazonia	73.05%
3	Manilkara zapora	13.36%
4	Alchornea latifolia	20.87%

Appendix A

Plot I-MPFOV (Top of Little Quartz Ridge)

Name	sp.#	#
Chamaedorea sp.	73	958
Euterpe precatoria var. *longivaginata*	128	158
Psychotria elata	295	81
fnga sp.	169	71
Miconia impetiolaris	216	58
Critonia sexangularis	95	39
Damlea elliptica	107	39
Lindsaea sp.	186	38
TreeFern	357	37
Colpothrinax. cookii	89	34
Dryopreridaceae	275	34
Roupala montana	314	32
Myrcia splendens	231	30
Dendropanax sp. 1 *(arboreus ?)*	*109*	27
Cyathea ? Thelypteris?	102	26
Trichomanes sp.	360	26
Myrtaceae	233	24
Faramea occidentalis	131	22
Xylopia frutescens	460	17
Ardisia sp.	26	11
Clusia sp.	82	11
Nectandra sp.	239	10
Pseudolmedia spuria	290	10
Faramen sp.	132	9
Terminalia amazonia	352	8
Chamaedorea sp.2	74	7
Rubiaceae	316	7
Licaria sp.	185	6
Miconia hondurensis	215	6
Guatteria sp. (2 species)	147	5
Lysiloma acapulcense	190	5
Miconia holoseriaca	214	4
Zanthoxylum riedelianum	464	4
Alchornea latifllia	8	3
Calophyllum brasiliense var. rekoi	51	3
Ficus popenoei	140	3
Licania sp.	181	3
Nectandra hihua	237	3
Psychotria capitata	293	3
Calyptranthes megistophylla	52	2
Ficus sp.	141	2
Magnolia sp.	193	2
Miconia laevigata	218	2
Morinda panamensis	224	2
Nectandra coriacetl	234	2
Photina microcarpa	261	2
Psychotria trichotoma	301	2
Quercus sp.	305	2
Siparuna thecaphora	335	2
Unknown #29	395	2
Unknown #40	409	2
Aciostis rostellata	4	1
Bunchosia lindeniana	46	1
Chamaedorea spA	75	1
Clidemia sp.	81	1
Eugenia ft.rameoides	123	1
Fabaceae Type 3	130	1
Guarea sp. (2 species)	146	1
Hedyosmum mexicanum	155	1
Licania sparsipilis	182	1
Magnolia sp. 1	194	1
Magnolia sp. 2	195	1
Moraceae	222	1
Nectandra cuspidata	235	1
Nectandra globosa	236	1
Piper sp. 1 (M)	266	1
Pouteria reticulata	282	1
Psych~tria poeppigiana	297	1
Pterocarpus officinalis	301	1
Roupala sp.	315	1
Scutellaria orichalcea	324	1
Slotlnea meianthera	336	1
Sloanea tuerckheimii	337	1
Gleicheniaceae *(Sticherus?)*	344	1
Unknown	365	1
Unknown #1604	377	1
Unknown #30	398	1
Unknown #31	401	1
Unknown #32	403	1
Unknown #36	406	1
Unk11.own#39	407	1
Unknown #41	410	1
Xylopia sp.	461	1
Zinowiewia pallida	465	1

Plot 2-BHFLRF (Near Camp 2)

Name	sp.#	#
Unknown #48	418	565
Chamaedorea sp.	73	198
Fern #7	136	163
Calophyllum brasiliense var. *rekoi*	51	145
Euterpe prectuoria var.. *longivagintua*	128	86
Astrocaryum mexiccmurn	31	76
Guatteria sp. (2 species)	147	63
Cryosophilla stauracantha	99	59
Protium copal	266	53
Trophis racemosa	362	50
lnga sp.	169	43
Cupania belizensis	100	41
Oumtea lucens	248	40
Pseudolmedia spuria	290	38
Strychnos panamensls	345	32
Nectandra sp.	239	30
Pouteria reticulata	282	28
Psychotria simiarum	299	28
Vochysia hondurensls	455	26
Bactris major var.. *major*	34	23
Cassipourea guianensis	63	23
Lindsaea sp.	186	21
Acan thaceae	3	19
Faramea occidentalis	131	18
Sloanea tuerckheimii	337	17
Sideroxylon floribundum subsp. *belizense*	329	17
Aspidosperma cruentum	29	12
Laeistema agregatum	173	12
Terminalia amazonia	352	12
Pouteria campechiana	281	11
Heisteria media	156	8
Licania sp.	181	8
Pouteria amygdalina	280	6
Protium sp. 2	287	6
Quercus sp.	305	6
Tree Fern	357	6
Chameodom sp. 2	74	5
Critonia sexangularis	95	5
Miconia impetiolaris	216	5
Ardisia sp.	26	4
Cyathea? Thelypteris?	102	4
Dalium guianense	112	4
Drypetes brownii	115	4
Eugenia capuli	121	4

Name	sp.#	#
Euphorbiaceae	127	4
flex belizensis	166	4
Melasomataceae	211	4
Psychotria nervosa	296	4
Stemmadenia donnell-smithii	342	4
Symphonia globulifira	348	4
Trichospermum grewiiftlium	361	4
Unknown #45	415	4
Virola kO"chnyi	452	4
Coccoloba belizensis	86	3
Guettarda combsii	149	3
Licania sparsepilis	182	3
Manilkara zapota	206	3
Miconia tomentosa	220	3
Mouriri exllis	227	3
Myrtaceae	233	3
Piper sp.	265	3
Psychotria elata	295	3
Alchornea latifOlia	8	2
Annona squamosa	19	2
Annonaceae	20	2
Brosimum alicClJtrum subsp. *alicastrum*	44	2
Bunchosia lindeniana	46	2
Calyptranthes megistophylla	52	2
Cordia alliodora	90	2
Cordia sp.	93	2
Dend,;opanax. sp. *(arboreus?)*	109	2
Gum'ea sp. (2 species)	146	2
Pimenta dioica	264	2
Piper sp. 1 (M)	266	2
Siparuna thecaphora	335	2
Wild Cherry	459	2
Astronium graveolens	32	1
Calatola laevigattl.	49	1
Clusia sp.	82	1
Coccoloba acapulcensis	85	1
Coccoloba tuerckeimii	87	1
Croton draco	96	1
Cymbopetalum mayanum	104	1
Desm'lJrlchus orthacanthos	111	1
Licania hypoleuca	179	1
Learia sp.	185	1
Matayba apetala	209	1
Miconia hondurensis	215	1
Miconia lacem	217	1

Name	spot	#
Miconia laevigata	218	1
Miconia sp.	219	1
Mosquitoxylum jamaicense	225	1
Myrsinaceae	232	1
Picramnia antidesma subsp. *antideJma*	263	1
Psychotria quinqueradiata	298	1
Randia sp. *(aculeata* + other species)	306	1
Selaginella sp.	328	1
Swietenia macrophyla	347	1
Unknown #1076	368	1
Unknown #1193	369	1
Unknown #128	371	1

Name	spot	#
Unknown #1354	373	1
Unknown #1722	379	1
Unknown #1888	381	1
Unknown #1945	382	1
Unknown #249	389	1
Unknown #42	411	1
Unknown #43	413	1
Unlmown #44	414	1
Unknown #46	416	1
Unknown #47	417	1
Unknown #896	442	1
Unknown #979	445	1
Xylopitt fi"utescens	460	1

Plot 3-BHFLRF (Near **Camp** 3)

Name	spot	#
Unknown #29	395	1468
Eugenitt capuli	121	297
Chamaedorett.. sp.	73	278
Calophyllum bmsiliense var. *rekoi*	51	200
Cryosophila Jtauracantha	99	197
Ourarea lucem	248	163
Astrocaryum mexiCtlnum	31	133
Pouteria reticulata	282	110
Cupania belizensis	100	99
lnga sp.	169	70
Manilkara zttpota	206	51
Cassipourea guianensiJ	63	49
Trichilia mOJchata subsp. *moschata*	358	49
Nectandra sp.	239	39
Trophis racemostt	262	35
Protium copal	286	33
Acanthaceae	3	32
Fern #7	136	32
Euterpe precaroria var. *longivttginata*	128	29
Pouterid cttmpechiana	281	28
Drypetes brownii	115	22
LindJaea sp.	186	22
Pseudolmedia spurid	290	21
Strychnos pdnmnemis	345	21
Fammea occidentalis	131	18

Name	sp.#	#
Piper sp.	265	18
Desmoncus orthawnthos	III	16
Unknown #628	434	13
Mtttaybtt. apetala	209	12
Trichospermum grewiiflium	361	12
Guarea sp. (2 species)	146	10
Gleicheniadaceae *(Sticherus?)*	344	10
Cymbopetalum mayanum	104	9
Virola, koschnyi	452	8
Lacistema ttggregatum	173	7
Piper sp. 2 (5)	267	7
Bunchosia lindeniana	46	6
Calyptranthes megistophylla	52	6
Psychotria nervosa	296	6
Sideroxylon ftoribundum subsp. *belizeme*	329	6
Cynometra retUJtt	105	5
Sebastittna tuerckheimiana	327	5
Stemmadenia donnell-smithii	342	5
Terminalia amazonia	352	5
Vochysitt hondurel;Jsis	455	5
Ardisia sp.	26	4
Clusitl sp.	82	4
Coccoloba belizemis	86	4
Costus sp.	194	4
Dendropanax sp. I *(ttrboreus?)*	109	4

Name	sp.#	#
Guettarda elliptiCfl	150	4
Miconia impetiolariJ	216	4
Sloanea tuerckheimii	337	4
Annona reticulata	17	3
Heisteria media	156	3
Olym sp.	243	3
Piper sp.1 (M)	266	3
Trichomanes sp.	360	3
Aheis yucatanensiJ	11	2
Bauhinia divaricata	35	2
Danael1 elliptica	107	2
Dialium guianense	112	2
Miconia tomentosa	220	2
Mouriri exilis	227	2
Quaribea funebris	304	2
Unknown #222	388	2
Aristolochia sp.	28	1
Aspidospema megalocarpon	30	1
Bactris major var. *major*	34	1
Cordia alliodom	90	1
Erythroxylum guatemalense	120	1
Fern #815	138	1
Guatteria sp. (2 species)	147	1
Guatteria combsii	149	1
flex belizensis	166	1
Malpighiaceae	196	1
Miconia hondurensis	215	1
Moraceae Type 1	223	1
Palicollrea guianensis	250	1
Pem barbellata	259	1
Pimenta dioica	264	1
Pouteria amygdalina	280	1
Psychotria elata	295	1
Rinorea hummelii	310	1
Rubiaceae	316	1
Sapindus saponaria	321	1
Siparuna thecaphora	335	1
Swietenia macrophyllaJ	347	1
Symphonia globuliftra	348	1
Tetrosera vine	355	1
Tree Fern	357	1
Turpinia paniculata	363	1
Unknown #2119	386	1
Unknown #2130	387	1
Unknown #2652	390	1
Violaceae	451	1
Zanthoxylum riedelianum	464	1
Attalea cohune	33	1

Plot 4-BHFLRF (Near Camp 1)

Name	sp.#	#
Unknown #48	418	539
Chamaedorea sp.	73	340
Fern #7	136	238
Astrocaryum mexicanum	31	131
Calophyllurn bmsiliense var. *rekoi*	51	98
Gttatteria sp. (2 species)	147	72
Euterpe precatoria var. *longivaginata*	128	48
Psychotria elata	295	38
Protium copal	286	31
Cupania belizemis	100	29
fnga sp.	169	24
Cryosophila stauracantha	99	22
Sloanea tuerckheimii	337	22
Piper sp.	265	21
Lacistema aggregatum	173	20
7i'flphis racemosa	362	19
Miconia impetiolaris	216	16
Pseudolmedia spuria	290	16
Dendropanax sp. *(arboreus?)*	109	15
Nectandra sp.	239	15
Rubiaceae	316	14
Famrnea occidentalis	131	13
Terminalia amazonia	352	13
Famrnea sp.	132	12
Manilkara zapota	206	12
Xylopia sp.	461	11
Virola koschnyi	452	10
Ourarea lucentJ	248	10
Cyclanthaceae	103	8
Mouril'i exilis	227	8
Stemmadenia donnell-smithii	342	8
Strychnos panamensis	345	8
Alseis yucatanensis	11	7
Bactris major var, *major*	34	7

Name	sp.#	#
Licania sparsipilis	182	7
Miconia tomentosa	220	7
Pouteria campechiana	281	7
Cymbopetalum mayanum	104	6
Guarea sp. (2 species)	146	6
Hei,·teria media	156	6
Achomea latifolia	8	5
Aspidosperma cruentum	29	5
Costus sp.	94	5
Ga"cinia intermedia	142	5
Licania hypoleuCtl	179	5
Lindsaea sp.	186	5
Pouteria reticulata	282	5
Y;'ichilia moschata subsp. *moschtlta*	385	5
Dialium guianense	112	4
Poutaia amygdalina	280	4
Symphonia globulifera	348	4
Unknown #628	434	4
Cordia sp.	93	3
Drypetes brownii	115	3
Sideroxylon floribundum subsp. *belizeme*	329	3
Acanthaceae	3	2
Cyathea?. Thelypteris?.	102	2

Name	sp.#	#
Desmonchus orthacanthos	111	2
Psychotria navosa	296	2
Unknown #1951	383	2
Vochysia hondurensis	455	2
Annona reticulata	17	1
Aspidosperma megalocarpon	30	1
Cowipourea guianensis	63	1
Clethra occidentalis	80	1
Clidemia sp.	81	1
Clusia sp.	82	1
Croton draco	96	1
Eugenia capuli	121	1
flex belizensis	166	1
Melastomataceae	211	1
Platymiscium dimorphandrum	271	1
Protium sp.2	287	1
Pterocarpus officinalis	302	1
Stemmadenia sp.	343	1
Thevetia sp.	356	1
Tree Fern	357	1
Trichospermum *grewiifolium*	361	1
Verbenaceae	448	1
Vismia camparaguey	453	1

Botany Report of the Little Quartz Ridge Expedition-February, 1997 (including updates of 1992 RAP collection data)

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TECHNICAL REPORT

PART 1-SPERMATOPHYTES AND PTERIDOPHYTES

MATERIALS AND METHODS

Botanical specimens were collecred in the areas of Union Camp, Little Quartz Ridge summit and slopes, and along the southern and southeastern base of Little Quartz Ridge. Most material collected was fertile (with flowers or fruits), but sterile plants were gathered if considered important components of the vegetation or of interesting taxa. Extendible clipper poles to 11 m tall were used to gather tree, liana, and epiphyte specimens. Specimens were pressed between newspaper and placed in strong plastic bags with 70% Isopropyl Alcohol, later to be dried in plant presses. Live plants were collected and maintained in moist newspaper in open plastic bags; soil was removed prior to shipping.

634 vascular plant specimens were collected, each with an average of 4 duplicates. Approximately 50 of these specimens were lost during the incursion at Union Camp, but some of the plants were recollected near the end of the expedition. The first set of the specimens is deposited at the Herbarium of the Forestry Dept. in Belmopan, Belize (BRH). Additional sets will be deposited at MO, SEL,, and to taxonomic specialists. Approximately 50 live plants (Bromeliaceae, Orchidaceae, Gesneriaceae, Araceae, and Pteridophyta) were collected and are under cultivation at the Marie Selby Botanical Gardens in Sarasota, Florida.

For the plant list to be as comprehensive as possible, species collected during the 1992 Conservation International Rapid {\ssessment Program (RAP) trip are also included here (Hoist collection numbers 3864 to 4515) with updated identifications. Some of these come from areas along the main trail from San Jose, such as Gloria and American Camps, to the south and west of Little Quartz Ridge. See Parker et al. (1993) for information pertaining to collecting localities and other collection data. In addition, plants lisred in Meerman (1997) and Shawe (1998) from other parts of the Columbia River Forest Reserve are also included. Although the latter two sources contain data from throughout the CRFR, the focus here is on Broadleaf Hill Forests over Limestone in the eastern most sector of the Columbia River Forest Reserve. Also s~e Shawe (2003) in this volume.

OBSERVATIONS

A strong similarity between the summit of Li.tle Quartz Ridge and the Maya Mountain Divide was seen, particularly between the deep, shaded, cooler canyons and the high, moist part of the divide. Being smnewhat isolated from the main part of the divide, Little Quartz Ridge must play an important role in maintaining a higher degree of genetic diversity for both plants and animals in the region.

Plant diversity in general for the Little Quartz Ridge is high for Belize, and along with the divide is almost certainly the highest in the country. This is due to the wide range of topography of the Maya Mountains (400 -1140 m), strongly different types of bedrock

(granire, volcanic, limestone and orhers), relarively high rainfall, and low degree of human disrurbance. While rhere are no known endemic plants on Lirrle Quarrz Ridge (wirh the possible exception of an undescribed species of *Thelypteris),* the flora of the upper parts of the ridge is an excellent example of mid-montane Central American forests, which in other parrs of their range have been heavily disturbed by agricultural activities. While we made no arrempt to quantify the total number of species found on the ridge, a review of species collected at 800 m elevation or above yields the following numbers: Spermatophytes, 115 spp.; Ptetidophytes, 41 spp.; Bryophytes, 53 spp. These are indicated in rhe Plant List by the collection locality designated next to the collection as SL or SU, for slope or summit of Little Quartz Ridge. Several entire families are restricred to these higher elevations in Belize, such as Brunelliaceae, Magnoliaceae, and Chloranthaceae.

The largest spermatophyte families in the region are Araceae (20 spp.); Bromeliaceae (23 spp.); Orchidaceae (50 spp.); and Rubiaceae (33 spp.). Preridophyte representation was very high, accounting for approximately 21% of the vascular plant species. Ferns were also the group of vascular plants with the highest number of new country records. This was also true from the 1992 RAP trip collection, and highlights the hitherto poor knowledge of the regional flora.

The palm flora is fairly diverse in the area, and includes the widespread, bur patchily distributed *Colpothrinax cookii.* Until the early 90's, this species was believed to be restricted to Guatemala (Alta Verapaz) and eastetn Panama, but collections have now been made in Belize, Honduras, Nicaragua, and Costa Rica. *Colpothrinax cookii* forms elegant stands along nearly all of the higher ridges of the Little Quartz Ridge. Other common palms on the ridge were: *Chamaedorea* spp., *Euterpe precatoria* var. *fongivaginata* (previously identified as *E. macrospadix* in Belize), and *Synechanthus fibrosus.* The rare *Chamaedorea schippii* (previously identified as C. *graminijOlia* in Belize) was found on two different rocky limestone ridges neighboring the Little Quartz. Common palms in lower areas were *Calyptrogyne ghiesbreghtiana, Charnaedorea* spp., and *Astrocaryum rnexicanum.*

The epiphyte flora of the higher parts of the ridge was dramatically different from the surrounding lower areas as a result of the frequent high winds and rain. *Tilfandsia orogenes* (Bromeliaceae), a new species record for Belize, was common along the most windswept parts of the ridge and provided a bright display with its striking, red inflorescences. The colorful, *Vriesea-Iooking Tilfandsia mufticaufis* (Bromeliaceae) was also abundant at higher elevations, though in more protected areas. The large presence of "gray" *Tiffandsia* species (Bromeliaceae) throughout the area is a good indication that rainfall is limited at certain times of year. Other common epiphytes, hemiepiphytes, or stranglers throughout the area were *Anthurium* spp., *Monstera* spp. and *Philodendron* spp. (Araceae), *Oreopanax obtusiftlius* (Araliaceae), *Rhipsalis bacciftra* (Cactaceae), *Clusia* spp. (Clusiaceae), *Asplundia labefa* (Cyclanthaceae), *Satyria warszewiczii, Sphyrospermum cordijOfium* (Ericaceae), *Columnea su/fitrea* (Gesneriaceae), *Blakea cuneata* (Melastomataceae), *Ficus* spp. (Moraceae), *Dichaea* spp., *Encyalia* spp., *Elfeanthus* spp., *Epidendrurn* spp., *Maxiflaria* spp., *Pleurothallis* spp., and *Scaphygfottis* spp. (all Orchidaceae), *Hillia panamensis* (Rubiaceae), *Peperomia* spp. (Piperaceae), and a wide array of Pteridophytes.

Novelties or Rare Species

At least one new species for science was found on the trip, a species of *Thelypteris* (Pteridophyte), found near Camp 2 along a rocky creek bed and to be described later by Alan R. Smith (UC). An additional collection represents the second known gathering of *Acourtea belizeana* B.L. Turner, the first collection being from the upper Bladen River, and described as a new species only a few years ago.

One vascular plant family is new for the country from our collection, the Monotropaceae. The species, *Monotropa uniflora,* is a small reddish forest floor saprophyte that is usually associated with oak trees. The Monotropaceae is rarely collected, though fairly widespread throughout Central America.

The range of Brunelliaceae, which was only recently discovered in Belize (Alien *in* Matola 1995), was also slightly extended. We found *Bruneflia rnexicana* along deep, shaded, cool canyons on the southeastetn slopes of Little Quartz Ridge. It had only been known in Belize previously from the highest parrs of the Mrya Mountain Divide (and was first found there only in 1993).

A relatively high number of vascular plants (41 taxa, including 1 family, 5 g~nera, and 35 species) collected on the Little Quartz Ridge trip represent new records for the country. The majority of these came from either the summit of Lirrle Quartz Ridge, or from the deep, shaded, cool canyons on the sourhwestern slopes. Following is a listing of the family or major group, genus, species and author, and the corresponding collector and number.

New Records of Spermatophytes and Pteridophytes for Belize

New Families for Belize

Monotropaceae	*Monotropa uniflora* L.	Holst 5750

New Genera for Belize

Cyclanrhaceae	*Cyclanthus bipartitus* Poit.	HoIst 5823 (but also recorded in Meerman & Williams (1995).
Flacourtiaceae	*Macrohasseltia macroterantha* (StandI., & L.O. Wms.) L.O. Wms.	Holst 5840
Lophosoriaceae	*Lophosoria quadripinnata* (J.P. Gmel.) e.. Chr.. [var. *quadripinnata]*	Hawkins 1541
Tectariaceae	*Megalastrum lunense* (H. Christ) A.R. sm. & R.e.. Moran	Hoist 5820
Urticaceae	*Phenax mexicanus* Weddell	HoIst 5721

New Species for Belize

Araceae	*Monstera dubia* (Kunrh) Engl.. & K. Krause	Hoist 5947
Asreraceae	*Mikania pyrarnidata* Donn. sm.	Hawkins 1468
Begoniaceae	*Begonia manicata* Brongn. ex Cels.	Hawkins 1347
Bromeliaceae	*Tillandsia O/'ogenes* StandI.. & L.O. Wms.	Hawkins 1533; HoIst 5869
Bromeliaceae	*Tillandsia tricolor* Schltdl.. & Cham. [var. *melanocrater* (L.B. Sm.) L.B. Sm.]	HoIst 5986 (live)
Clusiaceae	*Clusia stenophylla* StandI..	Hawkins 1371; Hoist 4184,4408
Dryopteridaceae	*Stigmatopteris sordida* (Maxon) e.. Chr..	Hoist 5897
Gentianaceae	*Voyria truncata* (StandI.) StandI.. & Stqerm.	Hawkins 1416
Hymenophyllaceae	*Hymenophyllum sieberi* (e.. Presl) Bosch	Hoist 5974
Loganiaceae	*Strychnos panurensis* Sprague & Sandwith	HoIst 4272
Lomariopsidaceae	*Bolbitis hastata* (E. Fourn.) Hennipman	HoIst 5757
Lomariopsidaceae	*Elaphoglossum decursivum* Mickel	HoIst 5924
Melasromataceae	*Miconia glaberrirna* (Schltdl.) Naudin	Hawkins 1484, 1520
Melasromataceae	*Miconia gracilis* Triana	HoIst 5752, 5768, 5901
Melastomataceae	*Miconia nutans* Donn. Sm.	Hawkins 1404; HoIst 5925
Moraceae	*Ficus apollinaris* Dugand	Hoist 4190
Myrsinaceae	*Gentlea venosissima* (Ruiz & Pavon) Lundell	Hoist 5795
Orchidaceae	*Epidendrum phragmites* A.H. Heller & L.O. Wms.	HoIst 5793
Orchidaceae	*Oncidiurn cheirophorum* RchbJ.	HoIst 5694
Orchidaceae	*Pelexia callifera* (e.. Schweinf.) Kuntze	HoIst 4017
Passifloraceae	*Passiflora helleri* Peyr.	HoIst 5690, 5823 (but also recorded in Meerman & Williams (1995)

Piperaceae	*Peperomia emarginella* (Sw. ex Wiksrc.) C. DC..	HoIst 4066
Piperaceae	*Peperomia matlalucaensis* C. DC..	HoIst 4426
Preridaceae	*Adiantum trichochlaenum* Micked & Beirel	HoIst 5873
Rubiaceae	*Coussarea mediocris* StandI.. & Steyerm.	HoIst 5749
Rubiaceae	*Psychotria epiphytica* K. Krause	Hawkins 1431
Rubiaceae	*Psychotria orchidearum* Standi..	Hoist 5777
Sapindaceae	*Paullinia fibrigera* Radlk.	HoIst 4158
Sapindaceae	*Paullinia glomerulosa* Radlk..	Holsr 4109
Symplocaceae	*Symplocos limoncillo* Humb. & Bonpl..	Holst 4058
Thelypteridaceae	*Thelypteris decussata* (L.) Praetor [vac. *costaricensis* A.R. Srn.]	Holst 5819, 5919
Thelypteridaceae	*Thelypteris leprieurii* (Hook.) R.M. Tryon [vac. *subcostalis* A.R. Srn.]	Hawkins 1537
Thelypteridaceae	*Thelypteris sancta* (L.) Ching	Holsr 5968
Thelypteridaceae	*Trichomanes radicans* Sw.	HoIst 5815,5816
Verbenaceae	*Aegiphila martinicensis* Jacq.	HoIst 5664

PART 2-BRYOPHYTES

601 mosses, hepatics, and lichens were collected between 10 February and 24 February 1997 by Bruce Allen, and 28 mosses and hepatics by Bruce HoIst April 4-15, 1992. Plants were collected in paper bags and air-dried eirher in the field or immediately afterward. The first set of specimens will be deposited at the Herbarium of the Forestry Dept.. in Belmopan, Belize (BRH). An additional set of the mosses and hepatics will be deposited at MO, and the lichens at NY.

The following 37 taxa (1 family, 6 genera, 30 species), along with the corresponding collector and number, are reponed as new records for Belize.

New Records of Bryophytes for Belize

New Families for Belize

Ephemeraceae	*Ephemerum spinulosum* Bruch & Wr. Schimper	Allen 19082, 19094

New Genera for Belize

Brachytheciaceae	*Aerolindigia capillacea* (Hornschuch) Menzel	Allen 18687
Hookeriaceae	*Actinodontium standleyi* E.B. Battram	Alien 18760, 19003, 19021,19024
Dicranaceae	*Leucophanes molleri* C. Muller	AlIen 18775
Hypnaceae	*Ectropothecium leptochaeton* (Schwagrichen) W.R. Buck	Alien 18696, 18763
Lejeuneaceae	*Lepidolejeunea involuta* Gralle	AlIen 18926
Neckeraceae	*Thamnobryum tumidicaule* (K.A. Wagner) FD. Bowers	AlIen 18685

New Species for Belize

Bryaceae	*Brachymenium spirifolium* (C. Muller) Jaeger	Allen 18761
Calypogeiaceae	*Calypogeia peruviana* Nees & Momagne	Alien 18714
Daltoniaceae	*Daltonia pulvinata* Mitten	Allen 18660, 18677

Fissidentaceae	*Fis,'idens asplenioides* Hedwig	Alien 18708
Fissiden raceae	*Fissidens curvatus* Hornschuch	Alien 18875
Fissidentaceae	*Fissidens dubius* Palisor de Beauvois	Alien 18526, 19055
Fissidentaceae	*Fissidens lagenarius* Minen	Alien 18621, 18808, 18899, 18975,18991, 19007,19012
Fissidentaceae	*Fissidens oblongifolius* W.J. Hooker & Wilson	AlIen 18609, 18610A, 18637
Frullaniaceae	*Frullania gibbosa* Nees	Alien 19079
Hookeriaceae	*Callicostella vatteri* E.B. Banram	Alien 18865A
Hookeriaceae	*Cyclodicryon erubescens* E.B. Bartram	AlIen 18635, 18650
Hookeriaceae	*Hookeriopsis cruegeriana* (C Muller) Jaeger	Alien 18726
Hookeriaceae	*Hookeriopsis cwpidata* Jaeger	Alien 18545, 18610,18869,19054, 19061
Hookeriaceae	*Hookeriopsis guatemalensis* E.B. Bartram	Alien 18504, 18578, 18717A, 18880, 8891
Hookeriaceae	*Hookeriopsis subftlcata* (Hampe) Jaeger	Alien 18781
Hookeriaceae	*Lepidopilum cubense* (Sullivant) Mitten	Alien 18601
Hookeriaceae	*Lepidopilum muelleri* (Hampe) Spruce	Alien 18675
Hookeriaceae	*Lepidopilum surinarnense* C Muller	Alien 18712
Hookeriaceae	*Lepidopilum tortifllium* Mirten	Alien 18759, 18896
Hypnaceae	*Taxiphyllum ligulaefllium* (E.B. Bartram) WR. Buck	Alien 18552
Hypnaceae	*Vesicularia vesicularis* var. *portoricensis* (Bridel) WR. Buck	Allen 18514
Lejeuneaceae	*Cheilolejeunea decurviloba* (Srephan) He Xiao-Ian	Alien 18842
Lepidozoaceae	*Kurzia flagellifera* (Srephan) Grolle	Alien 18830
Mereoriaceae	*Squamidiurn macrocarpurn* (Spruce ex Mirten) Brorherus	Alien 18646, 18689, 18788, 18795,18885
Orthotrichaceae	*lvfacromitrium leprieurii* Montagne	Alien 18704,18737, 18882, 18985
Pilotrichaceae	*Pilotrichum fendleri* C. Müller	Alien 18513, 18579, 18584,18588,18623, 18748, 18765, 18794, 19033
Pilorrichaceae	*Pilotrichum ramosissimurn* Minen	Alien 18748B
Poniaceae	*Barbula arcuata* Griffirh	Alien 18724, 18797, 18867,19059
Radulaceae	*Radula husnotii* Casrle	AlIen 18680
Semarophyllaceae	*Trichosteleum bernoullianurn* (C Muller) Brorherus	Alien 19003B

PLANT LIST

The Plant List is divided up into Spermatophytes (114 families; 373 genera; ca. 635 species), Pteridophytes (52 genera; 130 species), and Bryophytes (79 genera; 166 species). The Spermatophytes are arranged in alphabetical order by family, genus, and species. The Pteridophytes are arranged alphabetically by genus, and the Bryophytes are arranged into mosses and hepatics, each alphabetically by genus.

Collector and number are also given, as well as the closest camp, or major collecting site. Abbreviations for the collecting localities are as follows: Camp 1 (Cl), Camp 2 (C2), Camp 3 (C3), Little Quartz Ridge slopes (SL), Little Quartz Ridge summit (SU), Union Camp (UC), Gloria Camp (GC), and "Broadleaf Hill Forest on Limesrone in Rolling or Flat Terrain" (BH). The latter does not represent a single locality but the total of a number of vegetation transects established by the Forest Planning and Manangement Project in this vegetation type within the Columbia River Forest Reserve (Shawe, 1998). Most transects in this vegetation type were taken in the eastern most section of the Columbia River Forest Reserve.

Plants listed under the Union Camp locality include those collected over a wide area, from the base of Little Quartz Ridge ro about half-way between Union Camp and Gloria Camp (700 - 800 m elevation), and partly includes the BH vegetation type sampled by Meerman (1997) and Shawe (1998).

The list contains only those collections identified to species and no attempt was made to separate the unidentified collections into morphotaxa. As a result, it is not possible to say how many species are known from the entire set of our collections, though when the final identifications are made, the list should not change considerably with the notable exception of the Piperaceae.

SPERMATOPHYTES

ACANTHACEAE	Collector, number	Collection Sites
Aphelandra aurantiaca (Scheidw.) Lindl..	*Hoist 4051*	UC
Justicia albobracteata Leonard	*HoIst 5643*	UC
Justicia bartlettii (Leonard) D.N. Gibson	*Hawkins* 1415; *HoIst 5642*	C2, UC
Justicia breviflora (Nees) Rusby	*Holst4025,4243,4245*	UC
Justicia candelariae (Gerst.) Leonard	*Hawkins* 1411	C2
Justicia fimbriiJta (Nees) V.A.W. Graham	*Hoist 5B92*	Cl
Justicia pectoralis Jacq.	*Hawkins 1436*	C3
Louteridium donnell-smithii S. Watson	*Hawkins* 1387; *Hoist 4045*	Cl, , VC, GC
Odontonema albiflorum Leonard	*Hawkins* 1439; *HoIst 5767*	C2, C3
Odontonema callistachyum (Schltdl.. & Cham.) Kuntze	*HoIst 3871*	UC
Odontonerna hondurensis (Lindau) D.N. Gibson	*Hawkins* 1373; *HoIst* 3873, 5939	Cl, UC
AGAVACEAE		
Yucca guatemalensis Baker	*Holst* 4454, *Shawe*	GC, BH
AMARANTHACEAE		
Cyathula achyranthoides (Kunth) Moq.	*Holst* 6017	UC
AMARYLLIDACEAE		
Crinum?	*Shawe*	

ANACARDIACEAE

Astronium graveolens	*Shawe*	BH
Metopium brownei	*Shawe*	BH
Mosquitoxylum jamaicense Krug & Vrb.	*Shawe*	BH
Spondias mombin	*Shawe*	BH

ANNONACEAE

Anaxagorea guatemalensis StandI..	*HoIst 5843*	SL
Annona reticulata	*Shawe*	BH
Annona scleroderma Saff.	*Holst4007*	VC
Annona squamosa	*Shawe*	BH
Cymbopetalum mayanum Lundell	*Holst4177,4195,Shawe*	VC,BH
Guatteria amplifllia Triana & Planch.	*Holst4198,* 4207, 4280, 5666	Cl, SV, VC
Malmea depressa (Bail!.) R.E. Fries	*HoIst 4115*	VC
Sapranthus campechianus	*Shawe*	BH
Xylopia frutescens	*Shawe*	BH

APOCYNACEAE

Aspidosperma cruentum Woodson	*HoIst* 4134, *Shawe*	VC,BH
Aspidosperma megalocarpon	*Shawe*	BH
Cameraria latifllia	*Shawe*	BH
Plumeria rubra	*Shawe*	BH
Sternmadenia donnell-smithii (Rose ex Donn. Sm.) Woodson	*Ho/rt* 4114, *Shawe*	VC,BH
Tabernaemontana arnygdalifllia Jacq.	*Holst4200*	VC
Tabernaemontana arborea Rose	*HoIst 5913*	SL
Thevetia ahouai (L.) A. DC..	*Holst 5934*	Cl

AQUIFOLIACEAE

flex belizensis	*Shawe*	BH
flex guianensis (Aub!.) Kunrze	*Holst4288,* 5789, 5905	SL, SV

ARACEAE

Anthurium bakeri Hook.f.	*HoIst* 3888, 5630	VC
Anthurium flexile Schon subsp. *flexile*	*HoIst* 4470	GC
Anthurium interruptum Sodiro	*Hawkins* 1408; *HoIst* 4024	C2, VC
Anthurium lucens Stand!..	*HoIst* 4241, 5910, 5998	SL, VC
Anthurium pentaphyllurn var. bornbaciflliurn (Schon) Madison	*HoIst 4116*	VC
Anthuriurn scandens (Aub!.) Eng!.. subsp. *scandens*	*Hawkins* 1480; *HoIst 4396*	SV, VC
Anthuriurn schlechtendalii Kunrh subsp. *schlechtendalii*	*HoIst* 4069	VC
Monstera acuminata K. Koch	*Holst4121, , 4382*	VC
Monstera dubia (Kunrh) Eng!'. & K. Krause	*HoIst 5947*	Cl
Philodendron aurantiiflliurn Schott	*Holst4437*	GC
Philodendron hederaceurn (Jacq.) Schott	*Holst4422*	GC
Philodendron radiatum Schott	*HoIst* 4303	SV
Philodendron sagittifllium Liebm.	*Hawkins* 1466; *HoIst 4499*	C3, GC
Philodendron s rnithii Eng!..	*Hawkins 1465*	C3

Philodendron tripartitum (Jacq.) Schort	*Hawkins* 1449; *Hoist 4388*	Uc,, C3
Rhodospatha wendlandii Schort	*HoIst* 4401, 4446	GC
Spathiphyllum blandum Schort	*HoIst* 4366, 5904	SL, UC
Syngonium macrophyllum Engl..	*Hoist 4201*	UC
Syngonium podophyllum Schott	*HoIst* 4057	UC
Xanthosoma cf mexicanum Liebm.	*HoIst* 4497	GC

ARALIACEAE

Dendropanax arboreus (L.) Decne. & Planch.	*HoIst* 4149, 4216	VC
Oreopanax obtusiftlius L.O. Wms.	*Hawkins* 1365; *Hoist* 4087,4491	UC,, GC
Scheffiera rnorototoni (Aub!.) Maguire, Steyerm. & Frodin	*Observed, Shawe*	UC,BH

ARECACEAE

Astrocaryum mexicanum Liebm.	*HoIst 4044*	VC,GC
Attalea cohune Mart..	*Shawe*	Observed in many localities around base ofLQR, but not on slopes or summit, BH
Bactris major. var. *major*	*Shawe*	BH
Bactris mexicana Mart.	*HoIst* 450 1	GC
Calyptrogyne ghiesbreghtiana H. Wend!..	*Hawkins* 1337; *Hoist* 4002, *Shawe*	UC,BH
Chamaedorea adscendens	*Shawe*	BH
Chamaedorea ernesti-augusti H. Wend!..	*HoIst* 4005	VC
Chamaedorea geonorniftrmis H. Wend!..	*Hoist* 3879, 3898, 4326, 5957, *Shawe*	Vc,, BH
Chamaedorea oblongata Mart..	*HoIst* 4104, 5969	VC
Chamaedorea pinnatifi'ons (Jacq.) Oerst.	*Hawkins* 1329, 1337, 1450A; *HoIst 3885,* 4l04A,, 4344, 5890, *Shilwe*	Cl, C3, VC,BH
Chamaedorea schippii Burret	*Hawkins* 1397; *HoIst 4330*	Cl, UC
Chamaedorea tepejilote Liebm.	*HoIst* 4387, 4409	UC,GC
Colpothrinax cookii Read	*Hoist* 4333, *5747,Shawe*	SL, SU, BH
Cryosophila stauracantha (Heynh.) R. Evans	*HoIst* 4210, *Shawe*	UC, Gc,, BH
Desmoncus orthacanthos	*Shawe*	BH
Desmoncus sp.	*HoIst* 4098	UC
Euterpe precatoria var. *longivaginata* (Mart.) Henderson	*HoIst* 4003, *Shawe*	SU, UC, BH
Geonoma interrupta (Ruiz & Pavon) Mart.	*HoIst 5891*	Cl
Reinhardtia gracilis (H. Wend!.) Burret	*HoIst* 4500	GC
Sabal mauritiiftrmis	*Shawe*	BH
Synechanthus fibrosus H. Wend!..	*Hawkins* 1362, 1448; *HoIst 3893*	Cl, C3, UC

ARISTOLOCHIACEAE

Aristolochia schippii Standl	*Meerman*	BH

ASCLEPIADACEAE

Marsdenia laxiflora Donn. Sm.	*Hawkins* 1549	SL

ASTERACEAE		
Acourtea belizeana B.L. Turner	*Hawkins 1395*	Cl
Baccharis trinervis Pers	*HoIst 5963*	VC
Bidens squarrosa Kunrh	*Hoist 5937*	Cl
Calea jamaicensis (L.) L.	*Hawkins 1498*	SV
Chromolaena odorata (L.) King & H. Rob.	*Hoist 6010*	VC
Critonia sexangularis (Kla([) King & H. Rob.	*Hawkins* 1492; *HoIst* 4269,5726, *Shawe*	SL, SV, BH
Fleischmannia pratensis (Kla([) King & H. Rob.	*Hoist 6019*	VC
Koanophyllon pittieri	*Shawe*	BH
Mikania houstoniana (L.) B.L. Rob.	*Hawkins 1354*	Cl
Mikania micrantha H.B.K..	*Hawkins* 1354A	Cl
Mikania pyramidata Donn. Srn.	*Hawkins 1468*	SV
Neurolaena lobata (L.) R. Br.	*HoIst* 6011, *Shawe*	VC, BH
Sinclairia polyantha (Kla([) Rydb.	*Hawkins* 1479; *Hoist 4126*	SV, VC
Smallanthus maculatus (Cav.) H. Rob.	*HoIst* 6013	VC
Verbesina oerstediana Benrh.	*Hawkins* 1473A	VC
BEGONIACEAE		
Begonia glabra Aubl..	*Hawkins* 1349,1552; *HoIst 5817*	Cl, SL
Begonia heracleifllia Schltd. & Charn.	*HoIst 3901*	GC
Begonia manicata Brongn. ex Cels.	*Hawkins 1347*	Cl
Begonia nelumbiifllia Schltdl.. & Charn.	*HoIst* 4373, 5999	VC
Begonia sericoneura Liebrn.	*HoIst 4035*	VC
BIGNONIACEAE		
Anemopaegrna chrysanthum Dugand	*Hoist* 4356	VC
Arrabidaea i naequalis (DC.. ex Splitg.) K. Schurn.	*HoIst* 4225, 4434	VC,GC
Arrabidaea podopogon A.H. Gentry	*HoIst 4262*	VC
Arrabidaea verrucosa (StandI.) A.H. Genrry	*HoIst* 4165, 4490	Vc, , GC
Arrabidaea viscida (Donn. Srn.) A.H. Gentry	*HoIst 4.420*	GC
Martinella obovata (Kunth) Bureau & K. Schurn.	*HoIst4118*	VC
Mussatia hyacinthina (Standil.) Sandwith	*HoIst 4315*	VC
Paragonia pyramidata (Rich.) Bureau	*HoIst* 4371, 4406	Vc, , GC
Pithecoctenium crucigerum (L.) A.H. Genrry	*HoIst* 4484	GC
Stizophyllum riparium (Kunrh) Sandwith	*HoIst* 4319	VC
Tabebuia chrysantha subsp. *chrysantha*	*Shawe*	BH
Tabebuia guayacan	*Shawe*	BH
Tabebuia rosea	*Shawe*	BH
Tynanthus guatemalensis Donn. Srn.	*HoIst* 4468	GC
BIXACEAE		
Bixa orellana	*Shawe*	BH
BOMBACACEAE		
Bernoullia flammea	*Shawe*	BH
Bombacopsis quinata Oacq.) Dugand	*HoIst* 4242	UC
Ceiba pentandra	*Shawe*	BH
Ochroma pyramidale	*Shawe*	BH

Pachira aquatica AubI..	*Hoist 4151*	UC
Pseudobombax ellipticum	*Shawe*	BH
Quararibea funebris	*Shawe*	BH
Quararibea pmckeri Srandl.. subsp. *Yunekeri*	*Hoist* 4062	UC

BORAGINACEAE

Bourreria oxyphylla	*Shawe*	BH
COldia oxyphylla	*Shawe*	BH
Cordia alliodora	*Shawe*	BH
Cordia glabra	*Shawe*	BH

BROMELIACEAE

Aeehmea lueddemanniana (K. Koch) Brongn. ex Mez	*Hoist* 4004, 4028	VC
Androlepis skinneri Brongn. ex Houller	*Hoist 4085*	VC
Guzmania lingulata (L.) Mez	*Hoist* 5715	Cl
Guzmania nicaraguensis Mez & c,P.. Baker ex Mez	*Hoist 5663*	Cl
Piteairnia imbrieata (Brongn.) Regel	*Hoist* 4162, 5634	SV, VC
Raeinaea sp.	*Hoist 5997*	Cl
Tillandsia aneeps Lodd.	*Hoist* 4046, 5983 *(live)*	VC
Tillandsia bulbosa Hook..	*Hawkins* 1396; *Hoist 4054*	Cl, VC
Tillandsia ef butzii Mez	*Hoist 3874*	VC
Tillandsia excelsa Griseb.	*Hoist 5679*	Cl
Tillandsia ftstucoides Brongn. ex Mez	*Hoist* 3872, 3887,4071,4379	VC
Tillandsia filiftlia SchltdI.. & Charn.	*Hoist* 4076, 5982	VC
Tillandsia juneea (Ruiz & Pavon) Poir.	*Hoist* 5981 *(live)*	Cl
Tillandsia leiboldiana Schlrdl..	*Hoist* 4053A, 5659	VC
Tillandsia monadelpha (E. Morren) Baker	*Hoist* 4140, 4430, 5720	Cl, Vc,, GC
Tillandsia multieaulis Sreud.	*Hoist* 4279, 5745	SL, SV
Tillandsia orogenes Srandl.. & L.O. Wrns.	*Hawkins* 1532; *Hoist 5869*	SV
Tillandsia pruinosa Sw.	*Hoist* 4072	VC
Tillandsia punetulata Schlrdl.. & Charn.	*Hoist 5725*	SL
Tillandsia trieolor var. *melanoerater* (L.B. Srn.) L.B. Srn.	*Hoist* 5986 *(live)*	VC
Vriesea helieonioides (Kunrh) Hook. ex Walp.	*Hoist 5714*	Cl
Werauhia viridiflora (Regel)].R.. Gram	*Hoist* 5713	Cl
Werauhia vittata (Mez & Werckle ex Mez) J.R. Gram	*Hoist 5801*	SL

BRUNELLIACEAE

Brunellia mexicana Standl.	*Holst* 5899	SL

BURMANNIACEAE

Gymnosiphon divaricatus (Benth.) Benth.	*Holst* 5621	UC

BURSERACEAE

Burse;"asimaruba (L.) Sarg.	*Observed, Shawe*	VC, BH
Protium ef. *glabrum* (Rose) EngI..	*Hoist* 4152, 4391	VC
Protium eopal (Sehlrdl.. & Charn.) EngI..	*Shawe*	BH
Protium sehippii Lundell.	*Hoist* 4079	VC
Tetragastrispanamensis (EngL.) Kunrze	*Shawe*	BH
Tetragastrisstevensonii Srandl..	*Shawe*	BH

CACTACEAE		
Epiphyllum crenatum (Lindl.) D. Don	*HoIst* 4483	GC
Epiphyllum oxypetalum (DC) Haw.	*HoIst* 4039	UC
Rhipsalis bacciftra (J.S. Mllell.) Steam	*Holst4427*	GC
CAESALPINIACEAE		
Bauhinia divaricata	*Shawe*	BH
Bauhinia guianensis Aubl..	*HoIst 4352*	UC
Cynometra retusa	*Shawe*	BH
Dialium guianense (Aubl.) Sandwith	*Hout4168,* 4170, *Shawe*	UC, GC, BH
Schizolobium parahybum (Veil.) S.F. Blake	*Shawe*	BH
Senna atomaria	*Shawe*	BH
CAMPANULACEAE		
Hippobroma longiflora (L.) G. Don	*Hout 6014*	UC
Lobelia sp., sect. *Revolutella* E. Wimm.	*Hout 5652*	UC
CARICACEAE		
Jacaratia dolichaula (Donn. Sm.) Woodson	*Holst* 4467	GC
CECROPIACEAE		
Cecropia obtusifolia	*Shawe*	BH
Cecropia sp.	*Observed*	UC
Coussapoa sp.	*Observed*	GC
Pourouma bicolor	*Shawe*	BH
Pourouma sp.	*Observed*	VC
CELASTRACEAE		
Crossopetalurn eucyrnosurn (Loes. & Pittier) Lundell	*Hout4032,* 4033, 4314, 4365	UC
May tenus guatemalensis Lllndell	*HoIst 5973*	UC
May tenus schippii Lllndell	*HoIst* 4053	UC
Wirnrneria bartlettii Lundell	*HoIst 4251*	UC
Zinowiewia pallida Lllndell	*Shawe*	BH
CHLORANTHACEAE		
Hedyosmum mexicanum C. Cordem.	*Hazukins* 1501; *HoIst* 4273, 5681, 5810, *Shawe*	Cl, C2, SU, BH
CHRYSOBALANACEAE		
Hirtella americana L.	*HoIst* 4237, *Shawe*	UC,BH
Hirtella racernosa var.. *hexandra*	*Shawe*	BH
Hirtella triandra Sw. sllbsp. *triandra*	*HoIst* 4167, 5677	Cl, UC
Licania hypoleuca Bemh.	*Hout* 5732, *Shawe*	SL, BH
Lietmia platypus	*Shawe*	BH
Licania sparsipilis	*Shawe*	BH

CLETHRACEAE		
Clethra occidendalis	*Shawe*	BH
CLUSIACEAE		
Calophyllum brasiliense var. *rekoi* (Standl.) Standl.	*Holst* 4094, 4186, *Shawe*	SU, Uc, , Gc, , BH
Chrysochlamys guatemaltecana OOl1n. Srn.	*Hawkins* 1360, 1364, 1407	Cl, C2
Clusia cf. *lundellii* Stal1dl.	*Hoist* 4378	UC
Clusia flava Jacq.	*Hoist 4180*	UC
Clusia guatemalensis Hernsl..	*Hawkins 1453*	C3
Clusia minor L.	*Hoist 3865*	UC
Clusia salvinii 001111.Srn.	*Hawkins 1481*	SU
Clusia stenophylla StandI..	*Hawkins* 1371; *Hoist* 4184, 4408	Cl, UC, GC
Garcinia cf. *intermedia* (Pinier) Harnrnel	*Hoist* 4175, *Shawe*	UC, BH
Symphonia globuliftra L.f..	*Hoist* 4185, *Shawe*	UC,BH
Tovornitopsis nicaraguensis (Oerst.) Planch. & Triana	*Hoist* 4013, 4189, 4407	Uc,, GC
Visrnia carnparaguey Sprague & L. Riley	*Hoist* 4097, *Shawe*	UC,BH
COMBRETACEAE		
Terminalia amazonia (J.F. Gmel.) Exell	*Holst* 4202, 4220, 4357, 4465,*Shawe*	UC, GC, BH
COMMELINACEAE		
Tradescantia zanonia (L.) Sw.	*Hoist* 4458	GC
Tripogandra grandiflora (001111.S111.)Woodsol1	*Hawkins* 1351; *Hoist* 4137	Cl, , UC
CONVOLVULACEAE		
Ipomoea setosa Ker Gaw!..	*Hoist* 4374	UC
Maripa nicaraguensis Hems!..	*Hoist* 4203, 4487	Uc,, GC
COSTACEAE		
Costus pulverulentus C. Presl	*Holst* 4332	UC
CUCURBITACEAE		
Gurania rnakoyana (Lern.) Cogn.	*Hawkins* 1341; *Holst4'b32,* 4263, 4392	Cl, , UC
Melothria pendula L.	*Hawkins* 1550; *Hoist 5723*	Cl, SL
Sicydium sp.	*Hoist* 4136, 4462	UC,GC
Sicyos sp.	*Hoist* 4064	UC
CYCLANTHACEAE		
Asplundia labela (R.E. Schult.) Hanlil1g	*Hoist* 4178, 4212	SU,UC
Cardulovica palrnata	*Shawe*	BH
Cyclanthus bipartitus Poit..	*Hoist 5823*	SL

CYPERACEAE		
Cam; polystachya Sw. ex Wahlenb.	*Hoist 5655*	UC
Rhynchospora cepha/otes (L.) Vahl	*Hoist 5790*	SL
Rhynchospora exa/tata Kunch	*Hawkins 1514*	SU
Rhynchospora radicans (Schhd!.. & Cham.) Pfeiffer subsp. *radicans*	*Hoist 6002*	UC
Rhynchospora watsonii (Brirron) Davidse	*Hoist 5697*	Cl
Scleria /atifo/ia Sw.	*Hawkins* 1405, 1516; *Hoist* 4060, 4278	*C2*, SU, UC
Scleria secans (L.) Urban	*Hoist 4300*	SU
CYRILLACEAE		
Cyrilla racemif/ora L.	*Ho/st4299*	SU
Purdiaea be/izensis (A.c.. Srn. & Srandl.)].L.. Thomas	*Hoist 5776*	SL
DILLENIACEAE		
Doliocarpus dentatus (Aubl.) Standl. subsp. *dentatus*	*Holst* 4206, 4297	SU, UC
DIOSCOREACEAE		
Dioscorea bartlettii C.V. Morton	*Holst* 4012	UC
DRACAENACEAE		
Dracaena americana	*Holst*	BH
ELAEOCARPACEAE		
S/oanea /aurifo/ia (Bench.) Benrh.?	*Hoist 5787*	SL, SU
Sloanea meianthera	*Shawe*	BH
Sloanea tuerckheimii Donn. Srn.	*Hoist* 4293, *Shawe*	SU, BH
ERICACEAE		
Satyria warszewiczii Klotzsch? (or *S. meiantha* Donn. Sm.?)	*Hawkins* 1445; *Hoist 4042*, 4182,4282,5695	Cl, *C3*, SU, UC
Sphyrospermum cordifolium Benth.	*Hawkins* 1369; *Ho/st 3868*	*Cl*, UC
ERYTHROXYLACEAE		
Erythroxylum guatemalense	*Shawe*	BH
EUPHORBIACEAE		
Acalypha diversifolia]acq.	*Hoist 4418*	GC
Acalypha gummifera Lundell	*Hawkins* 1399; *Hoist 5710*	Cl
Acalypha macrostachya	*Shawe*	BH
Alchornea !atifolia Sw.	*Hawkins* 1544; *Hoist* 4093, 4267, 5682, *5825, Shawe*	Cl,, SL, SU, UC,, BH
Bernardia interrupta (Schlrd!.) Muel!.. Arg.	*Hoist* 4112, 4421, *Shawe*	UC, Gc,, BH
Cleidion castaneifo/ium Muell. Arg.	*Hoist* 4009, 4099, 4174, 4223, 5811	*C2*, UC

Cnidoscolus multilobus	*Shawe*	BH
Croton draco	*Shawe*	BH
Croton glabellus	*Shawe*	BH
Drypetes brownii Standi..	*Shawe*	BH
Euphorbia ef, *lanciftlia* Sehltdl..	*Hoist 5649*	UC
Hyeronima alchorneoides Allernao	*Hoist* 4204	UC
Hyeronima oblonga (Tul.) Mudl.. Arg.	*Shawe*	BH
Jatropha curcas	*Shawe*	BH
Pera barbellata StandI..	*Shawe*	BH
Sapium sp.	*Hoist 5686*	Cl
Sebastiana confusa	*Shawe*	BH
Sebastiana cuspidata	*Shawe*	BH
Sebastiania tuerckheimiana (Pax & K.Hoffrn.) Lundell	*Hoist* 4056	UC
Tragia mexicana Muell. Arg.	*Hawkins 1344*	Cl

FABACEAE

Acosmium panamense (Benth.) Yakovlev	*Shawe*	BH
Andira inermis (W Wright) DC	*Shawe*	BH
Certtrosema plumieri (Turpin ex Pers.) Benth.	*Hoist 6015*	UC
Dalbergia cubilquitzemis (Donn. Srn.) Pittier	*Hoist* 4148	UC
Dalbergia stevensonii	*Shawe*	BH
Desmodium intorturn (Mill.) Urban	*Hoist* 4398	UC
Erythrina berteroana	*Shawe*	BH
Erythrina ftlkersii Krukoff & Mold.	*Hoist* 4080, 4450	UC,GC
Elythrina standleyana	*Shawe*	BH
Gliricidia sepium	*Shawe*	BH
Lonchocarpus castilloi	*Shawe*	BH
Machaerium if. riparium Brandegee	*Hoist* 4250	UC
Mucuna argyrophylla StandI..	*Hoist* 4471	GC
Ormosia ftlkersi ?	*Shawe*	BH
Ormosia macrocalyx Druce	*Shawe*	BH
Piscidia piscipula (L.) Sarg.	*Shawe*	BH
Platymiscium dimorphandrum	*Shawe*	BH
Pterocarpus officinalis	*Shawe*	BH
Swartzia cubensis var. cubensis (Britton & Wilson) StandI..	*Shawe*	BH
Tephrosia sp.	*Hoist 4451*	GC
Vcztairealundellii (Srandl.) Killip ex Record	*Hoist* 4504, *Shawe*	GC,BH

FAGACEAE

Quercus cortesii Liebm.	*Hoist* 4307	SU
Quercus imignis M. Martens. & Gal..	*Hawkim 1413*	C2
Quercus sp. (hybrid?)	*Hawki'ns 1520*	SU

FLACOURTIACEAE

Casearia arborea (L,e.. Rich.) Urban	*Hoist* 5844, 5865	SL, SU
Casearia arguta	*Shawe*	BH
Casearia bartlettii Lundell	*Hoist* 4117, 4256	UC

Casearia commersoniana Cambess.	*Hoist 5805*	C2
Casearia corymbosa	*Shawe*	BH
Casearia sylvestris Sw.	*Hawkins* 1377; *HoIst 5962*	Cl, UC
Casearia tremula (Griseb.) Griseb. ex C. Wright	*Holst4092,4214,4218*	UC
Hasseltia floribunda	*Shawe*	BH
Laetia procera	*Shawe*	BH
Laetia thamnia L.	*Holst4111,* 4259, *Shawe*	Uc, BH
Macrohasseltia macroterantha (Stand!.. & L.O. Wrns.) L.O. Wrns.	*HoIst 5840*	SL
Pleuranthodendron lindenii (Turcz.) Sleumer	*Hoist* 4466, *Shawe*	Gc, BH
Xylosma characanthum StandI..	*HoIst* 4353	UC
Xylosma oligandrum Donn. Srn.	*Hawkins 1380*	Cl
Zuleania guidonia	*Shawe*	BH

GENTIANACEAE

Voyria aparasitica (Schltd!.. & Cham.) Ruyters & Maas	*Hawkins* 1458; *HoIst* 4010	C3, UC
Voyria tenella Hook..	*Hawkins* 1456; *Hoist 5741*	C3, SL
Voyria truncata (Stand!.) Stand!.. & Steyerm.	*Hawkins 1416*	C2

GESNERIACEAE

Besleria laxiflora Benrh.	*Hoist 5896*	SL
Columnea purpurata J. Hans!..	*Hoist 5929*	SL
Columnea su/furea Donn. Srn.	*Hawkins* 1379; *Hoist* 4068, 5669, 5788	Cl, SL, UC

HELICONIACEAE

Heliconia aurantiaca Ghiesbr.. ex Lem.	*Hawkins* 1346; *HoIst* 3884, *Shawe, Meerman*	Cl, UC, BH
Heliconia bourgaeana O.G. Peters. (syn. H. champneiana)	Observed: American Camp, *Shawe, Meerrnan*	BH
Heliconia collinsiana Griggs	Observed: San Jose	
Heliconia librata Griggs	Observed San Jose to American Camp	
Heliconia mariae Hook.. f,	Observed: San Jose	
Heliconia cf. *tortuosa* Griggs	*Meerman*	C2
Heliconia vaginalis subsp. mathiasiae (Daniel & Stiles) L. Anderss.	Observed San Jose to American Camp, *Shawe, Meerrnan*	BH
Heliconia wagneriana O.G. Peters	*Meerrnan*	BH

HIPPOCRATEACEAE

Hippocratea volubilis L.	*Holst* 4089	UC

ICACINACEAE

Calatola laevigata Standl.	*Holst* 4494, 5872, *Shawe*	C2, GC, BH

IRIDACEAE

Neomarica variegata (M. Martens & Galeotti) Henrich & Goldblatt	*Holst* 4209	UC
Sisyrinchiurn tinctorium Kunth	*Holst* 5951	UC

LACISTEMATACEAE		
Lacistema aggregatum (P.J. Bergius) Rusby	*Hawkins* 1511; *HoIst* 4020, 5736, 5812, *Shawe*	C2, SL, SU, UC, BH
LAMIACEAE		
Hyptis capitata Jacq.	*Hoist 6012*	UC
Salvia miniata Fernald	*HoIst* 4022, 5895	Cl, UC
Scutellaria longifOlia Bemh.	*Hawkins* 1504, 1528; *Hoist 4301*	SU
Scutellaria orichalcea Donn. Sm.	*Hoist* 4016, 5654, 5785, *Shawe*	SL, UC, BH
LAURACEAE		
Beilschmiedia hondurensis Kosterm.	*HoIst* 4435	GC
Licaria capitata	*Shawe*	BH
Licaria peckii (I.M. JOhnsL) Kosterm.	*HoIst* 4128, *Shawe*	UC,, BH
Nectandra coriaceae	*Shawe*	BH
Nectandra cuspidata Nees & Mart.	*Hawkins* 1557; *Hoist 5729, Shawe*	SL, BH
Nectandra globosa	*Shawe*	BH
Nectandra hihua	*Shawe*	BH
Nectandra salicifolia	*Shawe*	BH
Ocotea cernua	*Shawe*	BH
Persea schiedeana	*Shawe*	BH
LENTIBULARIACEAE		
Utricularia sp.	*Holst* 5775	SL
LOGANIACEAE		
Spigelia humboldtiana Cham. & Schltdl.	*Hawkins* 1392,1418; *Hoist* 4043, 4342	C1, C2, UC
Strychnos brachistantha Srandl..	*HoIst* 4211, 4328	UC
Strychnos panamensis	*Shawe*	BH
Strychnos panurensis Sprague & Sandwirh	*HoIst 4272*	SU
Strychnos peckii B.L. Rob.	*HoIst 5739*	SL
LORANTHACEAE		
Oryctanthus cordifOlius (Presl) Urban	*HoIst 6000*	UC
Phoradendron crassifOlium (Pohl ex DC) Eichler	*HoIst* 4205	UC
Phoradendron chrysocladon A. Gray	*HoIst 5856*	SU
LYTHRACEAE		
Cuphea appendiculata Benth.	*HoIst 6005*	UC
Cuphea hyssopifOlia H.B.K.	*HoIst* 3877, 5954	UC

MAGNOLIACEAE		
Magnolia yoroconte Dandy	*Hawkins* 1553; *Holst* 4266, 5907	SL, SU
MALPIGHIACEAE		
Bunchosia guatemalensis	*Shawe*	BH
Bunchosia lindeniana A. Juss.	*HoIst* 4416, *Shawe*	GC, BH
Tetrapterys sp.	*HoIst* 4493	GC
MALVACEAE		
Hampea stipitata	*Shawe*	BH
Malvaviscus arboreus Cav.	*Holst* 6001, *Shawe*	UC,BH
MARANTACEAE		
Calathea crotalifera S. Watson	*HoIst* 4472	GC
Calathea rnicans (Mathieu) Koetn.	*HoIst 4372*	UC
MARCGRAVIACEAE		
Marcgravia schippii StandI..	*Holst4067*	UC
Souroubea sp.	*HoIst* 4309	SU
MELASTOMATACEAE		
Aciostis rostellata (Naudin) Triana	*Shawe*	BH
Arthrostemma parviftlium Cogn.	*Hoist 5949*	UC
Slakea cuneata StandI..	*Holst3878,4183,5704*	Cl, SU, UC
Clidernia involucrata DC..	*Hawkins* 1473; *HoIst* 4271, 5735	SL, SU
Graffenrieda galeottii (Naudin) L.O. Wrns.	*HoIst 5852*	SU
Miconia centrodesma Naudin	*Hoist 5766*	C2
Miconia desmantha Benth.	*HoIst 6006*	UCSL, SU
Miconia dodecandra (Dest.) Cogn.	*Hawkins* 1478; *Holst* 4268, 5737, 5866	SL, SV
Miconia glaberrima (Schltdl.) Naudin	*Hawkins* 1483, 1519	SV
Miconia gracilis Ttiana	*Holst5752*, 5768, 5901	C2, SL
Miconia holosericea (L.) DC..	*Holst* 5794, *Shawe*	SL, BH
Miconia hondurensis	*Shawe*	BH
Miconia impetiolaris (Sw.) D. Don vat. *impetiolaris*	*HoIst* 4001, 4414, *Shawe*	VC, GC, BH
Miconia lacera	*Shawe*	BH
Miconia laevigata	*Shawe*	BH
Miconia mirabilis (Aubl.) L.O. Wrns.	*HoIst* 4061	UC
Miconia nutans Donn. Srn.	*Hawkins* 1404; *H..0lst5925*	C2, SL
Miconia oinocrophylla Donll. Srn.	*Hawkins* 1482; *Hoist 5730*	SL, SU
Miconia prasina (Sw.) DC..	*Hawki.ns* 1471; *HoIst 5798*	SL, SU
Miconia tornentosa	*Shawe*	BH
Mouriri exilis Gleason	*HoIst* 4290, *Shawe*	SU, BH
Ossaea rnicrantha (Sw.) Macfad. ex Cogll.	*Hawkins* 1391; *HoIst 4447*	Cl, , GC

MELIACEAE

Carapa guianensis	*Shawe*	**BH**
Dedrela odorata	*Shawe*	**BH**
Guarea glabra Vahl	*HoIst* 4425	GC
Guarea grandifolia DC..	*Hoist* 4169, 5837	sL, UC
Swietenia macrophylla King	*Hoist* 4192, *Shawe*	UC,BH
Y;'ichilia erythrocarpa Lundell	*HoIst* 4052, 4248	UC
Y;-ichilia moschata subsp. moschata	*Shawe*	**BH**
Trichilia pallida Sw.	*Hoist* 4432	GC

MENISPERMACEAE

Abuta panamensis (StandI.) Krukoff & Barneby	*HoIst 4286*	SU
Cissampelos sp.	*Hoist* 4355	UC
Disciphania calocarpa StandI..	*HoIst* 4150, 4164	UC

MIMOSACEAE

Acacia collinsi saff	*Shawe*	**BH**
Calliandra belizensis	*Shawe*	**BH**
Calliandra houstoniana (MilL) Stand!..	*HoIst* 5711	Cl
Cojoba arborea (L.) Britton & Rose	*Hoist* 4055, *Shawe*	SU, UC, **BH**
Cojoba dormell-smithii Brinon & *Rose*	*HoIst* 4231	UC
Inga acrocephala steud.	*HoIst 5958*	UC
Inga affinis	*Shawe*	**BH**
Inga coc!eensis Pinier	*Hoist 4215*	UC
Inga davidsei M. sousa	*Hoist 4304*	SU
Inga multijuga Bench.	*Hoist 4383*	UC
Inga thibaudiana DC.	*Hoist 5824*	SL
Lysiloma acapulcense	*Shawe*	**BH**
Lysiloma latisiliquum	*Shawe*	**BH**

MONIMIACEAE

Mollinedia guatemalensis Perkins	*HoIst* 5927, *Shawe*	sL, **BH**
Siparuna thecaphora (Poepp. & End!.) A. DC..	*Hawkins* 1537; *Hoist* 3866,4078,5842, *5926*, *Shawe*	sL, SU, UC,, **BH**

MONOTROPACEAE

Monotropa uniflora L.	*Holst* 5750	C1

MORACEAE

Brosimum alicastrum subsp. alicastrum	*Shawe.*	BH
Brosimum guianense (AubI.) Huber	*Hoist 5781*	SL
Cmtilia elmtica subsp. elmtica	*Shawe*	BH
Dorstenia contrajerva L.	*Hoist 4481*	GC
Dontenia lindeniana Bureau	*HoIst* 3891, 5625	UC
Ficus apollinaris Dugand	*HoIst* 4190	UC
FiclIS colubrinae Stand!..	*Hawkins* 1365A; *Hoist 5936*	C1

Fials crassiuscu!a Warb. ex Srandl..	*Ho!st4063*	VC
Ficus guajavoides Lundell	*Ho!st4173*	UC
Ficus popenoei	*Shawe*	**BH**
Pou!senia armata (Miq.) Srandl..	*Shawe*	**BH**
Pseudo!rnedia g!abrata (Liebrn.) CC Berg	*Ho!st4172,5786*	SL, VC
Pseudo!media spuria (Sw.) Griseb.	*Ho!st* 4260, *Shawe*	Vc,, **BH**
Trophis mexicana (Liebrn.) Bureau	*Hawkins* 1327, 1390; *Hoist* 3886,4124, 5680, 5706, 5966	Cl,, VC
Trophis racemosa	*Shawe*	BH

MYRISTICACEAE

Cornpsoneura sprucei (A. DC) Warb.	*Hoist* 4424	GC
Virola kosc/myi Warb.	*Ho!st* 5809, *Shawe*	C2, **BH**

MYRSINACEAE

Ardisia cornprma H.B.K..	*Ho!st* 4084, 5644	VC
Ardisia guianensis (Aubl.) Mez	*Hoist 4015*	VC
Ardisia nigrescens Oersr..	*Hoist* 4240	VC
Aldisia nigropunetata Oersr..	*Ho!st 4393*	VC
Ardisia paschalis Donn. Srn.	*Ho!st* 41 07, *Shawe*	Vc,, **BH**
Aldisia schippii	*Shawe*	**BH**
Gent!ea micranthera (Donn. Srn.) Lundell.	*Ho!st 5863*	SU
Gentlea venosissima (Ruiz & Pavon) Lundell.	*Hoist 5795*	SL
Partlthesis sessi!ift!a Donn. Srn.	*Hawkins* 1331, 1332; *Ho!st* 4096, 4358, 5946	Cl, VC

MYRTACEAE

Cal.yptranthes if. chytracu!ia (L.,) Sw.	*Ho!st* 4160, 4348	VC
Cal.yptranthes cuneiftlia Lundell	*Ho!st 5796.*	SL
Cal.yptranthes rnegistophyl!a StandI..	*HoIst4157,4227,* 5696, *Shalue*	Cl, UC, BH
Charnguava gentlei	*Shawe*	**BH**
Chamguava schippii	*Shawe*	**BH**
Eugenia capu!i	*Shawe*	BH
Eugenia co!oradensis	*Shawe*	**BH**
Eugenia ftrameoides	*Shawe*	**BH**
Eugenia origanoides O. Berg	*Ho!st 5952*	VC
Eugenia sp.	*Ho!st 5885*	Cl
Myrcia sp!endens (Sw.) DC	*Ho!st* 4291, *Shawe*	SV, **BH**
Myrciaria cf. *floribunda* (West ex Willd.) O. Berg	*Hoist* 3895, 4247	VC
Pimenta dioica (L.) Merr..	*Ho!st* 4113, *Shawe*	Vc,, **BH**
Psidium sartorianum	*Shawe*	BH

NYCTAGINACEAE

Pisonia aculeata L.	*Holst* 4122, 5884	C1, UC

OCHNACEAE		
Ouratea lucens	*Shawe*	BH
Ouratea sp.	*Hoist 5774*	SL
OLACACEAE		
Heisteria media S.F. Blake	*Holst* 4486, *Shawe*	GC, BH
OLEACEAE		
Chionanthus oblanceolatus (B.L. Rob.) P.S. Green	*Hawkins* 1441; *Hoist* 4120, 4411, 5676, *5678; Shawe*	*Cl, C3,* VC, *GC,* BH
ORCHIDACEAE		
Beloglottis sp.	*Hoist 4369*	VC
Coelia bella (Lern.) Rchb.f	*Hoist* 4129	UC
Cranichis Jylvatica A. Rich. & Galeotti	*Hoist 5671*	Cl
Cyclopogon sp.	*Hoist 5719*	Cl
Dichaea glauca (Sw.) Lind!..	*Hawkins 1488*	SU
Dichaea panamensis Lindl..	*Hoist* 5970, *Meerman*	UC,, BH
Elleanthus caricoides Nash	*Hawkins* 1444; *Hoist 5938*	*Cl,* C3
Elleanthus graminiftlius (Barb. Rodl'.) Lojrnanr	*Hoist 3896*	UC
Emyalia cf *abbreviata* (Schltr.) DressIer	*Hoist* 4163	UC
Emyalia baculus (RchbJ.) DressIer & G.E. Pollard	*Hoist 5783*	SL
Eruyclia cochleata (L.) Lernee	*Hoist* 5894, *Mm'man*	Cl,BH
Encyclia polybulbon (Sw.) DressIer	*Hoist* 4101	UC
Epidendmm isomerum Schltr..	*Hawkins 1426*	C2
Epidendrum nitens Rchb.f	*Hawkins 1522*	SU
Epidendrum paranthicum Rchb.f	*Hawkins* 1485,1527; *Hoist 5848*	SU
Epidendrum phragmites A.H. Heller & L.O. Wrns.	*Hoist 5793*	SL
Epidendrum rigidum	*Meerm'an*	BH
Gongora sp.	*Hawkins 1417*	C2
Kegeliella kupperi Mansf	*Hoist* 4019	UC
Lacaena sp. [cf]	*Hoist* 4274	SU
Lockhartia hercodonta RchbJ. ex Kraenzl..	*Hawkins 1489*	SU
Maxillaria aciantha Rchb.f	*Hoist* 4103; 5990 *(live)*	UC
Maxillaria cf *elatior* Rchb.f	*Hoist 4130*	UC
Maxillaria cucullata Lind!..	*Hawkins* 1464, 1524; *Hoist 5802*	*C3,* SL, SU
Maxillaria densa Lind!..	*Hawkins 1434*	C3
Maxillaria fitgens (RchbJ.) L.O. Wrns.	*Hoist 5778*	SL
Maxillaria uncata Lind!..	*Hoist* 4197	UC
Maxillaria variabilis Barernan ex Lind!..	*Hoist 5803*	C3
Myoxanthw oetomerioides	*Meerman*	BH
Oncidium ascendens	*Meerman*	BH
Oncidium cheirophorum Rchb.f	*Hoist 5694*	Cl
Ornithocephalus gladiatus Hook..	*Hoist* 4086	UC
l'elexia calliftra (C. Schweinf) Kunrze	*Hoist* 4017	UC
l'elexia laxa (Poepp. & End!.) Lind!..	*Hoist 4476*	GC
l'elexia richardiana (Schltr.) Garay	*Hoist* 4026	UC

Platythelys if. querceticola (Lindl.) Garay	*HoIst* 5717	Cl
Platythelys vaginata (Hook.) Garay	*Hoist 5718*	Cl
Pleurothallis cardiothallis RchbJ.	*Hawkins 1381*	Cl
Pleurothallis cobanensis Schltr..	*HoIst 5799*	SL
Pleurothallis erinacea RchbJ.	*Hawkins* 1510	SV
Pleurothallis pansamalae Schltr.	*Hawkins 1493*	SV
P09,stachya ftliosa (Lindl.) RchbJ. [vel sp. aff]	*HoIst 4254*	VC
Ponera striata Lindl..	*HoIst* 4238	VC
Prescottia stachyodes (Sw.) Lindl..	*Hoist 5692*	Cl
Psygmorchis sp.	*Hawkins 1339*	VC
Scaphyglottis leucamha Rchb.f	*Hawkins 1423*	C2
Scaphyglottis lindeniana (A. Rich. & Galeorri) L.O. Wrns.	*Hawkins* 1546; *Hoist 5800*	SL, SV
Scaphyglottis longicaulis S. Watson	*HoIst* 5994 *(live)*	VC
Scaphyglottis prolifera Cogn.	*HoIst 4139*	VC
Ji-ichosalpinx blaisdellii (S. Watson) Luer	*HoIst 4166*	VC
Trigonidium egertonianum Bateman ex Lindl..	*HoIst* 4181	VC
Vanilla hartii Rolfe	*Hawkins 1462*	C3
Vanilla planiftlia Jacks. ex Andrews [vel sp. aff.]	*HoIst* 4234	VC

PASSIFLORACEAE

Passiflora ambigua Hemsl.	Observed San Jose to American Camp, *Meerman*	BH
Passiflora biflora Lam.	Observed Vnion Camp, *Meerman*	UC, BH
Passiflora guatemalensis S. Watson	*Hoist* 4138, *Murman*	Vc;, BH
Passiflora helleri Peyr.	*HoIst* 5690, *Meerman*	Cl, BH
Passiflora lancetillensis (Sp. Nov. Ined. J.M. MacDougal)	*HoIst* 4144	VC
Passiflora obovata Killip	*Holst4194,4455,5691*	Cl, VC, GC
Passiflora oerstedii var. choconiana (S. Watson) Killip	*Hoist* 4345	VC
Passiflora pittieri Masters	Observed American Ca~p to Vnion Camp, *Meerman*	BH
Passiflora serratifolia L.	Observed San Jose to Camp 1, *Meerman*	BH

PHYTOLACCACEAE

Phytolacca rivinoides Kunth & Bouché	*Holst* 4469, 5618	GC

PIPERACEAE

Peperomia c!aytonioides Kunrh	*Hawkins* 1424; *Hoist 5959*	C2, VC
Peperomia deppeana Schltdl.. & Cham.	*HoIst* 4415	GC
Peperomia distachya (L.) A. Dietr..	*Hawkins* 1374; *HoIst 5878*	Cl
Peperomia emarginella (Sw. ex Wiksrr.) C. DC..	*Hoist* 4066	VC
Peperomia hirta C. DC..	*Hoist 5808*	C2
Peperomia maculosa (L.) Hook..	*HoIst 5627*	VC
Peperomia matlalucaensis C. DC..	*Hoist* 4426, 5620	GC, VC
Peperomia obtusiftlia (L.) A. Dietr.	*Hawkins* 1335, 1367	Cl, VC
Peperomia petrophila C. DC..	*Hawkins* 1412; *Hoist 5701*	Cl, C2
Peperomia urocarpa Fisch. & C.A. Mey.	*Hawkins* 1447; *HoIst* 5674,5880	Cl, C3

Peperomia spp. (ca. 5 additional species)		
Piper aequale Vahl	*HoIst* 4294	SU
Piper arboreum Aubl..	*HoIst 5903*	SL
Piper glabrescens (Miq.) C.. DC..	*HoIst 4361*	UC
Piper pseudoft.ligineum C.. DC..	*HoIst 6007*	UC
Piper sanctum Schltdl.. ex Miq.	*Hawkins 1442*	C3
Piper spp. (ca. 5 additional species)		

POACEAE

Ichnanthus pallens (Sw.) Munro ex Benrh.	*Hawkins* 1432; *HoIst 5916*	C3, SL
Isachne pubescens Swallen	*Hawkins 1467*	SV
Lasiacis sorghoidea (Desv.) Hitchc. & Chase	*Hawkins 1334*	VC
Olyra glaberrima Raddi	*Hoist 3892*	VC
Olyra latiftlia L.	*Hawkins* 1409; *HoIst* 4155, 5908, 5955	C2, SL, VC
Oplismenus burmannii (Retz.) P. Beauv.	*Hoist 4351*	VC
Oplismenus hirtellus (L.) P. Beauv. subsp. hirtellus	*Hawkins 1356*	Cl

PODOCAPACEAE

Podocarpus guatemalensis var. pinetorum Buchh. & n.E.Gtay	*Shawe*	BH

POLYGONACEAE

Coccoloba acapu!caensis StandI..	*Hoist* 4239, *Shawe*	Vc,, BH
Coccoloba belizensis StandI..	*Hoist* 4156, *Shawe*	Vc,, BH
Coccoloba diversiftlia Jacq.	*Hawkins 1455*	C3
Coccoloba tuerckheimii Donn. Srn.	*HoIst* 4228, *Shawe*	Vc,, BH

PROTEACEAE

Roupala montana Aubl.	*Holst* 4050, 5972, *Shawe*	UC, BH

RHAMNACEAE

Rhamnus cf. *sphaerosperma Sw.*	*Holst* 4221	UC

RHIZOPHORACEAE

Cassipourea guianensis Aubl.	*Holst* 4308, 5851, *Shawe*	SU, BH

ROSACEAE

Photinia microcarpa Standl.	*Holst* 4258, *Shawe*	UC, BH

RUBIACEAE

Alseis yucatenensis ,	*Shawe*	BH
Amaioua corymbosa Kunrh	*Shawe*	BH
Chiococca alba (L.) Hitchc.	*Hoist* 4249	UC
Coccocypselum herbaceum P. Browne	*Hawkins 1503*	SU
Coccocypselum hinutum Bart!. ex DC..	*Hoist 5855*	SU
Coussarea mediocris Srandl.. & Sreyerrn.	*HoIst 5749*	C1

Diodia sarmentosa Sw.	*Hoist 6016*	UC
Faramea occidentaLis (L.) A. Rich.	*Hoist* 4419, *Shawe*	GC, BH
Guettarda combsii	*Shawe*	BH
Guettmda eLLiptica	*Shawe*	BH
Guettarda macrospenna Oonn. Srn.	*Hoist 5807*	C2
HameLia caL)'cosa Oonn. Srn.	*Hoist* 4413	GC
HameLia patens Jacq.	*Hawkins* 1548, *Shawe*	SU, BH
HiLLia panamensis Srandl..	*Hoist* 4292, 5841	SL, SU
Hoffmannia discoLor (Lem.) Hemsl..	*Hoist* 4399,4448	UC,GC
Morinda panamensis Seem.	*Shawe*	BH
Hoffmannia ghiesbreghtii (Lem.) Hems!..	*Hoist* 4322, 4461, 5622	UC,GC
PaLicourea guianensis	*Shawe*	BH
Palicourea padijoLia (Willd. ex Roem. & Schult.) CM. Taylor & Lorence	*Hawkins* 1554; *HoLst4031, 4346*	UC
Ps),chotria acuminata Benrh.	*Hawkins* 1352; *Hoist* 5933, *Shawe*	Cl, BH
Psychotria capitata	*Shawe*	BH
Ps),chotria chiapensis StandI..	*Hoist* 4433	GC
Psychotria costivenia Griseb.	*Hoist* 3867, 4261, *Shawe*	UC,, BH
Psychotria de/lexa DC	*Hawkins* 1328, 1437; *Hoist* 4074,5731	C3, SL, UC
Ps)'chotria eLata (Sw.) Hammel	*Hawkins* 1469; *Hoist* 4295, 4296, 5733, *5839, Shawe*	SL, SU, BH
Psychotria epiph)'tica K. Krause	*Hawkins* 1431	C3
Psychotria guadaLupensis (DC) R.A. Howard	*Hawkins 1494*	SU
Psychotria nervosa	*Shawe*	BH
P,ychotria officinaLis (Aubl.) Raeusch. ex Sandwith	*Hawkins 1454*	C3
Ps)'chotria orchidearum Stand!..	*Hoist 5777*	SL
Ps),chotria panamensis Srandl..	*Hawkins* 1440; *HoLst4302*	C3,SU
Ps),chotria pLeuropoda Oonn. Srn.	*Hoist* 4404	GC
Ps),chotria poeppigiana Mud!.. Arg.	*Hawkins* 1518; *Holst4011,* 4284, 5665, *Shawe*	Cl, SU, UC,, BH
Ps)'chotria quinquemdiata	*Shawe.*	BH
Psychotria simiarum StandL.	*Hoist* 4021, 4176, 4405, *Shawe*	UC, GC, BH
Psychotria tenuifoLia Sw.	*Hoist* 4081, 4452	UC,GC
P,ychotria trichotoma	*Shawe*	BH
Ps),chotria uLiginosa Sw.	*Hawkins* 1547; *Hoist 5864*	SU
Randia cf. *gentlei* Lundell	*Hoist 4133*	UC
Randia matudae Lorence & Dwyer	*Hawkins* 1533; *Hoist* 4281,, 5867	SU
Rehdera penninervia	*Shawe*	BH
Rudgea comifoLia (Kumh) Srandl..	*Hoist* 4479	GC
Sabicea panamensis Wernham	*Hawkins 1543*	SU
Simira saLvadorensis	*Shawe*	BH

RUTACEAE

ZanthoxyLum juniperinum Poepp.	*Hoist 4123*	UC
ZanthoxyLum riedeLianum	*Shawe*	BH

SAPINDACEAE

ALLoph),LLus cf. *psiLospermus* Radlk..	*Hoist* 4119	UC
ALLophyLus campsach)'s	*Shawe*	BH

Cupania belizensis	*Shawe*	BH
*Cupania rnacrophyLla*A. Rich.	*HoIst* 4488	GC
Cupania ruftscens Triana & Planch.	*HoIst* 4208	UC
Cupania spectabilis	*Shawe*	BH
Matayba apetala (Macfad.) Radlk..	*HoIst* 4257, *Shawe*	UC, BH
Paullinia costata Schltdl.. & Cham.	*HoIst 4193*	UC
Paullinia fibrigera Radlk.	*HoIst* 4158	UC
Paullinia glornerulosa Radlk.	*HoIst* 4109	UC
Sapindus saponaria L.	*Shawe*	BH

SAPOTACEAE

Chrysophyllum mexicanum Brandegee ex StandI..	*HoIst* 4390, Shawe	UC,BH
Manilkara chide	*Shawe*	BH
Manilkara zapota (L.) P Royen	*HoIst* 4082, *Shawe*	SU, UC,, BH
Pouteria amygdalina	*Shawe*	BH
Pouteria campechiana	*Shawe*	BH
Pouteria durlandii (Stand!.) Baehni	*HoIst* 4008	UC
Pouteria izabalensis (Stand!.) Baehni	*HoIst* 4088	UC
Pouteria reticulata (Eng!.) Eyma subsp. *reticulata*	*HoIst* 4246, *Shawe*	UC, BH
Pouteria sapota	*Shawe*	BH
Pouteria torta	*Shawe*	BH
Sideroxylon floribundum subsp. *belizense* (Lundell) Penn.	*Shawe*	BH
Sideroxylon ftetidis;-irnum Grieseb.	*Shawe*	BH
Sideroxylon stevensonii (StandI.) Per1l1.	*Shawe*	BH

SIMAROUBACEAE

Picramnia antidesma subsp. *antidesma* W Thomas	*Shawe*	BH
Simarouba glauca DC..	*HoIst* 4147, Shawe	SU, UC, BH

SMILACACEAE

Smilax luculenta Killip & C.V. Morton	*Holst* 4127	UC

SOLANACEAE

Cestrurn noctumum L.	*HoIst* 4222, 4436	UC,, GC
Cestrum racemosum	*Shawe*	BH
Lycianthes hypoleuca Stand!..	*HoIst* 4125	UC
Lycianthes nitida Bitter	*HoIst* 4386, 5923	SL, UC
Lycianthes purpusii (Brandegee) Bitter	*HoIst* 4389	UC
Solanum bicolor	*Shawe*	BH
Solanum erythrotrichum	*Shawe*	BH
Solanum lepidotum Dunal	*HoIst 5900*	SL
Witheringia solanacea L'Her..	*HoIst 5920*	SL

STAPHYLEACEAE

Turpinia paniculata	*Shawe*	BH

STERCULIACEAE		
Guazuma ulmifolia	*Shawe*	BH
STYRACACEAE		
Styrax argenteus C. Presl	*Holst* 4277	SU
SYMPLOCACEAE		
Symplocos limoncillo Humb. & Bonpl.	*Holst* 4058	UC
THEACEAE		
Symplococarpon purpusii (Brandegee) Kobuski	*Holst4255*	UC
Temstroemia tepezapote Schlrdl.. & Charn.	*HoIst* 4306	SU
THEOPHRASTACEAE		
Deherainia smaragdina subsp. *smaragdina*	*Shawe*	BH
TILIACEAE		
Heliocarpus americanus L.	*Hoist* 5709, 5953, *Shawe*	Cl, VC, BH
Luehea speciosa Willd.	Shawe	BH
Muntingia calabura L.	Shawe	BH
Trichospermum grewiiftlium (A. Rich.)	*HoIst* 5915, Shawe Kosterrn.	SL, BH
TURNERACEAE		
Erblichia odorata Seem.	*Holst* 4145	UC, GC
ULMACEAE		
Ampelocera hottlei (Standl.) Standl.	*Shawe*	BH
URTICACEAE		
Boehmeria rarnifiora Jacq.	*HoIst* 4018	UC
Myriocarpa longipes Liebrn.	*Hawkins* 1332; *Hoist 4463*	GC
Myriocarpa obovata Donn. Srn.	*HoIst* 4108, 4238A	UC
Phenax mexicanus Weddell	*HoIst 5721*	C1
Pilea ecbolophylla Donn. Srn.	*HoIst* 4106	UC
Urera baccifira	*Shawe*	BH
VERBENACEAE		
Aegiphila martinicensis Jacq.	*HoIst 5664*	C1
Aegiphila monstrosa	*Shawe*	BH
Citharexylum caudatum L.	*HoIst 5813*	C2
Stachytarpheta caymnensis (Rich.) M. Valll	*HoIst 4364*	UC
Vitex gaumeri	*Shawe*	BH

VIOLACEAE		
Orthion malpighiiftlium (Srandl.) Stand!.. & Sreyerm.	*HoIst* 4423	GC
Rinorea guatemalensis (S. Watson) Bartlett	*Hout4006,4065,Shawe*	UC,BH
Rinorea hummelii Sprague	*HoIst* 4412, *Shawe*	Gc,, BH

VITACEAE		
Cimis biftrrniftlia Stand!..	*Hout4110*	UC
Vitis tiliifolia Humb. & Bonpl.. ex Roem. & Schult..	*HoIst419l*	UC

VOCHYSIACEAE		
Vochysia hondurensis	*Shawe*	BH

ZAMIACEAE		
Ceratozamia robusta Miq.	*HoIst* 4105	UC
Zamia prasina W. Bull	*HoIst 3897*	UC

PTERIDOPHYTES		
Adiantum capillus-veneris L.	*HoM* 4014, 5636	UC
Adiantum macrophyllum Sw.	*HoIst* 4226, 4377	UC
Adiantum pulverulentum L.	*HoM4503*	GC
Adiantum tenerum Sw.	*HoIst* 4142	UC
Adiantum tetraphyllum Humb. & Bonp!.. ex Willd.	*Hout4360,* 5881	Cl, UC
Adiantum trichochlaenum Mickel & Beitel	*HoIst 5873*	Cl
Auophila firma (Baker) D.S. Conant	*Hawkins 1363*	Cl
AIsophila salvinii Hook.	*HoIst 5854*	SU
Anemia adiantiftlia (L.) Sw.	*Hawkins 1393*	Cl
Anetium citriftlium (L.) Splitg.	*Hout 5940*	Cl
Antrophyum ensiftrme Hook..	*HoIst* 4143, 5941	Cl, UC
Asplenium auritum Sw.	*Hawkins* 1368; *HoIst 5883*	Cl
Asplenium cirrhatum Rich. ex Willd.	*HoIst 5755*	C2
Asplenium crassiftlium (L.) Lellinger	*HoIst 3889*	UC
Asplenium cristatum Braclc	*HoIst* 4397, 4480	Uc,, GC
Asplenium juglandiftlium Lam.	*Hawkins* 1446, 1452; *Hout* 4027,4289	C3, SU, UC
Asplenium monodon Liebm.	*HoIst* 4038, 4224	UC
Asplenium pseudoerectum Hieron.	*HoIst* 5821, 5918	SL
Blechnum gracile Kaulf..	*HoIst* 4316	UC
Blechnum occidentale L.	*HoIst 6009*	UC
Bolbitis hastata (E. Fourn.) Hennipman	*HoIst 5757*	C2
Bolbitis hemiotis (Maxon) Ching?	*HoIst* ?759	C2
Bolbitis pergamentacea (Maxon) Ching	*HoM4464*	GC
Cmnpyloneurum angustifolium (Sw.) Fee	*Hawkins 1348*	Cl
Campyloneururn costatum (Kunze) C. Presl	*HoIst 4359*	UC
Campyloneurum repens (Aub!.) C. Presl	*HoIst* 4385	UC
Cochlidium lineariftlium (Desv.) Maxon ex C. Chr..	*Hawkins* 1561; *HoIst 5693*	Cl

Cochlidium serru!atum (Sw.) L.E. Bishop	*Hawkins* 1401,1517	*C2,* SU
Ctenitis excelsa (Desv.) Proctor	*Hawkins 1438*	C3
Ctenitis interjecta (e.. Chr.) Ching	*Ho!st4502*	GC
Ctenitis me!anosticta (Kunze) Copel..	*Ho!st4368*	UC
Ctenitis sa!vinii (Baker) Stolze	*Hawkins* 1378, 1402; *Ho!st 3890*	*Cl, C2,* UC
Cyathea divergens var. tuerckheimii (Maxon) R.M. Tryon	*Hawkins* 1507,1513	SU
Cyathea mu!tiflora Sm.	*Hawkins* 1457, 1502; *Ho!st* 3883, 4217, 5782	*C3,* SL, SU, UC
Cyathea myosuroides (Liebm.) Domin	*Hawkins* 1499; *Ho!st 4285*	SU
Cyathea schiedeana (e.. Presl) Domin	*Hoist 5911*	SL
Danaea e!!iptica Sm.	*Hawkins* 1539; *Ho!st* 4305, 5845	SL, SU
Dennstaedtia bipinnata (Cav.) Maxon	*Hoist* 4474	GC
Didymoch!aena truncatu!a (Sw.) J. Sm.	*Hawkins* 1355; *Ho!st* 4394, 5945	*Cl,* UC
Dip!aziurn p!antaginifl!ium (L.) Urban	*Hawkins* 1375; *Ho!st 5758*	*Cl,* C2
Dip!azium riede!ianum (Bong. ex Kuhn) Kuhn ex e.. Chr.	*Ho!st4317*	UC
Dip!azium striatastrum Lellinger	*Ho!st4473*	GC
Dip!azium vero.pax (Donn. Sm.) Hieron.	*Ho!st 5712*	Cl
Dip!azium werck!eanum H. Christ	*Holst4317A,4323,5877*	*Cl,* UC
Elaphog!ossum decursivum Mickel	*Ho!st 5924*	SL
Elaphog!ossum g!aucum T. Moore	*Ho!st 3869*	UC
E!aphog!ossum guatema!ense (Klotzsch) T. Moore	*Hawkins 1366*	Cl
E!aphog!ossum herminieri (Bory ex Fee) T. Moore	*Ho!st* 3870, 4402	UC,, GC
E!aphog!ossum !atifl!iurn (Sw.)]. Sm.	*Ho!st 5672*	Cl
Elaphog!ossum !atum (Mickel) Atehortua ex Mickel	*Ho!st* 3875, 5862	SU, UC
E!aphog!ossum pe!tatum (Sw.) Urban	*Ho!st* 3894, 5700	*Cl,* UC
E!aphog!ossum pi!ose!!oides (e.. Presl) T. Moore	*Ho!st 5670*	Cl
Huperzia dichaeoides (Maxon) Holub	*Hawkins 1529*	SU
Huperzia !inifl!ia (L.) Trevis.	*Hawkins 1487*	SU
Huperzia pithyoides (Schltd!.. & Cham.) Holub	*Ho!st 4381*	UC
Hymenophy!!um polyanthos (Sw.) Sw.	*Hoist 5762*	C2
Hymenophy!!um pu!che!!um Schldl.. & Cham.	*Ho!st4041*	UC
Hyrnenophy!!urn sieberi (e.. Presl) Bosch	*Ho!st 5974*	UC
Le!!ingeria rnitche!!ae (Baker ex Hernsl.) AR. Srn. & R.e.. Moran	*Hawkins 1398*	Cl
Lindsaea k!otzschiana Moritz	*Hawkins* 1476; *Ho!st* 4265, 5728, 5870	SL, SU
Lindsaea !ancea (L.) Bedd.	*Hawkins* 1474; *Hoist* 4283, 5675, 5909	C1SL,, SU
Lornariopsis recurvata Fee	*Hoist 4417*	GC
Lornariopsis vestita E. Fourn.	*Ho!st 4171*	UC
Lophosoria quadripinnata (J.P. Gme!.) e.. Chr. var. *quadripinnata*	*Hawkins 1540*	SU
Lycopodie!!a cernua (L.) Pie. Serm.	*Hawkins 1472*	SU
Lygodium heterodoxum Kunze	*Ho!st* 4153, 5942.	Cl, , UC
Mega!astrum !unense (H. Christ) A.R.. Sm. & R.e.. Moran	*Ho!st 5820*	SL
Microgramma lycopodioides (L,) Cope!..	*Hawkins 1419*	C2
Micrograrnrna percussa (Cav.) de la Sota	*Hawkins* 1370; *Ho!st4000,* 4141, 4403, 5886, 6004	Cl,, Uc,, GC
Micropolypodium taenifl!ium (Jenman) A.R.. Srn.	*Hawkins 1526*	SU
Nephro!epis mu!tiflora (Roxb.) EM. Jarrett ex e.v.. Morton	*Hawkins 1559*	UC
Nephro!epis rivu!aris (Vahl) Men. ex Krug	*Hawkins 1425*	C2
Niphidiurn crassifllium (L.) Lellinger	*Ho!st* 4354, 5917	SL, UC

Oleandra articulata (Sw.) C Presl	*Hawkins 1542*	SU
Olftrsia cervina (L.) Kunze	*HoIst 5930*	SL
Ophioglossum palmatum L.	*HoIst 5935*	Cl
Pecluma divaricata (E. Fourn.) Mickel & Beitel	*Hawkins* 1496; *Hoist 4460*	SU, GC
Pleopeltis astrolepis (Liebm.) E. Fourn.	*HoIst 5792*	SL
Polybotrya osmundacea Hllrnb. & Bonpl.. ex Willd.	*HoIst* 4048,4049	UC
Polybotr),a polybotr)'oides (Baker) H. Christ	*Hawkins* 1406; *HoIst 4047*	C2, UC
Polypodium dissimile L.	*Hawkins* 1490; *HoIst 4034*	UC, SU
Polypodium fallax Schltdl.. & Charn.	*Hawkins* 1461; *HoIst 5763*	C2, C3
Polypodium Faxinifolium Jacq.	*Hawkins 1429*	C3
Psilotum nudum (L.) P. Beauv.?	*HoIst 5772*	C2
Pteridium caudatum (L.) Maxon	*Hoist 6018*	UC
PtCl'is altissima Pair.	*Hawkins* 1353,1551; *HoIst* 4395	Cl, UC
Pteris pungens Willd.	*Hoist 3864*	UC
Ptel'is quadriaurita Retz [s.l.]	*HoIst 3900*	GC
Radiovittaria stipitata E.H. Crane	*Hoist 5943*	Cl
Salpichlaena volubilis (Kaulf.)]. Srn.	*HoIst 4287*	SU
Schizaea sp,	*HoIst 5673*	Cl
Selaginella guatemalensis Baker	*Holst4030,4311,5703,Shawe*	Cl, UC, BH
Selaginella huehuetenangensis Hieron.	*HoIst 5948*	Cl
Selaginella pallescens (C Presl) Spring	*Hoist 3881*	UC
Selaginella sertata Spri ng	*Holst4029,4341,* 5707, 5961	Cl, UC
Sphaeropteris horrida (Liebrn.) R.M, Tryon	*Hawkins* 1383,1430; *HoIst* 4213	Cl, , C3, UC
Stlcherus palmatus (J.H. Schaffn, ex Underw.) Cope!..	*Hoist* 4270, 5797, 5906	SL, SU
Stigmatopteris sordida (Maxon) C Chr.	*Hoist 5897*	SL
Tectaria heracleifolia (Willd.) Underw.	*Hawkins* 1451; *Hoist* 3880,4318,5702	Cl, C3, UC
Tectaria incisa Cav.	*Hoist* 4478	GC
Tectaria mexicana (Fee) Cv. . Monon	*Hoist* 4475	GC
Terpsichore asplenifolia (L.) A.R. Srn.	*Hawkins* 1508; *HoIst 5764*	C2, SU
Terpsichore mollissima (Fee) A.R. Srn.	*HoIst* 4040	UC
Thelypteris blanda (Fee) CF.. Reed	*Hawki(ls* 1357; *Hoist* 4312,4477, 5882	Cl, UC
Thelypteris decussata (L.) Proctor var. costaricensis A.R.. Srn,	*HoIst* 5819,5919	SL
Thelypteris falcata (Liebm.) R.M. Tryon	*Hoist 5791*	SL
Thelypteris ghiesbreghtii (Hook.) Cv. . Morton	*Hoist* 4320	UC
Thelypteris kunthii (Desv.) cv. . Morton	*Hoist 6020*	
Thelypteris leprieurii var. *subcostalis* A.R. Sm.	*Hawkins 1536*	SU
Thelypteris nicaraguensis (E. FOllrn.) Cv. . Morton	*Hoist* 4324	UC
Thelypteris obliterata (Sw.) Proctor	*HoIst 6008*	UC
Thelypteris patens var. *patens* (Sw.)	*Hoist 5976*	UC
Thelypteris paucipirmata (Donn. Srn.) CF.. Reed	*HoIst* 4343, 5887	Cl, , UC
Thelypteris sancta (L.) Ching	*HoIst 5968*	UC
Thelypteris sp. novo	*HoIst 5756*	C2
Thelypteris toganetra A.R. Srn.	*Hoist 4132*	UC
Trichomanes capillaceum L.	*HoIst 5829*	SL
Trichomanes collariatum Bosch	*Hawkins* 1350; *HoIst* 4196, 4313,5753	Cl, C2, UC
Trichomanes crispum L.	*Hawkins* 1475; *HoIst* 4023, 5771	C2, SU, UC
Trichomanes diaphanum Kllnth	*HoIst* 5853, 5912	SL, SU
Trichomanes galeottii E. FOllrn.	*Hawkins 1505*	SU
Trichomanes krausii Hook.. & Grev.	*HoIst 5716*	Cl
Trichomanes polypodioides L.	*Hawkins* 1459; *HoIst 5668,5921*	C1,C3,SL

Trichomanes punctatum subsp. *sphenoide,* (Kunze) Wess. Boer	*HoIst* 4496	GC
Trichomanes pyxidiferum L.	*HoIst 4310*	VC
Trichomanes radicans Sw.	*HoIst* 5815,5816	SL
Trichomanes rigidum Sw.	*Hawkins* 1538; *Hoist 5773*	C2, SV
Vittaria graminifolia Kaulf..	*Hawkins* 1325, 1509; *Hoist 3876*	VC, SV
Vittaria stipitata Kunze	*HoIst* 4070	VC

BRYOPHYTES

MOSSES

Acroporium estrellae (C. Muller) W.R. Buck & Schafer- Verwinp	*Allen* 18510, 18653, 18656, 18661, 18945	C1, SU, UC
Acroporium longirostre (Bridel) WR. Buck	*AlIen* 18641,18657,18779,18992	Cl, C2, SV
Acroporium pungens (Hedwig) Brorherus	*AlIen* 18864, 18912, 18928, 18932, 18935	C2, SV
Actinodontium standleyi E.B. Bartram	*AlIen* 18760,19003,19021,19024	C2, SV
Aerolindigia capillacea (Hornschuch in Mart.) Menzel	*AlIen 18687*	Cl
Barbula agraria Hedwig	*AlIen.* 19092B	VC
Barbula arcuata Griffirh	*AlIen* 18724, 18797, 18867, 19059	C2, VC
Barbula ehrenbergii (Loremz) Fleisher	*AlIen 19081*	VC
Barbula indica (W.J.. Hooker) Sprengel	*Allen 19092*	VC
Brachymenium spirifolium (C. Muller) Jaeger	*AlIen 18761*	C2,
Brachymenium wrightii (Sullivant) Brorherus	*AlIen* 18515, 18620, 18700, 18884, 18967	Cl, , C2, SV,
Bryum billarderi Schwagrichen	*AlIen* 18560, 19067	Cl, VC
Bryum pseudocapillare Bescherelle	*AlIen* 18521, 18541, 19049, 19068A	VC
Callicostella depressa (Hedwig) Jaeger	*Allen* 18649, 18739, 18976	Cl, C2, SV
Callicostella grossiretis LB. Bartram	*Allen* 18590, 18715	Cl, C2,
Callicostella pallida (Hornschuch) Angsrrom	*AlIen 19025*	SV
Callicostella rivularis (Mitten) Jaeger	*AlIen* 18565, 18716, 18865, 18886A	Cl, C2
Callicostella vatteri E.B. Bartram	Alien 18865A	C2
Calymperes aftelii Swartz	Alien 18543, 19074	VC
Calymperes lonchophyllum Schwagrichen	Alien 18512, 18525,18528, 18749, 18784, 18961.	C2, SV, VC
Calymperes nicaraguense Renauld & Cardor	*AlIen* 18771, 18815	C2, SL
Calymperes palisotii Shcwagrichen	*AlIen* 19076, 19078, 19069	VC
Campylopus arctocarpus (Hornschuch) Mitten	*AlIen* 18799,18911,18948,19023,19035	C2, SL, SV
Crossomitrium patrisiae (Bridel) C. Muller	*AlIen* 18564, 18619, 18665, 18658,18662,18676,18722,18751,18954	Cl, C2, SV
Cyclodictyon albicans (Hedwig) Kuntze	*AlIen* 18553,18556,18890	Cl, C2, VC
Cyclodictyon erubescens E.B. Bartram	*AlIen* 18635, 18650	Cl
Cyclodictyon humectatum Cardor	*AlIen* 18577,18719	Cl, C2
Cyclodictyon varians (Sullivant) Kumze	*AlIen 18582*	Cl
Cyrtohypnum minutulum (Hedwig) WR. Buck & H. Crum	*AlIen* 18629,18638,19040	Cl, SL
Daltonia longifolia Taylor	*AlIen* 18656A, 18958	Cl,SV
Daltonia pulvinata Mitten	*AlIen* !8660, 18677	Cl
Ectropothecium leptochaeton (Schwagrichen) W R. Buck	*AlIen* 18696,18763	C2
Ephemerum spinulosum Bruch & Wp. Schimper	*AlIen* 19082, 19094	VC
Fissidens asplenioides Hedwig	*AlIen 18708*	C2
Fissidens curvatus Hornschuch	*Allen 18875*	C2
Fissidens dibiw Palisor de Beauvois	*AlIen* 18526, 19055	VC
Fissidens dissitifolius Sullivam	*AlIen 18757*	C2

Fissidens elegans Bridel	*Alien* 18551,18555,18600,18626,18627, 18723,18787,18804,18871,19043	Cl, C2, SL, UC
Fissidens flaccidus Mi nen	*Alien* 18670, 18707, 18725, 18881, 18886	Cl, C2
Fissidens lagenarius Minen	*Alien* 18621, 18808, 18899, 18975, 18991, 19007,19012	Cl, SL, SU
Fissidens minutus Thwaites & Mitten	*Alien 19088*	UC
Fissidens neglectus H. Crum	*Alien 18732*	C2
Fissidens oblongifolius W.J. Hooker & Wilson	*Allen* 18609, 18610A, 18637	Cl
Fissidens pellucidus Hornschuch	*Alien* 18615, 18711, 18747, 18817, 18861, 18906, 19041	Cl,, C2, SL, SU
Fissidens polypodioides Hedwig	*Allen18750, 18840*	C2, SL
Fissidens radicans Montagne	*Alien 18694*	C2
Fissidens santa-clarensis Theriot	*Alien 18536*	UC
Fissidens serratus C MUller	*Alien* 18536A, 19077	UC
Fissidens weirii Minen var. weirii	*Alien* 18572, 18628, 18691, 18923	Cl, SU
Fissidens zollingeri Monragne	*Allen* 18557,18617,18639,19090	Cl, UC
Groutiella mucronifolia (W.J. Hooer & Greville) H. Crum & Steere	*Allen* 18508, 18666, 18802, 18949	Cl, C2, SU, UC
Groutiella tornentosa (Hornschuch) Wijk & Margadant	*Allen18613, 18803*	Cl, C2
Groutiella tumidula (Mitten) Vitt	*Allen* 19068, 19093	UC
Hildebrandtiella guyanensis (Monragne) WR. Buck	*Alien* 18495, 18900	SU,UC
Holomitrium arboreum Minen	*Allen* 18614, 18677, 18764,18792; *Hoist* 4438, 4444	Cl, C2, GC
Homalia glabella (Hedwig) B.S.G.	*Alien* 18573; *Hoist* 4338B, 4339	Cl, UC
Hookeriopsis cruegeriana (C MUller) Jaeger	*Alien 18726*	C2
Hookeriopsis cuspidata Jaeger	*Alien* 18545, 18610, 18869,19054,19061	Cl, C2, UC
Hookeriopsis guatemalensis E.B. Bartram	*Allen* 18504, 18578, 18717 A, 18805, 18880, 18891	Cl, C2, SL, UC
Hookeriopsis incurva (Hornschuch) Brotherus	*Allen* 18575A, 18596, 18652, 18791	Cl, C2
Hookeriopsis subfalcata (Hampe) Jaeger	*Allen 18781*	C2
Hymenostylium recurvirostre (Hedwig) Dixon	*Alien* 18866, 18878	C2
Hyophila involuta (WJ. Hooker) Jaeger	*Allen* 18720, 18727, 18796	C2
Hypopterygium tamariscinum (Hedwig) Bride!	*Allen 18630*	Cl
Isodepanium lentulum (Wilson) Britton	*Allen* 18743, 18774, 18903	C2, SU
Isopterygium tenerum (Swartz) Minen	*Alien 18618*	Cl
Lepidopilidium portoricense (C MUller) H. Crum & Steere	*Allen* 18644, 18773, 18786, *18898,18930,18950,18955,19014;* *Hoist* 4335	Cl, C2, SU
Lepidopilum brevipes Mitten	*Alien 18672*	Cl
Lepidopilum cubense (Sullivant) Mitten	*Alien 18601*	Cl
Lepidopilum muelleri (Hampe) Spruce	*Alien 18675*	Cl
Lepidopilum polytrichoides (Hedwig) Bride!	*Alien* 18570, 18589, 18669	Cl
Lepidopilum scabrisetum (Schwagrichen) Steere	*Alien* 18563,18580,18659,18671,18686, 18701,18970	Cl, C2, SU
Lepidopilum surinamense C MUller	*Alien 18712*	C2
Lepidopilurn tortifolium Minen	*Alien* 18759,18896	C2
Leucobryum antillarum Wp. Schimper ex Bescherelle	*Alien* 18625,18946	Cl, SU
Leucobryum martianum (Hornschuch) Hampe ex C Muller	*Allen* 18800, 18828, 19038, 19045, 19048	C2, SL

Leucobryum pofakowskyi (C. Muller ex Bescherelle)	*Allen* 18836, 18938	SL,SU
Leucofoma cruegerianum (C. Muller)]aeger	*Alfen* 18498, 18818, 18851, 18934	SL, SU, UC
Leucofoma mariaei Bescherelle	*Alien* 18980A	SU
Leucofoma serrufatum Bride!	*Alfen* 18611, 18744, 18776, 18980	Cl, C2, SU
Leucomium strumosum (HornSchuch) Mitten	*Alien* 18532, 18770, 19042	C2, SL, UC
Leucophanes molleri C. Muller	*Alfen 18775*	C2
Macromitrium cirrosum (Hedwig) Bridell	*Allen* 18497,18511, _, 18518, 18636, 18703, 18767,18782,18832,18838,18916, 18978, 18987, 19000, 19060	Cl, , C2, SL, SU, UC
Macromitrium contextum Harnpe	*Allen* 19063, 19064; *HoIst 4340*	UC
Macromitrium feprieurii Monragne	*Alien* 18704, 18737, 18882, 18985	C2, SU
Macromitrium punctatum (W]. Hooker & Greville) Bride!	*Alfen* 18634, 18766, 18892	Cl, C2
Meteoridium remotifofium (C. Muller) Manuel	*Alfen 18681*	Cl
Meteorium ilfecebrum Sullivanr.	*Alien* 18640,18654,18697,18742	Cl, C2
Mittenothamnium reptans (Hedwig) Cardot	*Alfen* 18509, 18674, 18752, 19019	C2, SU, UC
Mittenothamnium salleanum (Bescherelle) Cardot	*Allen* 18756,19051	C2, UC
Neckeropsis undufata (Hedwig) Reichardt	*Alien* 18889; *Hofst4440, 4514*	C2, UC,, GC
Octobfepharum cocuiense Mitten	*Allen* 18844A	SL
Octobfepharum erectifofium Mitten ex R.S. Wrns.	*Allen* 18844, 19010	SL, SU
Octobfepharum pufvinatum (Dozy & Molkenboer) Mitten	*Aflen* 18493, 18587, 18608, 18673, 18809	Cl, , SL, UC
Orthostichopsis tetragona (Swartz ex Hedwig) Brotherus	*Aflen* 18648, 19052	Cl, UC
Oxystegus tenuirost/"is (W.]. Hooker & Taylor) A.].E. Smith	*Allen* 18522, 18544, 18872	C2, UC
Papilfaria nigrescens (Swartz ex Hedwig)]aeger	*Alien* 18647, 18754	Cl, C2
Philonotis uncinata (Schwagrichen) Bridel	*Alfen 19091*	UC
Phyllodon truncatufus (C. Mi.iller) WR. Buck	*Alfen 18887*	C2
Phyllogonium viride Bride!	*Allen* 18762, 18822, 18829, 19011; *Hoist* 4336	C2, SL, SU
Pilotrichella flexilis (Hedwig) Angström	*Aflen* 18524, 18813, 18831, 18524, 19008, 19009, 19028	SL, SU, UC
Pilotrichella pentasticha (Bridel) Wijk & Margadant	AlIen 18531, 18566, 18679, 18746, 18778, 19057; *HoIst* 4515	C1, C2, UC
Pilotrichum evanescens (C. Muller) Crosby	*Alien* 18888; HoIst 4512B	C2, UC
Pilotrichum fendferi C. Muller	*Allen* 18513, 18579, 18584, 18588, 18623, 18748, 18765, 18794, 19033	Cl, C2, SL, UC
Pilotrichum ramosissimum Mitten	*Allen* 18748B	C2
Pireella angustifofia (C. Muller) Arzeni	*Allen* 18517,18519,18534,18607,18616, 18741,, 18821, 18883, 18918, 18929, *18957,18962,19005; flolst4337*	Cl, , C2, SL, SU, UC
Porotrichum korthalsianum (Dozy & Molkenboer) Mitten	Alien 18870; HoIst 4338	C2, UC
Porotrichum lindigii (Harnpe) Mitten	*Alfen18736*	C2
Porotrichum substriatum (Harnpe) Mitten	*Alfen* 18502,18559,18567,18581,18632, 18682, 18683, 18730, 18745, 18758, 18768,18793,18879,18901	Cl, C2, SU, UC
Puiggariopsis aurifofia (Mitten) Menze!	*Allen* t8640A	Cl
Pyrrhobryum spiniforme (Hedwig) Mitten	*Alfen 18908*	SU
Racopilum tomentosum (Hedwig) Bride!	*Alien* 18550, 18690; *HoIst* 4445	Cl, UC, GC
Rhynchostegiopsisflexuosa (Sullivanr) C. Mi.iller	*Allen* 18527, 18597, 18603, 18605, 18651, 1871 0, 18986, 19006	Cl, C2, SU, UC
Rhynchostegiopsis lutescens Britton ex Broth.	*Alien 18539*	UC

Schlotheimia rugifolia (W.J. Hooker) Schwagrichen	*Allen 18777*	C2
Schfotheimia torquata (Swarrz ex Hedwig) Bridel	*ALien* 18733, 18927	C2, SU
Sematophyllum adnatum (Michaux) Brinon	*ALien 19013*	SU
Sematophyllum galipense (e. Muller) Minen	*Allen* 19092A	UC
Sematophyllum subpinnatum (Bridel) Britton	*ALien* 19075, 19085	UC
Sematophyllum subsimplex (Hedwig) Mitten	*Allen* 18801, 18814, 18925, 19034, 19037	C2, SL, SU
Squamidium isocLadum (Renauld & Cardot) Brocherus	*ALien* 18731, 18734, 18947, 18973	C2, SU
Squamidium macrocarpum (Spruce ex Mitten) Brocherus	*Allen* 18646, 18689, 18788, 18795,18885	Cl, C2
Squamidium nigricans (WJ. Hooker & Kumh) Brotherus	*ALien 18705*	C2
Syrrhopodon autotomaius W.D. Reese	*ALien* 18785, 18816, 18839, 18933, 18943, 18988	C2, SL, SU
Syrrhopodon circinatus (Bridel) Mitten	*ALien* 18549, 18783	C2, UC
Syrrhopodon gaudichaudii Momagne	*Allen* 18917, 18936, 18977	SU
Syrrhopodon incompletus. Schwagrichen var. incompletus	*Allen 19070*	UC
Syrrhopodon incornpletus var. *berteroanus* (Bride!) WD. Reese	*ALIen* 18699,18972	C2, SU
Syrrhopodon parasiticus (Swartz ex Bridel) Paris	*ALIen* 18876, 18944	C2, SU
Syrrhopodon prolifer var. *cincinnatus* (Hampe) W.D. Reese	*Allen 19004*	SU
Syrrhopodon prolifer var. *scaber* (Mitten) WD. Reese	*ALien* 18586, 18798, 18825, 18833, 19031	Cl, C2, SL
Taxiphyllum ligulaefoliurn (E.B. Bartram) WR. Buck	*Allen 18552*	UC
Taxiphyllum taxirameum (Mitten) Fleischer	*ALien 18678*	Cl
Taxitheliurn planum (Bridel) Minen	*ALien 19072*	UC
Tharnnobryum turnidicaule (K.A. Wagner) f. D. Bowers	*Allen 18685*	Cl
Thuidiurn delicatulum (Hedwig) W.P. Schimper	*ALien 18571*	Cl
Thuidium tomentosum WP. Schimper	*Allen 18501*	UC
Tortella richardsii E.B. Bamam	*ALien* 18496,18505,19066	UC
Tortella tortuosa (Hedwig) Limpricht	*ALIen 18868*	C2
Trichosteleum bernoullianurn (e. Muller) BrO[herus	*ALien* 19003B	SU
Trichosteleum fluviale (Minen) Jaeger	*ALien 18735*	C2
TrichosteLeum sentosum (Sullivant) Jaeger	*ALien* 18695, 18739A	C2
Vescicularia vesicularis (Schwagrichen) Brotherus	*ALIen* 18548, 18592, 18688, 19084	Cl, UC
Vesicularia vesicularis var. *portoricensis* (Bridel) WR. Buck	*ALIen* ~8514	UC
Weissia controversa Hedwig	*ALien 18655*	Cl
Zelometeorium patulum (Hedwig) Manuel	*ALIen* 18561, 18606, 18631, 18674A, 18772, 19046	Cl, C2, SL

HEPATICS

Baania stolonifera Trevisan de Saint-Lean	*ALIen* 18500, 18806, 18942	SL, SU, UC
Bryopteris jilicina (Sw.) Nees	*Hoist* 4441, 4513	UC,, GC
CaLypogeia peruviana Nees & Montagne	*ALien 18714*	C2
CheiLolejeunea decurviloba (Scephan) He Xiao-lan	*ALien 18842*	SL
FrulLania caulisequa Nees	*Allen 19044*	SL
Frullania gibbosa Nees	*ALIen 19079*	UC
Kurzia flageLlifera (Stephan) Grolle	*ALIen 18830*	SL
Lejeunea laetivirens Nees & Montagne	*ALIen* 19080, 19087	UC
Lepidolejeunea involuta Grolle	*ALIen 18926*	SU
Lepidopilum poLytrichoides (Hedwig) Bridel	*ALien 4495*	GC
Micropterygiurn trachyphyllum Reimers	*Allen* 18834, 18939, 18956	SL, SU
Odontoschisma denudatum (Nees in Mart.) Dumorrier	*ALien 18941*	SU
Plagiochila disticha Lindenb.	*ALien 4512*	UC
Plagiochila sp.	*Hoist 4334*	SU

Plagiochila superba Dumorrier	*Alien* 18516, 19056	UC
Radula husnotii Castle	*Alien 18680*	C1
Stictolejeunea squamata (Willd. ex Web.) Schiffn.	*Hoist* 4442	GC
Taxilejeunea sp.	*Hoist* 4439, 4443	GC

Plant identifications were made by the following botanists. See Holmgren et al. (Index Herbariorum, Regn. Veg. 120. 1990, New York Botanical Garden) for herbarium acronyms. The plants listed in Meerman (1997) and Shawe (1998) have been identified tentatively and of some species no voucher specimens exist.

Spermatophytes:
Acanthaceae-T. . Daniel (CAS), B. HoIst (SEL); Annonaceae-G.E. Schatz (MO), B. Hoist (SEL); Apocynaceae-B. HoIst (SEL); Aquifoliaceae-B. Hoist (SEL); Araceae-T.. Croat (MO), M. Grayum (MO); Araliaceae-B. Hoist (SEL); Arecaceae-M. Grayum (MO), D. Hodel, R. Evans (MO), B. HoIst (SEL); Aristolochiaceae-]. Meerman (BTFS); Asclepiadaceae-WD. Stevens (MO); Asteraceae-H. Robinson (US), B. HoIst (SEL), R. Noyes (MO); Begoniaceae-B. HoIst (SEL); Bignoniaceae-A.. Gentry (MO); Bombacaceae (Quararibea)-W Alverson (WIS), B. Hoist (SEL); Bromeliaceae-H. Luther (SEL), B. HoIst (SEL); Burmanniaceae-B. HoIst (SEL); Burseraceae-B. HoIst (SEL); Cactaceae-]. Solomon (MO); Campanulaceae-B. Hoist (SEL); Caesalpiniaceae-B. Hoist (SEL); Caricaceae-B. Hoist (SEL); Celasuaceae-B. HoIst (SEL); Chloranthaceae-B. Hoist (SEL); Chrysobalanaceae-G. Prance (K), B. Hoist (SEL); Clusiaceae-B. Hammel (MO),]. Pipoly (BRIT), B. Hoist (SEL); Combretaceae-c. . Stace (LTR), B. HoIst (SEL); Commelinaceae-R. Faden (US), B. HoIst (SEL); ConvolvuIaceae-M. Grayum (MO), B. Hoist (SEL); Costaceae-B. Hoist (SEL); Cucurbitaceae-B. HoIst (SEL); Cyclanthaceae-B. Hoist (SEL); Cyperaceae-G. Davidse (MO); Cyrillaceae-B. HoIst (SEL); Dilleniaceae-B. HoIst (SEL); Dioscoreaceae-O. Tellez (UNAM); Elaeocarpaceae-D. Smith, B. HoIst (SEL); Ericaceae-B. HoIst (SEL); Euphorbiaceae-B. Hoist (SEL), G. McPherson (MO); Fabaceae-B. Hoist (SEL), N. Zamora (INB); Fagaceae-B. Hoist (SEL); Flacourriaceae-B. HoIst (SEL); Gentianaceae-P.].M. Maas (U), B. HoIst (SEL); Gesneriaceae-B. HoIst (SEL); Heliconiaceae-]. Meerman (BTFS), B. HoIst (SEL); Hippocrateaceae-B. HoIst (SEL); Icacinaceae-B. HoIst (SEL); Iridaceae-P. Goldblatt (MO); Lacistemataceae-B. Hoist (SEL); Lamiaceae-B. Hoist (SEL), A. Pool (MO); Lauraceae-B. HoIst (SEL), H.. v.d. Werff (MO); Loganiaceae-B. Hoist (SEL); Loranthaceae-B. Hoist (SEL),]. Kuijt (UVIC); Lythraceae-B. HoIst (SEL); Magnoliaceae-B. Hoist (SEL); Malpighiaceae-W Anderson (MICH); Malvaceae-B. Hoist (SEL); Marantaceae-B. Hoist (SEL), H. Kennedy (UBC); Marcgraviaceae-B. HoIst (SEL); Melastomataceae-F. . Almeda (CAS); Meliaceae-B. Hoist (SEL), T. Pennington (K), W Palacios (MO); Mimosaceae-B. Hoist (SEL), M. Sousa (UNAM), N. Zamora (INB); Monimiaceae-B. Hoist (SEL); Moraceae-c.c. . Berg (BG), B. HoIst (SEL); Myristicaceae-B. HoIst (SEL); Myrsinaceae-]. Pipoly (BRIT),]. Ricketson (MO); Myrtaceae-B. Hoist (SEL); Nyctaginaceae-B. HoIst (SEL); Olacaceae-B. HoIst (SEL); Oleaceae-B. Hoist (SEL); Orchidaceae-]. Atwood (SEL), G. Carnevali (CICY), R. DressIer (FLAS), D. Szlachetko, A. Vasilijev (SEL); Passifloraceae-]. MacDougal (MO),]. Meerman (BTFS); Phytolaccaceae-B. Hoist (SEL); Piperaceae-R. Callejas (HUA); Poaceae-G. Davidse (MO); Polygonaceae-B. Hoist (SEL); Proteaceae-B. Hoist (SEL); Monotropaceae-B. HoIst (SEL); Rhamnaceae-B. Hoist (SEL); Rhizophoraceae-B. HoIst (SEL); Rosaceae-B. HoIst (SEL); Rubiaceae-c. . Taylor (MO), D. Lorence (PTBG); Rutaceae-c. . Reynel (MO); Sapindaceae-P. Acevedo-Rdgz. (US), B. HoIst (SEL); Sapotaceae-T.. Penningron (K); B. HoIst (SEL); Simaroubaceae-B. HoIst (SEL); Smilacaceae-B. Hoist (SEL); Solanaceae-W D'Arcy (MO), B. HoIst (SEL); Symplocaceae-F.. Almeda (CAS); Theaceae-B. Bartholomoew, B. HoIst (SEL); Tiliaceae-B. Hoist (SEL); Urticaceae-A.. Pool (MO); Verbenaceae-A. Pool (MO), B. Hoist (SEL); Violaceae-B. Hoist (SEL); Vitaceae-]. Solomon (MO); Zamiaceae-D. Stevenson (NY).

Pteridophytes: A.R. Smith (UC), R. Moran (NY).

Bryophytes:
Hepatics-A. Whittemore (MO).
Mosses-All identified by B. Allen (MO), except for the following: Calymperaceae (Calymperes, Syrrhopodon)-W. Reese (LAF); Fissidentaceae (Fissidens)-R.. Pursell (PAC); HooKeriaceae, in part-So Churchill (MO); Pottiaceae-R.. Magill (MO).

Observations on *Passiflora obovata* (Passifloraceae) in the Columbia River Forest Reserve

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Belmopan, Belize

P. obovata was described by Killip in 1936 from material collected by W A. Schipp in 1934, at "camp 35," British Honduras (now Belize) at an altitude of 850 meters. Since then the species has rarely been collected and John MacDougal, the Passiflora specialist at the Missouri Botanical Garden (pers. comm.) reports ro me that *P. obovata* has a scattered known distribution from Oaxaca in Mexico ro Southern Costa Rica in primary, wet forests (map 4, p.90). One specimen is known from Oaxaca, Mexico, another from Guatemala, one from Honduras, several from Monte Verde and Las Cruces in Costa Rica and a few from southern Belize (map 4).

Initially Killip (1936) placed *P. obovata* in the subgenus *Plectostemma* but comments: "The proposed species occupies an anomalous position in the subgenus *Plectostemma.* Most of the species there have glandless petioles, but there are several, such as *P. suberosa, P. bryonioides,* and *P. sicyoides,* which have well-defined glands. In *P. obovata* the glands are almost scar-like, similar to those in the wholly dissimilar subgenus *Astrophea.* In no other respect does it seem closely related ro the glanduliferous species of *Plectostemma,* and the very minute bracts, closely appressed ro the peduncle near its base, and not characteristic of *Plectostemma."*

Later Killip (1938) created the section Mayapathanthus within the subgenus *Plectostemma* with *P. obovata* as it's only member. MacDougal (1996), however, removed it from the subgenus *Pleetostemma,* but did not assign a new subgenus.

In spite of all my searches throughout Belize, *P. obovata* was the one Belizean Passionflower which kept eluding me. I had nearly given up on it until Hoist (1993) described finding abundant flowe~s of this species on the rarest floor in the more remote areas of the Columbia River Forest Reserve. On the 9th of February, rogerher with our Maya support team and 9 packhorses, we left rhe village of San Jose and started the hike inro the forests of the Columbia River Forest Reserve. At the end of our third day, we had reached Union Camp, one of the areas from which Hoist (1993) had reported *P. obovata.* Along our way, I had checked the identity of every plant growing along our trail. I had found several passionflower species; *P. ambigua, P. guatemalensis, P. helleri, P. oerstedii, P. serratifilia* and even *P. lancetillensis* (sp. ~ov. ined. MacDougal) and *P. pittieri,* but no *P. obovata.*

Once in Union Camp, my chances improve~. After all, now we were more or less stationary and I had more time ro look at the vegetation in greater derail. Sure enough, I found a tiny seedling vine growi~ at the base of a tree. With the aid of a hand lens, I established that the location of the tendrils potentially classified this vine as a passionvine. Encouraged by this, I started looking more carefully and discovered that these particular seedlings were quite common. Also, I found some larger plants growing on the trunks of trees. I noticed the gradual change in leafshape when the plant grew older and bigger. Finally, I found a tree with several shoots going up it's trunk, but when I investigated, these shoots proved to come from the base of a very large black vine going up into

the canopy. Careful search under this tree revealed many fallen leaves undoubtedly belonging to *P obovata* (see Meerman, 1996). Also, I found old, half-decayed, completely round fruits with a diameter of 5-6 cm (presumingly belonging to this species).

Now rhat I had developed a search image, I quickly found that *P obovata* was a common species in these mid-elevation (± 700 m) karst hills. Higher up, on the slopes of the Little Quartz Ridge, where the soils became acidic, I failed ro find them. Also I learned that Standley & Williams' (1961) description of *P obovata* as "a large glabrous vine as much as 18 meters long, the stem 5 cm in diameter", was an understatement.. The vine became very large indeed. The forest canopy here was more than 30 m high and the vines disappeared well into the canopy, from there on probably vining into adjacent trees as well. And the largest vine that I found had a DBH of 15 cm (see picrure 8)! Definitely the largest Passionvine I have ever seen!

More interestingly, *P obovata* appears ro have a very unusual biology. All the seedlings that I found had germinated inside (rodent?) burrows at the base and even under large to very large trees. Many trees in the CRFR develop no taproot but grow buttress roOtS and thus create space under the tree where rodents can dig their burrows. Possibly the rodents collect the *P obovata* seeds together with the juicy arils from the fruits and carry them inro their burrows. The seeds they discard eventually germinate and grow out the burrow roward the light.. Some of the seedlings that I collected were rooted as much as 15 cm down the burrow. Outside the burrow the first small leaves develop. The tendrils hook into the bark of the tree and, hugging the tree closely with the leaves appressed to the bark, the vine Starts growing. Gradually the leaves increase in size and change in shape from clearly ovate to elliptic with a round apex. A pair of dorsolateral petiole glands becomes obvious just above the middle of the petiole. Noteworthy is the fact that the leaves in these stages are slightly but clearly peltate. Even more interestingly, many tendrils develop a disk shaped structute at the apex.

Eventually, the leaves develop their abruptly acute apex and when the vine reaches the canopy the rounded, peltate base is lost and the leaf gets its final shape which is usually more broadly elliptic than obovate (± 110 x 60 mm) as it's scientific name would suggest..

Initially, as the vine grows, it remains attached to the host tree. When girth and weight increase, it may become detached from the tree, but the myriad of vines attached in the canopy keep it suspended. The age of these vines is difficult to assess. Definitely, I found them growing only in the larger trees.

I never got to see the vine as it grows in the canopy. Also, I have yet ro see the flowers. Killip (1936) describes them as follows: "Flowers about 4 cm wide, greenish white; calyx tube patelliform; sepals oblong, 1.5 cm long, 0.8 cm wide, obtuse; petals linear-oblong, about 1.3 cm long, 0.4 cm wide; corona filaments in 2 series, the outer subequal to the petals, ligulate, filiform toward apex, the inner capillary, about 2 mm long, minutely capitellate; operculum membranous, 4 mm high, closely plicate, slightly incurved; limen annular, low; ovary globose."

The one part of *P obovata's* anatomy that requires further study is the disk-tipped tendril.. These disks assist the rendril to wedge itself between crevices in the bark. To a lesser extent I have seen the same in *P guatemalensis*, and it is a well known feature of Passionflowers of the subgenus *Decaloba* section Discophorea (where the tendrils are forked as well). In *P obovata*, these disks are more or less flat where they are attached ro the tendril, but clearly convex terminally. Magnified, the convex side of the disk shows a granular surface. In young plants which I am now growing at the "National Passionflower Collection" at Green Hills in the Cayo District, Belize, these disks rarely show up on new tendrils until I provide the plant with a piece of batk.. After this, the majority of new tendrils develop disks. Probably, this is a response of the plant to the tactile stimuli offered by the piece of bark. Once in contact, the granular "bubbles" on the disk inflate to maximize their grip on the baulc

P obovata appears to be the foodplant of the butterfly *Heliconius hecalesia octavia*. One of the plants that I found clearly showed traces of herbivory on one of the lower shoots. On the tip of t.dlisshoot, I found the remains of a pupa which Or.. Gilbert from the University of Texas identified as belonging to this butterfly. Over much of its range, the foodplant preferences for this species are still poorly known, and this find may prove an important clue to discovet more of the biology and ecology of this rare bunerfly.

Another element that requires further research is the potential relation of *P obovata* with rodents as the seed disperser.. It was indeed striking to note that all the *P obovata* plants that I found were rooted at the very base of large to very large trees, or even seemed to come from underneath it. Also, the seedlings seem unable to get hold as a freestanding

specimen as is rhe case in mosr orher *Passiflora* rhar I am familiar with. All these characteristics condemn the species to undisrurbed, high forest.. Secondary forest is simply unsuitable. Primary, high forest is getring increasingly scarce in Meso-America and the already disjuncr distriburion of *P. obovata* is likely to become even more fragmented in the near future.

Now rhar the "National Passionflower Collection" has some *P. obovata* growing under semi-natural conditions, I hope to be able to conduct further studies on this rare and unusual species.

Entomology of the Columbia River Forest Reserve

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The insect fauna of the Columbia Rivet Forest Reserve in the Maya Mountains (Toledo District, Belize) was selectively surveyed and sampled during 10-24 February 1997 by Jan Meerman and Larry D. Munsey (Little Quartz Ridge area) and during 2-6 June 1997 by Jan Meerman (Compartment 33 in the eastern section of the Columbia River Forest Reserve). Meerman is a lepidoptera researcher, natural hisrory tour leader, and environmental consultant associated with Belize Tropical Forest Studies (BTFS) in Belmopan; Munsey is a tropical entomologist and the president of Larry Munsey Inrernational, an international environmental consulting company headquartered in California, USA. Other investigators contributing specimens ro the survey effort were H. Lee Jones, Bruce HoIst, Bruce Miller, and Martin Meadows.

The February survey was conducted at, between, and in the general vicinity of five camps: HLS 500 on Little Quartz Ridge proper at 940-1035 m elevation, and four sites below ro the west and south at 700-730 m elevation, known as Union Camp, Camp 1, Camp 2, and Camp 3. Individual investigator time was divided among the five camps as follows: Meerman-HLS 500 (2 days), Union Camp (4 days), Camp 1 (3 days), Camp 2 (5 days), and Camp 3 (1 day); Munsey-Union Camp (4 days), Camp 1 (5 days), Camp 2 (5 days), and Camp 3 (1 day).

The June 1997 survey of the 1 X 1 km subcompartmenr 2 of compartmenr 33 by Meerman, was conducted from a single camp in the northeast corner of that subcompartmenr (UTM 2895 x 18115)(see Bird, 1994). The elevation here varied between 300-360 m.

Insect sampling consisted of active collecting (primarily by hand capture and aerial netting; secondarily by limited sweep nerting, "log rolling", and beating of live foliage and dead or dying wood) and passive ~ait rrapping during the day, and passive light attraction (with active specimen selecti~n) ar night.. Bait trapping was with conventional hanging burterfly traps suspended at or above eye level and baited with overripe fruit; generally two traps were employed at each camp. In the case of diurnal lepidoptera, data gathered by capmre was supplemented by observations made by the naked eye or with the aid of binoculars for species flying in the fotest canopy. In February, light attraction was accomplished by means of one 15-w ultraviolet tube and two to three 160-w mercury vapor bulbs (one sometimes intetchanged with a 2?0-w bulb) reflecting against a custom-made 2.5 x 3.5-m white tipstop nylon "sheet" with gtound apron, and powered by a 650 hp portable gasoline-driven generator. During the June survey, only a single 15-w ultraviolet mbe, powered by a car battery was utilized. Genetally, a minimum of 6, and as many as 12, investigator-hours was spent ~ach day in active collecting. The light apparams was operated continuously from dusk to dawn (with the exception of a few hours of mechanical difficulties) during-every night of the expedition, except for 11 February, resulting in an approximate total of 130 lighting-hours. Insects attracted to the sheet and vicinity were hand collecred regularly from dusk to midnight or later, and rhen at 2- to 3-hour intervals thereafter.

Insect taxa rargeted principally by the investigation were Lepidoptera (butterflies and moths) and Cerambycidae (long-horned wood-boring beetles), reflecting the specializa-

tion of the investigators and the putative value of these groups as indicators of biodiversity and general ecological "health". Butterfly data was gathered both by capture and observation; information on all other groups was derived from captured material only. All butterflies and cerambycids detected were recorded. All Coleoptera (beetles) above microscopic size encountered were collected. Representative samples of all moth species generally greater than 20 mm wingspread attracted to the lights were collected; most diurnal moths observed were collected. Representative samples of all other non-microscopic insect orders (except ants) encountered were collected casually in the course of collecting the target groups. In all cases, only adult stages were collected and recorded.

Meerman was responsible for identification of butterflies, Sphingidae (hawk moths) and Samrniidae (Emperor moths). Odonata (dragonflies and damsel flies) were identified by Tineke Boomsma (BTFS), Munsey will be responsible for identification of cerambycids and all other groups. Specimens collected will reside temporarily in the private collections of the BTFS facility and Munsey. Ultimately, the specimens will be deposited in the insect reference collection of the Florida State Museum of Arthropods and/or appropriate repositories in Belize.

A growing body of research and literature during recent years advances insects as especially useful indicators of biodiversity, ecological health, and vigor of tropical forest ecosystems. Among the virtues of certain insect groups in this regard are the following: vast diversity, ecological and taxonomic; intimate linkage to plants (and in certain taxa, exclusively woody plants) through obligate herbivOlY; relative logistical ease of collecting specimens for study; well-developed taxonomy; and sheer numbers and ubiquity, rendering acquisition of large sample sizes reasonably dependable. Two groups that have received the most attention and been touted most highly in this application are Lepidoptera and Coleoptera. Almost all butterflies are exclusively herbivorous, they are the most studied and well-known of the insects, high degrees of host specificity prevail, and their generally non-furtive behavior renders observation and capture comparatively practical.. Most moths are also exclusive herbivores, very high numbers of species occur in all tropical habitats, and collection in high numbers and diversity is made especially dependable by the generally strong positive phototropism of nocturnal species, which includes the bulk of the group. Beetles are by far the most diverse group of organisms known to man (excepting perhaps bacteria and viruses), and several large families are exclusively herbivorous, a few of which, including Cerambycidae, are restricted almost entirely to woody plants (as opposed to herbaceous plants, subshrubs, or vines). Cerambycidae is one of the largest of all insect families, possesses both diurnally and nocturnally active groups, and during the appropriate time of year can normally be collected in high species numbers by beating dead and dying wood, netting on flowers, attracting to light, and examining fallen wood at night.

Insect activity was low during the February survey period and collecting was correspondingly poor. To an extent this was expected for this time of year, which in this region normally is the end of the "rainy" season or beginning of the "dq" season. In tropical regions where such seasonality occurs insect activity is generally at its peak during the onset of the "rainy" season, a time when adulrs of many major groups emerge from the dormant stage in which they passed the "dry" season. Judging from 8 years of Lepidoptera data maintained in the BTFS database, it was expected that numbers of nocturnal Lepidoptera attracted to lights would be relatively low during February. This data reflects that as a rule numbers of most nocturnal Lepidoptera families encountered at lights in Northern and Central Belize are lowest during February-March and highest during Ma y- July (Meerman, 1999). Although this pattern has not been proven for the south of Belize, it is consistent with expectations based upon behavior and ecology, as noted above. Moreover, the prevailing weather during this expedition was cold and rainy. Thus, this expedition transpired when [Wo external factors, season and weather, were not ideal for insect surveying, i.e.: (1) internally "fixed" seasonal cycles of many nocmrnallepidoptera dictate peak activities at the beginning of the rainy season, (2) low temperature and infrequent sunlight greatly reduced favorable opportunities for activity of heliothermic and hellotropic diurnal insects. This combination of seasonal timing was undoubtedly largely responsible for the overall depressed level of insect activity encount;>:red in February and the much higher levels of nocturnal Lepidopteran activities encountered in June. Another complicating factor for nocturnal groups was the phase of the moon during which the expeditions occurred. Nocturnally active insects are most readily attracted to lights during the dark phase of the moon, especially the several nights immediately preceding the new moon. Thus, the ideal timing of a [Wo-week period for sampling nocturnal insects places the new moon at approximately mid-period. The February expedition commenced just after the new moon and concluded just after full moon. The June expedition, on the other hand was timed to occur during new moon.

The results of the survey, to the extent ascertained to date, are provided in Tables 1 and 2. Table 1 summarizes the number of specimens collected by major insect group, and Table 2 provides a species list for butterflies, a few moth families, and cerambycids. The results presented are based upon counts and determinations made in the field, except for butterflies and cerambycids, some of the former and all of the latter of which have been examined in rhe laboratory subsequent to the expedition. All specimen and species counts provided ar this time are subject to confirmation in the laboratory and further integration of the data collected by each investigator.. Efforts will continue to determine to the lowest taxon practical for all remaining specimens collected; in many cases this will be to the species level, in most at least to genus, and in a few perhaps only to family. This requires that all specimens first be properly mounted and labelled, which is currently underway; then much of the material will have to be examined by specialists on the various groups represented.

A total of 2,584 insect specimens were collected, the majority of which fall within the following major groups (not including observations):

Odonata	61
Coleoptera (beetles)	178
Lepidoptera (moths)	2,182
Lepidoptera (butterflies)	41
Hymenoptera (wasps & bees)	39

Table 1.

It is grossly estimated that ar least 900 different species are represented within the total number of specimens collected.

The two surveys encountered some distinct differences between the composition of the Lepidopterous faunas. For example, the number of Papilionidae and Pieridae together comprise 30% of the total day active "butterfly" fauna in compartment 33 while they comptise only 17% during the LQR Survey. This difference, however, must be attributed to seasonal fluctuations. Both Papilionidae and Pieridae are most common towards the end of the dry season (Meerman, 1999).

	Little Quartz Ridge, Feb. 1997	Compartment 33, June 1997
Butterflies		
Papilionidae	5	7
Pieridae	5	6
Lycaenidae	3	1
Riodinidae	8	4
Nymphalidae	38	25
Moths		
Sphingidae	12	29
Satu rni idae	13	30

Table 2.

Also, the substantially larger number of the "moth" families Sphingidae and Saturniidae at the current survey *site* is entirely the result of seasonal fluctuations. Both families are most numerous around the start of the rainy season (Meerman, 1999; Meerman & Boomsma, 1993). More interesting, both families virtually equal each other in diversity at both sites. Nation-wide, there have been 103 species of Sphingidae recorded while the reported number of Saturniidae is only 53 (Meerman, 1999). In other words, The Saturniidae appear over-represented in both samples. At thtee other relatively well research sites in Belize, the Shipstern Nature Reserve (Corozal District), Caracol (Cayo Disn'ict) and the Slate Creek Preserve (Cayo District) the relationship between Sphingidae/Saturniidae is 49/16, 40/36 and 57/36, respectively. Here, only the Caracol site shows a comparable "over-representation" of Saturniidae. This phenomenon can be explained by the fact that as a group, the Neo-tropical Sphingidae larvae tend to feed on herbs and shrubs. Neotropical Saturniidae larvae, on the other hand, tend to feed on trees. As a consequence, in areas with low forest (Ships tern) or with large clearings (Slate Creek), Sphingidae can be expected to be dominant, while in areas with high forest, Saturniidae are the main group. As such, the two families act as indicators for the amount of forest cover in a given area. With a closed canopy, such as at both Columbia River Forest Reserve survey sites and to a somewhat lesser extent at the Caracol site, the Saturniidae fauna is extremely diverse. Continued monitoring in selected areas might be expected to show an increase in Sphingidae diversity (and a decrease in Saturniidae diversityl) as intensive logging ;n parrs of the Forest Reserve progresses.

Although certain families of Lepidoptera in Belize are rather well sampled (BTFS database), the wet, medium altitude regions of southern Belize are among the poorest known habitats of Belize with respect to Lepidopteran fauna. In particular, no Lepidoptera data were available from the medium

and higher altitude sections of the Columbia River Forest Reserve prior to the current survey. For this reason it was expected that the results of this survey would add several new Lepidoptera species to the Belize country list. Occurrence or distributional data for other insect groups in Belize is virtually nonexistent in the entomological literature, except as it may be inferred from recorded species range information that would logically include Belize because of its geographic location between Mexico and other Central American countries that may be specifically listed.

To date, it has been determined that butterfly specimens collected and observed during the expedition represent 89 species belonging to the families Papilionidae, Pieridae, Nymphalidae, Lycaenidae, and Riodinidae (Hesperiidae collected have not yet been determined, and will add 5 to 10 more species to this total). Six of these species are new records to Belize (as indicated by the list maintained in the BTFS database): *Protographium calliste, Electrostrymon denarius, Euse!asia aurantiaca, Eueides !ineata, He!iconius sara* and *Dynastor stryx.* For such a short species list, we consider this a very high number of new species records for a group so well studied. In general, the butterfly species composition encountered on the current expeditions was very similar to that recorded recently along the Maya Mountain Divide east of Doyle's Delight (Meerman & Williams, 1995).

One of the new records, *P. ca!!iste,* is considered a rare species from high-elevation cloud forests in Mesa-America. The presence of this species is another indication of the affinity of the Little Quartz Ridge area with lower montane habitats in neighboring countries such as Guatemala and Honduras, as also indicated by the botanical and herpetological data from this expedition.

Another interesting new species record is *E. !ineata,* generally a rate and localized species of Heliconinae which was suspected to occur in the area on the basis of the occurrence of a potential foodplant, *Passiflora !ancetiliensis,* discovered in the area during a 1992 expedition (Hoist, 1993).

Approximately 22 families are tepresented by the nocturnal Lepidoptera collected. Only two families of nocturnal Lepidoptera, Sphingidae and Saturniidae, have been relatively well sampled and recorded in Belize, and are also reasonably easy to identify. Among the 12 species of Sphingidae and 15 species of Saturniidae recorded during this expedition, 5 were new records for Belize: *Amphimoea wa!kerz; Manduca pe!!enia, Pachy!ia dargeta, Xy!ophanes zurcheri* and *Citheronia co!!aris.* Again, we consider this a very high number for such a limited sample. Once taxonomic determinations are complete for the other nocturnal Lepidoptera families collected, the resulting information will greatly expand the database for this group in Belize, and may be expected to disclose several species new to science.

Seasonal and weather factors, especially the former, greatly restricted the number of cerambycid species obtained by the survey. At the appropriate time of year (April through July), considerable collecring experience in neigh boring locales in Mexico and Central America indicates that rigorous targeted collecting could have been expected to produce as many as 200-400 species during a survey of comparable duration. As no comprehensive source of information on Cerambycidae in Belize is known to the authors, and it is doubtful that one exists, it is difficult to assess the possible uniqueness of any of the species collected during this expedition. Once further examination of existing records is concluded, it is likely that some of the species collected will be revealed as new records for Belize.

Collectively, although numbers of both insect species and individuals recorded by the two expeditions were comparatively low, the data gathered do suggest high ecosystem biodiversity and, more importantly, demonstrate the unusual biogeographical position of the wet, medium altitude regions of southern Belize. The data also demonstrate the general lack of and need for entomological information from this region.

TABLE 1

SUMMARY OF INSECT SPECIMENS COLLECTED DURING THE COLUMBIA RIVER FOREST RESERVE RAPID ASSESSMENT PROGRAM, BELIZE, FEBRUARY AND JUNE 1997 (PRELIMINARY)[1]

Taxonomic Group	Total specimens [2]
ODONATA-DRAGONFLIES & DAMSELFLIES	
Anisoptera-Dragonflies	42
Zygoptera-Damselflies	19
PLECOPTERA—STONEFLIES	3
ORTHOPTERA-GRASSHOPPERS & ALLIES	3
Acrididae-shon-horned grasshoppers	2
Gryllidae-crickets	4
Rhaphidophoridae-cave & camel crickets	3
Phasmatidae--walkingsticks	1
HEMIPTERA-TRUE BUGS	3
Pentaromidae-stink bugs	10
Scutelleridae-shield bugs	1
Coreidae-squash bugs	2
Lygaeidae-seed bugs	2
Reduviidae-assassin bugs	1
HOMOPTERA-HOMOPTERANS	7
Cicadellidae-leafhoppers	8
Membracidae-treehoppers	3
Fulgoridae-fulgorids	5
COLEOPTERA-BEETLES	4
Dytiscidae-predaceous diving beetles	1
Telegeusidae-telegeusid beetles	1
Silphidae-carrion beetles	8
Staphylinidae-rove beetles	1
Can tharidae-soldier beetles	2
Lycidae-net-winged beetles	3
Osromidae-bark-gnawing beetles	1
Elateridae-click beetles	1
Coccinellidae-ladybird beetles	2
Tenebrionidae-darkling beetles	5

(table continued on next page)

[1] Pending further taxonomic determination and more complete integration of data between the two authors.

[2] Numbers shown reflect counts made in the field, and are subject to confirmation and refinement in the laboratory. Numbers of specimens shown at the Order taxon level reflect specimens not yet identified to the Family level.

[3] Families listed with no corresponding numbers of specimens reflect those thus far confirmed represented by specimens collected, but for which no specific counts have yet been determined.

[4] Counts reflect both captured and observed specimens; no counts shown for Hesperiidae, as species determinations not yet made.

TABLE I (continued)

Taxonomic Group	Total specimens [2]
Passalidae-bessbugs	3
Scarabaeidae-scarab beetles	54
Cerambycidae-long-horned wood-boring beetles	18
Chrysomelidae-leaf beetles	3
Curculionidae-snout beetles	15
TRICHOPTERA—CADDISFLIES	2
LEPIDOPTERA - MOTHS AND BUTTERFLIES	2,182
Heteroceta-Moths [4]	
Thyrididae-window-winged moths	
Pytalidae-pyralid moths	
Sesiidae-clear-winged moths	
Megalopygidae-flannel c moths	
Cossidae-catpenter moths	
Dalceridae-dalcerid moths	
Limacodidae-slug caterpillar moths	
Tortricidae-tortricid moths	
Sematuridae-sematurid moths	5
Castnidae-casrnid moths	7
Geometridae-geometer moths	
Thyatiridae-thyatirid moths	
Apatelodidae-apatelodid moths	
Mimallonidae-mimallonid moths	
Lasiocampidae-lappet moths	
Saturniidae-giant silkworm moths	216
Sphingidae-hawk moths	212
Notodontidae-prominents	
Dioptidae-oak moths	
Lymantriidae-mssock moths	
Arctiidae-tiger moths	
Noctuidae-noctuid moths	
Ctenuchidae-ctenuchid moths	
Rhopalocera-Butterflies [3]	
Hesperiidae-skippers	7
Papilionidae-swallowtails	58
Pieridae-whites & sulfurs	71
Nymphalidae-brush-footed butterflies	173
Lycaenidae-hairstreaks, coppers & blues	8
Riodinidae-metalmarks	31
DIPTERA - TRUE FLIES	3
Tipulidae-crane flies	
Tabanidae-horse & deer flies	1
Syrphidae-hover flies	1
Tachinidae-tachinid flies	1

HYMENOPTERA-ANTS, BEES & WASPS	17
Ichneumonidae-ichneumon id wasps	6
Chalcididae-chalcid wasps	1
Vespidae-paper wasps	11
Sphecidae-thread-waisted and digger wasps	3
Apidae-bumble bee & honey bees	1
Total Specimens Collecred	2,584

TABLE II

	No. of Specimens	American Camp	Union Camp (UC)	Camp 1 (Cl)	Camp 2 (C2)	Camp 3 (C3)	LQR Summit (SU)	Camp. 33/2 (BR)
LEPIDOPTERA								
PAPILIONIDAE	12 species, 58 specimens							
Battus (halceus	1							June
BattltS sp.	1		23-Feb					
Euritydes salliini	10							June
Hemdides anchisiades	1							June
Mimoidej phaon	1							June
Paridej childrenae	2				15-Feb			
Paridej' euri11ledes	1			13-Feb				
Protographium agej-il.aus	6							June
Protogmphillm callijte	25						20121-Feb	
Protographiu11l epidaus	6							June
Protographium phi/olaus	19							June
I'rotogmphill11l thyastes	3		23-Feb				20/21-Feb	
PIERIDAE	11 species, 71 specimens							
Aphrijsa boisdlllNdli	5							June
Aphrisj-a statim	35							June
Appias dmsi/la	6							June
Charonias tereas	11		22-Feb	13-Feb	15-Feb	16-Feb		
Dismorphia amphiona	1		22-Feb					
Dijmorphia thet/charilla	2			13-Feb				
Eurema albula	1							June
ElIrema sp_	1		22-Feb					
!.aballia pandosa	4							June
Phoebis {!rgante	3							June
l'hoebis sp_	2		22-Feb				14-Feb	
LYCAENIDAE	4 species 8 specimens							
EumaeltS toxea	3			13-Feb			20-Feb	
E!ectro!jtrymon denariu~-	1						21-Feb	
Everes c011lyntas	1		24-Feb					
"Thecla" sp.	3							June
RIODINIDAE	12 species, 31 specimens							
Calephelis sp.	1							June
Calospila slldias	1			14-Feb				

(continued)	Nr. of Specimens	American Camp	Union Camp (UC)	Camp I (Cl)	Camp 2 (C2)	Camp 3 (C3)	LQR Summit (SU)	Camp. 33/2 (BH)
Charis sp.	3		22-Feb					
Elllybia patrolla	2							June
Eusalesia a/trantiaca	1			13-Feb				
Juditha mo/pe	2							June
Leucochimona nivalis	1			23-Feb				
MesoJ-ernia gaudioium	9		22-Feb	12/13-Feb	15-Feb			
Mesosemia lamachus	3			12/13-Feb				
Napaea umbra	1		22-Feb					
Thisbe irenea	5							June
Thisbe /ycorias	2		23-Feb					
NYMPHALIDAE	50 species. 173 specimens							
Actinote guatemalena	1		23-Feb					
Ade/pha sp.	2		23-Feb					
Anartia fttima	5		22-Feb				21-Feb	
Antirrhea rniltiades	3					16-Feb		June
Archaeoprepona demophon	4		22-Feb					June
Biblis hyperia	1							June
Caligo /trantlS	5			13/21-Feb			June	
Castilia eranitis	1			13-Feb				
Castilia myia	1						21-Feb	
Cbloreuprychia sericeella	4			12/13-Feb			20-Feb	
Ch!myne gaudealis	1							June
Cissia metaleuca	3		21-Feb	22-Feb				
Dryadula phaetusa	1		23-Feb					
Dryas iulia	9		22-Feb				21-Feb	June
Dynastor stryx	1							June
Eueides lineata	6			22-Feb			20/21-Feb	
Euprychia westwoodi	1		23-Feb					
Godyris zavelata	3			19-Feb				June
Creta nero	7	9-Feb	22-Feb	12/22-Feb	6-Feb			
Greta oto	1						20-Feb	
Hamadryas guaternalena	1		22-Feb					
Hamadryas sp.	2							June
Heliconius charitonius	12		10-22-Feb			20/21-Feb	June	
Heliconius eydno	17	lO-Feb		12/13-Feb	15-Feb	16-Feb	20-Feb	June
Heliconius hecalesia	2			13-Feb	16-Feb			
Heliconius ismeniuJ	2			22-Feb			20-Feb	
Heliconius sapho	8		22-Feb		15-Feb			June
Heliconius sara	5			13-Feb	15-Feb			
Hyposcada virginiana	1			14-Feb				
Laparus doris	5							June
Libytheana carinenta	1							June
Lycorea cleobaea	1			13-Feb				
Marpesia chil'On	2							June
Melinaea eth,.is	2							June
Morpho peleides	5		10-Feb	13-Feb				

(continued)	Nr. of Speci-mens	American Camp	Union Camp (UC)	Camp 1 (Cl)	Camp 2 (C2)	Camp 3 (C3)	LQR Summit (SU)	Camp. 33/2- (BH)
MOJpho thesew	8		23-Feb		15-Feb		2l-Feb	June
lvIyseelia cyaniris	1							1
Niea fiavilla	2		24-Feb					
Olerill paulll	7			l2/13-Feb				June
Opsiphanes eassina	3		22-Feb					June
Philllethrill. dido	5						20/21-Feb	
Pierella luna	10			12/13-Feb	15-Feb			June
Pteronymia eotytto	4		23-Feb	12-Feb				
Pyrrhogyra neaerell	1							June
Pyrrhogyra ,po	1		23-Feb					
Siproeta superba	1						14-Feb	
Taygetis andromeda	1		22-Feb					
Taygetis virgilia	1							June
Temenis laothoe	1							June
Tigridia aeeste	1							June
SPHINGIDAE	37 species, 212 specimens							
Adhemllrius gllnnaseus	3		23-Feb					June
Adhemarius ypsilon	4							June
Arnphimoell. wllkeri	6			13-Feb	15-Feb			
Cllllionima ftleifera	1		23-Feb					
Callionima inuus	16							June
Callionima paree	4							June
Cautethia ,purill	6		ll-Feb					
Cocytius duponchel	1							June
Cocytius Lucifer	1							June
EurnOJpha llnehernolus	5		10-Feb					June
Eumorpha obliquus	3							June
Eumorpha satellitll	11							June
EumOJphll triangulum	62							June
Madoryx plutonius	1							June
Manduell. lllbiplagll	4							June
Mllnduea fiorestan	8							June
Manduea lanuginow	2							June
Manduea liehenea	2		10-Feb					
Manduca oeculta	3							June
Mllnduea pellenia	3							June
ManduCll rustica	2							June
Orybll kadeni	1							June
Paehylia dargeta	1		to-Feb					
Pachylia resumem	1		17-Feb		17-Feb			
Perigonia m: lu,'ca	5							June
Protambulyx strigilis	1							June
Protambulyx xanthw	1		23-Feb					June
Xylophanes amadis	9							June
Xylophanes anubus	7							June
Xylophanes belti	3							June
Xylophanes ceratomioides	4							June

(continued)	Nr. of Speci-nlens	American Camp	Union Camp (UC)	Camp I (Cl)	Camp 2 (C2)	Camp 3 (C3)	LQR Sunlnlit (SU)	Camp. 33/2 (BH)
Xylophanes lybia	7							June
Xylophanes neoptelmus	I		23-Feb					
Xylophanes pluto	I							June
Xylophanes thyelia	3		1l/24-Feb					
Xylopha nes tyndarus	3							June
Xylophanes zurcheri	16		23-Feb	14/21-Feb				June
SATURNIIDAE	33 species, 216 specimens							
Adeloneivaia irrorata	4							June
Adeloneivaia isara	I		lO-Feb					
Adeloneivaia jason	la			14-Feb	15-Feb			June
ArseJwrtl annida	1							June
Autorneris acutissima	1							June
Automeris banus	8				IG-Feb			June
Automeris beti	8				15-Feb			June
Automeris gabriellae	1							June
Automeris moloneyi	5							June
Autonzeris montezuma	1							June
Automeris zozine	3							June
Caio championi	I							June
Citheronia collaris	4		24-Feb					June
Citheronia mexicana	7							June
Cithioictl amhonilis	3							June
Copaxa esealamei	6		23-Feb	14-Feb	21-Feb			June
Copaxtl rufinans	1			13-Feb				
Dysdtlemonia boreas	15							June
Eaales imperialis	41							June
Eaales masoni	21							June
Eaales ormondei	7		10/23-Feb	14-Feb	16-Feb			June
Hylesia dalina	I		23-Feb					
Hylesitl sp 1.	6							June
Hylesia sp 2.	14							June
Othorene purpuraseens	12		10/II-Feb	14-Feb	15/16/18-Feb			June
Othorene veramJ	6		10-Feb	14-Feb	18-Feb			June
Periphoba areaei	7		II-Feb	13-Feb				June
Rothschildia roxana	5		23-Feb		18-Feb			June
Rothschilditl lebetlu	9							June
Syssphinx colla colla	1							June
Syssphinx mexictlna	1							June
Syssphinx molina	4							June
Sys'sphinx quadrilineata	1							June
CASTNIDAE	2 species, 7 specimens							
Cyanostola diva	2							June
C,zstnia Lietts	5							June
SEMATURIDAE	1 species, 5 specimens							
Nothus lunus	5			14-Feb	16-Feb			June

(continued)	*Nc.* of Speci-mens	Ameri-can Comp	Union Camp (UC)	Camp I (Cl)	Camp 2 (C2)	Camp 3 (C3)	LQR Summit (SU)	Camp. 33/2 (BH)
COLEOPTERA								
CERAMBYCIDAE	14 species, 17 specimens							
Adetus baeillarius	1		22-2					
Colobothea sp. *(pareens or vidua ?)*	1		24-2					
Furona (degenera ?)	3			21-2	14-2			
Haruspex inscriptus	1		22-2					
Leptostylus if. albieinctus. or *lazltlinus*	1				14-2			
Megacyllene angulata	1			13-2				
Nealcidion if. seute/ltltum	1		23-2					
Neocompsa ,I macrotricha, spinosa, & squalida	1				17-2			
Nyssodrysina htildernani	1		22-2					
Nyssodrysina leucopyga	1		22-2					
Parmenonta ,I valida.	1			20-2				
Pygrnodeon obtusum	1				15-2			
Sehwarzerion holoeMorltm	1			20-2				
Jioiehalphus pilosus	1		22-2					
Urgleptes if. bivitt{ltuS or *mixtus*	1				17-2			
ODONATA	12 species, 61 specimens							
ANISOPTERA-AESHNIDAE								
Aeshna psillts	1						21-2	
Jioiacanthagyna caribbea	1		22-2					
ANISOPTERA-LIBELLULIDAE								
Brechnzorhoga nubecula.	1			22-2				
Macrothenzis pseltdoimitans	5							June
Orthemis fermginea	31			22-2				June
Pantala jlrJvesce1u	3							June
ZYGOPTERA-CALYGOPTERIDAE								
Hetaerina capitalis	2			13-2				
Hetaerina pilula	1			13-2				
ZYGOPTERA-COENAGRIONIDAE								
Argia cuprea	2				14;2			
Argia Itlmeca	6				13/22-2			
ZYGOPTERA-MEGAPODAGRIONIDAE								
Heteragrion alienunz	2				14-2			June
ZYGOPTERA-PSEUDOSTIGMATIDAE								
Megaloprepus caemlatus	6							June

Amphibians and Reptiles of the Columbia River Forest Reserve

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Amphibian and reptile data were collected on two trips to the Columbia River Forest Reserve. Our collection of amphibians and reptiles numbers 53 specimens representing 26 species, 17 genera, and 12 families. The specimens are in the private collection of Jan Meerman, presently on loan to Julian C. Lee of the University of Miami under authority of Exportation Permit CD/72/2/97.

We have sight records for an additional fourteen species representing nine additional genera and five additional families, and we found the shed skin of an unidentified snake, possibly that of *Dendrophidion* sp. Together with data already available (Emmons & Meyer, 1993; Lee, 1996), we can now verify the presence of 56 species of amphibians and reptiles for the Columbia River Forest Reserve

General collecting methodology:

The presumed log-normal distribution of species abundances in tropical herpetofaunal communities (a few common species, many rare ones) means that short-term surveys cannot hope to detect all or even most of the resident species. Standardized, labor-intensive methods of sampling (e.g., drift fences, pit-fall traps, quadrat sampling) are also incomparable with the short-term RAP protocol.

Accordingly, we carefully searched all major habitats likely occupied by amphibians and reptiles, with the exception of the forest canopy. In particular, we waded streams by night and day, searching stream banks and overhanging vegetation. Muddy stream banks were raked in search of caecilians. Tadpoles were collected from streams by dip-net. We searched the forest floor, also by night and day, raking through leaf litter, overturning surface debris, opening fallen logs, examining the surfaces of buttresses and lower portions of tree trunks, and searching within terrestrial bromeliads. We entered caves where we also searched carefully for amphibians and reptiles.

In addition to our efforts, other members of the expedition collected amphibians and reptiles opportunistically, in the course of their research activities. Our Maya assistants also provided several specimens.

Itinerary of participants during the 1997 expeditions:

JM = Jan Meerman, JL = Julian Lee. 9/Feb. San Jose Camp to American Camp (JM); 10/Feb. Arrive at Union Camp (16° 23' 88.5" N, 89° 08' 56" W, 730 m elev) (JM, JL); 11/Feb. Union Camp to Camp #1 (16° 22' 97.0" N, 89° 07' 16.7" W, 700 m elev) (JM, JL); 11-14/2 Camp #1 and vicinity (JM, JL). 14/Feb. Camp #1 to Camp #2 (16° 23' 37.7" N, 89° 05' 49.2" W, 730 m elev) (JM, JL); 14-16/Feb. Camp #2 and vicinity (JM, JL); 16/Feb. Camp #2 to Camp #3 (16° 23' 24.0" N, 89° 04' 61.9" W, 700 m elev) and return (JM, JL); 17-19/Feb. Camp #2 and vicinity OM, JL); 20/Feb. Camp #2 to HLS500 (16° 24' 04.0" N, 89° 06' 67.0" W, 940 m elev) and eastward, overnight at 1035 m. (JM). Camp #2 to Camp #1 (JL); 21/Feb. Vicinity HLS500 to Camp #1, Camp #1 to Union Camp (JM); 22/Feb. Camp #1 to Union Camp OL); 23/Feb. Union Camp and vicinity (JM, JL); 24/Feb. Depart Union Camp (JM, JL); 2-6/June Compartment 33/2 (Eastern Section of the Columbia River Forest Reserve (JM).

Results

Taxonomic and distributional considerations:
A single subadult specimen of the giant salamander, *Bolitoglossa dofleini,* taken at Camp 2, is the third specimen from Belize. The species is otherwise known from Cayo (McCoy, 1990; Meerman, pers. obs.). Our specimen is the first record of the species from Toledo District..

The two specimens of the salamander *Oedipina elongata* collected at Camp 3 represent the first of rhat rare species to be found in Belize since 1941. They are the first records of the species for Toledo District..

The recently described *Eleutherodactylus psephosypharus* (Campbell, et al., 1994) found in a cave at Camp 1 is one of only a few specimens of that species known from Belize.

Two frog specimens of the genus *Eleutherodactylus* may prove to be new to science. These are ptesently under study by Or.. Jay M. Savage, University of Miami, who is an authority on the Middle American members of this enormous genus. Dr. Savage informs us that at the moment these two frogs are ten tatively assigned to the *Eleutherodactylus gollmeri* group. The twO specimens may actually reptesent the same species. but even that, at the moment, is uncertain.

We found a mud turtle, *Kinosternon,* to be common in the streams in the vicinity of Camp 2, and we collected one voucher specimen. This individual appears somewhat intermediate in morphology between *Kacutum* and *Kleucostomum,* but is provisionally identified as the latter species. This is the first record of the genus from the Columbia River Forest Reserve.

The five specimens of the lizard *Lepidophyma mayae* collected at Camp 3 and the single specimen from Compartment 33 are the first records of that species from Belize. In both locations they were taken in syntopy with their congener and presumed close relative *L. flavimaculatum,* raising questions about the mechanisms of coexistence in such ecologically similar and closely related species.

The single specimen of *Dendrophidion* collected on the Little Quartz Ridge Summit is unquestionably *D. vinitor.* Prior to 1988 the name *D. vinitor* was applied to members of that genus in Belize. In his revision of the genus, Lieb (1988) assigned all known Belizean *Dendrophidion* to *D. nuchale.* Thus, the SU specimen represents the first confirmed record of *D. vinitor* from Belize.

A single specimen of the snake *Stenorrhina degenhardtii* taken at Union Camp represents the third record of that species from Belize. Previously it has been reported from the Chiquibul (as *Stenorrhina fteminvillei* by Stafford, 1991); and from the "southern Maya Mountains" (Stafford, pers. comm.). Our specimen may be the first and only record from Toledo District..

Ecological and behavioral observations:
Prior to this field work. the advertisement call of the frog *Eleutherodactylus chac* was unknown. Because males of that species possess neither vocal sacs nor vocal slits. they were thought possibly to be mute. We observed males of this species vocalizing, and. through the courtesy of Mr.. Lee Jones, will have tape recordings of the advertisement call of this species available for sound analysis.

We found breeding congregations of the recently described *Bufo, campbelli* (Mendelson, 1994) at Camps 1 and 2. The advertisement call of this species was already described in Meerman & Williams (1995), but thtough the courtesy of Mr.. Lee Jones, we will now have rape recordings of the advertisement call of this species available for sound analysis.

Prior to this field work, the tadpole of *Bufo, camp belli* was undescribed. Bufonid tadpoles, almOSt surely those of *B.campbelli,* were seen commonly in the streams at Camps 1 and 2. We verified reproductive activity for *Bt/fo, campbelli* (breeding congregations, eggs masses, tadpoles); *Hyalinobatrachium fleischmanni* (breeding congregations. graviq females. egg clutches); *Rana juliani* (gravid female, tadpoles); and *Rana vaitlanti.* (egg mass, tadpoles). At lower elevations in southern Belize. anuran breeding activity is generally associated with the spring and summer rainy season. We conjecture that during the rainy season the velocity of stream flow in the Little Quartz Ridge area is such as to preclude breeding activity for stream-associated species and that reproduction is tlws shifted to the relatively "dry" winter months.

The *Stenorrhina degenhardtii* from Union Camp was a gravid female who produced a clutch of 14 eggs on 26 February. As virtually nothing is known concerning reproduction in this uncommon species, our observations concerning the timing of oviposition. and clutch size are noteworthy.

At Camp 1, *Rana vaillanti.* was a common inhabitant of streams, where many individuals were observed at night at the edges of stteams, on stream banks, and on rocks within streams. At camp 2, only a few km to the east, *Rana vaillan-*

ti was absent from streams altogether, where it was apparently replaced by a related member of the *Rana palmi pes* group, *Rana juliani,* the only species of amphibian known to be endemic to Belize. The ecological basis for this replacement is unknown, but offers an intriguing basis for future research.

Lowlights:

A previous RAP assessment of the Columbia River Forest Reserve (Parker et aI., 1993) revealed the presence of a small yellow tree frog *Hyla bromeliacia* and a rare fringe-limbed treefrog *Hyla valanciftr* at Gloria Camp (reponed as *Hyla minera* by Emmons and Meyer, 1993). We were disappointed not to find these species. In particular we had hoped to find the radpole of *H.. valanciftr,* which is unknown.

Caecilians are known from only rwo records in Belize, both from the vicinity of the Upper Raspaculo, Cayo District.. The wet forests of the Columbia River Forest Reserve must surely support caecilians, for the habitat seems ideal, but we failed to find caecilians.

Conclusions.

The composition of the herpetofauna of the Columbia River Forest Reserve is summarized in Table 1. This list includes the results of the present field work, together with data compiled by Lee (1996). The latter includes a thorough teview of the holdings of 54 museums and private collections in the United States, Latin America, and Europe, and all relevant literature published through 1995.

As ptesently understood, the herpetofauna of the Columbia River Forest Reserve consists of 22 species of amphibians and 34 species of reptiles. The six amphibian families are represented by nine genera. Included in this summary are rwo un described species of the genus Eleutherodactylus. Turtles are represented by a single species. The seven lizard families are represented by nine genera, and the three snake families are represented by 14 genera.

Our field work documented the occurrence of 36 species of amphibians and reptiles, 21 of which are new records for the Columbia River Forest Reserve. This dramatic increase in the number of species known for the CRFR indicates very clearly that our knowledge of the composition of this herpetofauna is still far from complete. Funher field work willunquestionably reveal the presence of additional species new to the CRFR, new to Toledo District, new to Belize, and, doubtless, new to science.

It is clear, however, that the herpetofauna of the Columbia River Forest Reserve is exceptionally rich. The very inadequately known herpetofauna numbers 56 species, with many additional species awaiting discovery.. By comparison, the entire Yucatan Peninsula (defined to include the Guatemalan Department of El Peten and all of Belize), some 240,000 sq. km, has a herpetofauna of only 182 species. Thus, at a minimum, the 103,000 acres of the Columbia River Forest Reserve supports 31 percent of the Yucatecan herpetofauna. It is likely that when the full extent of the species richness of this herpetofauna is known it will prove to be the most diverse in Belize.

Table 1.

Amphibians and reptiles of the Columbia River Forest Reserve. Species collected or observed by us are marked with an asterisk (*). Those that represent new records for the CRFR appear in bold type. AC ~ American Camp; Cl, C2, and C3 ~ Camps 1,2, and 3, respectively; UC ~ Union Camp; SU ~ Little Quartz Ridge Summit; *C3312* ~ Compartment 33, subcomparrment 2 in the eastern section of the Columbia River Forest Reserve.

	AC	UC	C1	C2	C3	SU	C33/2
AMPHIBIA, URODELA, PLETHODONTIDAE							
*Bolitoglossa rufescens**			20-Feb				
*Bolitoglossa dofleini**				15-Feb			
*Oedipina elongata**					16-Feb		
AMPHIBIA, BUFONIDAE							
Buft rnarinuJ							
*Bltft campbelfi**	9-Feb	22-Feb	12-Feb	14-Feb		20-Feb	June

(continued)	AC	UC	Cl	C2	C3	SU	C33/2
AMPHIBIA, LEPTODACTYLIDAE							
*Eletttherodactylw chac**	IQ-Feb	22-Feb	12-Feb	IS-Feb	6-Feb	2Q-Feb	
Eleutherodactylus /atiaps							
Eleutherodactylus leprus							
*Eleutherodactylw psephosypharus**		13-Feb					
*Eleutherodactylus "rugulosus"**	IQ-Feb	12-Feb	IS-Feb				
*Eleutherodactylus sandersoni**		12-Feb	15-Feb				
Eleutherodactylus sp. '~"*			12-Feb				
Eleutherodactylus sp. *"B"**			13-Feb				
AMPHIBIA, CENTROLENIDAE							
*Hyalinobatrachium fleischmanni**	9-Feb	IQ-Feb	12-Feb	IS-Feb			June
AMPHIBIA, HYLIDAE							
*Agalyalmi,- moreleti**				16-Feb			June
*Agalychnis callidryas**							June
Hyla bromeliaca							
Hyla va/anciftr							
*Smilisca baudinii**							June
*Srnilisca cyanosticta**		IQ-Feb		16-Feb			June
AMPHIBIA, RANIDAE							
Rana juliani				12-Feb			
*Rana vaillanti**		IQ-Feb	12-Feb				June
REPTILIA, SAURIA, EUBLEPHARIDAE							
Coleonix elegans							
REPTILIA, SAURIA, GEKKONIDAE							
Sphaerodactylus glaucu,-							
Thecadactylus rapicauda							
REPTILIA, SAURIA, XANTUSIIDAE							
Lepidophyma flavimaculatum *				16-Feb			June
*Lepidophyma maya**			13-Feb		16-Feb		June
REPTILIA, SAURIA, POLYCHROTIDAE							
*Anolis capito**		22-Feb	12-Feb	14/IS-Feb			June
A nolis lemurinus *							June
Anolis rodriguezi'				IS-Feb			Jlll1e
Anolis sagrei							
Anoli,- tropidol/otus							
*Ano/is uniftrmis**	9-Feb	22-Feb	12-Feb	14-Feb	16-Feb		June
REPTILIA, SAURIA, CORYTOPHANIDAE							
*Basiliscus vittatus**		24-Feb					
*Corytophanes cristatus**							June
Laernanetus longipes							

(continued)	AC	UC	Cl	C2	C3	SU	*C3312*
REPTILIA, SAURIA, SCINCIDAE							
EUllzeces schwa1'tzei*							June
*Spbeno11lorpbus cberriei**				IS-Feb			
REPTILIA, SAURIA, TEIIDAE							
*Ameiva ftstiva**		22-Feb		IS-Feb			June
REPTILIA, SERPENTES, BOIDAE							
BOil constrictor							
REPTILIA, SERPENTES, COLUBRIDAE							
*A11lastridium veliferum **			13/21-Feb				June
*Coniopbanes fissidens**			12-Feb				
Coniophanes imperialis							
*Dendropbidion vinitor**						21-Feb	
*D1J!11larcbon corais**				IS-Feb			
Drymobius margaritiftrus			?				
*Immltodes cenchoa**							June
Leptophis ahaetulla'							June
Sibon nebulata							
Tantilla schistosa							
*Stenorrbina degenbardtii**		24-Feb					
Urotheca elapoides							
*Xenodon rabdocepbalus**			12-Feb				
REPTILIA, SERPENTES, ELAPIDAE							
Micrurus sp.*			20-Feb				
REPTILIA, SERPENTES, YfPERIDAE							
*Atropoides IlWmmiftr**			I-Feb				
REPTILIA, TESTUDINES, KINOSTERNIDAE							
***Kinosternon leucosfol1lU1rl** *				14/17-Feb			

Bird Species Recorded in the Vicinity of Little Quartz Ridge, 10- 24 February 1997

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Introduction

The avifauna of the Little Quartz Ridge area of the Columbia River Forest Reserve was surveyed from 10-24 February 1997. Jones, an independent biological consultant, and Gardner, a free-lance bird artist, are collaborating on a *Guide to the Birds of Belize* to be published in 2003. Jones was the team's principal ornithologist; Gardner assisted Jones in the field and made sketches of some of the lesser known species for the color plates in their forthcoming book.. Other team members Julian Lee, Martin Meadows, Jan Meerman, and Bruce Miller provided significant additional bird observation data.

The avian survey methodology employed consisted of "saturation" coverage of the area surrounding five camps: The summit of Little Quartz Ridge at 940-1035 m elevarion, and four camps below and to the west and south of Little Quartz Ridge at 700-730 m elevation at Union Camp, Camp 1, Camp 2, and Camp 3. Jones and Gardner spent 4 days at The Little Quartz Ridge Summit, 3 days each at Union Camp and Camp 1, and 2 days each at Camps 2 and 3. Coverage consisted of walking the trails leading out from each camp from dawn until dusk each day and recording all observations of birds heard or seen at the camps and along the trails. These observations were supplemented with tape recordings of unfamiliar vocalizations for later analysis and vocalizarions of the more significant species to document their occurrence in this area. Tape recordings were also made of the "dawn chorus" each morning because it is often difficult for the unaided ear to process the multitude of sounds emanating from the forest at this hour. Mist nets were not employed to capture secretive species, as this method is time consuming and inefficient for a rapid assessment of an area's avifauna. The presence of most sectetive species can be confirmed by their vocalizations.

Results

During the two-week assessment period, 164 species of birds were recorded. This number compares favorably and corresponds closely with species recorded on a similar RAP expedition conducted in Spring 1992 (Parker et al., 1993) to the extent that geographical coverage of the two expeditions overlapped. The 1992 expedition covered lower elevations within the Forest Reserve from American Camp near San Jose Village to Union Camp at 730 m, and was conducted during the height of spring migration. The mid-winter 1997 expedition covered the higher elevations within the reserve, with coverage overlapping the 1992 expedition only at Union Camp. The 1992 RAP expedition recotded two species in Belize apparently for the first time: Chuck-will's-widow *(Caprimulgus carolinensis)* and Warbling Vireo *(Vireo gilvus)*, both Neotropical migrants. Slaty Antwren *(Myrmotherula schisticolor)*, a mid-to high elevation resident, and Crested Owl *(Lophom'ix cristata)*, were recorded for the second time in Belize. The 1997 expedition confirmed the resident status of the antwren and owl and recorded what may be the second Belize record of Warbling Vireo; however the observation of the latter was too brief to confirm the record. The nocturnal Chuck-will's-widow, although probably a scarce winter visitor in Belize, generally vocalizes only in spring just prior to its departure, and is not likely to be detected in winter.. In addition, the 1997 expedition recorded at least 3 Tawny-throated Leaftossers *(Sclerurus mexicanus)* on Little Quartz Ridge, confirming its

status as a resident at the highest elevations in Belize. One individual recorded on Doyle's Delight (1124 m) in 1993 was the only previous record of its occurrence in the country. The multiple sightings on Little Quartz Ridge strongly suggest that this non-migratory species is a breeding resident of the highest elevations in the Maya Mountains, eliminating speculation that the Doyle's Delight observation may have been of a vagrant from the highlands of Guatemala.

Another species, the Tropical Parula *(Parula pitiayumi)* was previously considered, at best, a vagrant to Belize and was not included in the list of confirmed Belizean avifauna by Howell and Webb (1995). The 1992 RAP expedition found it to be "uncommon" at both Union Camp and Gloria Camp (Howell and Webb may not have been familiar with this report), and the current expedition found it to be uncommon to fairly common, paired, singing, and territorial at all sites from Union Camp to Camp 3 (but not on the Little Quartz Ridge Summit), strongly supporting its status as a fairly common breeding resident at mid- to high elevations in the Maya Mountains.

The Brown Violet-ear *(Colibri delphinae)*, a hummingbird species seldom seen in Belize, and not recorded on the 1992 expedition, was fairly common at the Little Quartz Ridge Summit and may also prove to be present at other high altitude sites along the crest of the Maya Mountains such as Doyle's Delight.. Another seldom seen bird in Belize, the White-vented Euphonia *(Euphonia minuta)* was recorded at Union Camp by the 1997 expedition.

We were surprised to find very few broadleaf woodland inhabiting Neotropical migrants on this expedition. T. A. Parker, leader of the 1992 expedition, commented that the Maya Mountains appear to be an important stOpover point for Neotropical migrants during migration. Our observations, on the other hand, suggest that they are relatively scarce at these elevations during the winter months, which only emphasizes the importance of rapidly disappearing low-elevation coastal broadleaf forests in the conservation of these species. Unexpectedly scarce or absent on this expedition were typical inhabitants of mature broadleaf forest such as Wood Thrush *(Hylocichla mustelina)*, Yellow-throated Vireo *(Vireo flavifrons)*, Worm-eating Warbler *(Helmitheros vermivol'Us)*, Ovenbird *(Seiurus aurocapillus)*, Kentucky, Warbler *(Oporornisftrmosus)*, and to a lesser degree, Hooded Warbler *(Wilsonia citrina)*. All of these species are fairly common to common components of lowland broadleaf forests in southern Belize in winter..

Both the 1992 and 1997 expeditions found the Crested Guan *(Penelopepurpurascens)* to be inexplicably scarce in this remote area where hunting pressure is presumed to be low. However, we also found the Great Curassow *(Crax rubra)* and Spotted Wood-Quail *(Odontophorus guttatus)* to be relatively scarce, certainly not "fairly common" as designated in the previous expedition. Likewise, the numbers of hawk-eagles (top carnivores) were also lower than reported by the 1992 expedition. Although the lower numbers recorded may be an artifact of the season (some species are more vocal, and therefore, more readily detected, in spring), we suspect that hunting ptessure is much higher in this area than previously thought or has increased substantially in recent years.

We suspect that the endangered Keel-billed Motmot *(Electron carinatum)* continues to be relatively common in the Columbia River Forest Reserve, although we recotded fewer individuals. This species is much less vocal in February than in April, and the fact that we were able to record it at two, and possibly three, of the five sites visited is encouraging.

Conclusions

We concur with the conclusions of the 1992 RAP expedition that avian diversity in the Columbia River Forest Reserve is as high or higher than elsewhere in Belize, and that higher elevation forests within the reserve harbor several species not known (or not likely) to occur elsewhere in the country. We strongly emphasize the need to protect the western and southern borders of the forest reserve, and especially to curtail illegal hunting by poachers encroaching from the west (we did not visit the southern portion of the reserve). Unfortunately, the statement in the 1993 RAP report that "the far interior of the reserve, tOward the higher parts of the Maya Mountains, provides a reservoir too remote to exploit to extinction" may no longer be true. Union Camp, in particular, is easily reached from Guatemalan settlements on the western border, and all areas we visited, with the po~sible exception of Camp 3, are less than a day's walk from the Guatemalan border.. It should be noted that we recorded no guans and only 2 curassows west of Camp 1, and that Sporred Wood-Quail were recorded only in the vicin4ty of Camp 2.

Spech:s Accounts

The species in the accounts below were recorded in the vicinity of Little Quartz Ridge, Columbia Forest Reserve, Toledo District, Belize between 10 and 24 February 1997 in conjunction with a Conservation International-sponsored Rapid Assessment Program (RAP). The principal ornithologist for this expedition was H. Lee Jones, Ph.D., assisted by

Dana Gardner. The few species recorded by other members of the team but nor Jones or Gardner are indicated as such. Sites visited are as follows: Little Quartz Ridge Summit (SU), Union Camp (UC), Camp 1 (Cl), Camp 2 (C2), and Camp 3 (C3), located as shown in map 3.

Abundance designations in the list below were derived as follows, based solely on observations by Jones and Gardner (observations by others are included in the accounts, but not considered in the abundance designations):

> Very common: 10 or more recorded daily.
> Common: 1-10 recorded daily.
> Fairly common: Not recorded every day.
> Uncommon: Recorded at least rwice, but generally not more than 4-5 times.
> Rare: Recorded only once; or I individual recorded on 2 or more dates.

Great Tinamou *Tinamus major*. Fairly common: Recorded all five camps.

Slaty-breasted Tinamou *Crypturellus boucardi*. Uncommon: Recorded Cl, C2, C3.

Gray-headed Kite *Leptodon cayanensis*. Rare: 1, possibly 2, at Uc.

Swallow-tailed Kite *Elanoides ftrficatus*. Uncommon: Migrating individuals seen from clearings at SU and UC (l seen on 11 Feb over SU was an early spring migrant but not unprecedented).

Double-toothed Kite *Harpagus bidentatus*. Rare: 2 seen flying over clearing at UC on 24 Feb.

Sharp-shinned Hawk *Accipiter striatus*. Rare: I seen chasing a smaller bird across the clearing at UC at dusk on 23 Feb. Identification based on accipiter shape, small size (probably a male) and relarively short, square-tipped tail (which eliminates *A. bicolor)*.

Great Black-Hawk *Buteogallus urubitinga*. Rare to uncommon: 1 seen in forest west of C2 on 18 Feb (an unidentified *Buteogallus* seen briefly over UC by Jones, and others reported near C2 by other team members, were probably this species).

Short-tailed Hawk *Buteo brachyurus*. Rare: A light-morph adult seen daily over Uc..

Black-and-white Hawk-Eagle *Spizastur melanoleucus*. Rate to uncommon: 1 at SU on 12 and 13 Feb; 1, either this or *Spizaetus ornatus*, heard at CIon 21 Feb.

Black Hawk-Eagle *Spizaetus tyrannus*. Uncommon: 1-2 recorded daily from 12-14 Feb at SU; other individuals thought to be this species were heard or seen briefly at the other four camps.

Barred Forest-Falcon *Micrastur rujicollis*. Uncommon: 1-2 heard daily at SU; 1 each heard at CIon 16 Feb and C3 on 18 Feb.

Collared Forest-Falcon *Micrastur semitorquatus*. Uncommon: 1 heard almost daily at SU; 1 heard on 22 Feb at uc..

Crested Guan *Penelope purpurascens*. Rare: Not recorded by Jones and Gardner; disproportionately recorded by other team members and guides familiar with this species but not many of the others -1 seen berween Cl and SU on 14 Feb (Romero); near C2 on 16 Feb and 1 there on 17 and 18 Feb (Meerman); 2-3 seen near C3 on 18 Feb (Romero);

Great Curassow *Crax rubra*. Rare: 1 male seen near UC on 23 Feb. As with the preceding, disproportionately recorded by othet team membets -6 near C2 on 15 Feb (Meerman); 1 between Cl and UC on 21 Feb (Miller).

Spotted Wood-Quail *Odontophorus guttatus*. Uncommon: recorded near SU on 11 and 14 Feb and C2 on 17 Feb (2 groups); the group heard from SU was in the valley to the southeast ofHLS 500 (SU) and could have been one of the same groups heard near C2 on the 17th.

Pale-vented Pigeon *Columba cayennensis*. Rare: 1 seen flying over HLS 500 (SU) on 14 Feb.

Scaled Pigeon *Columba speciosa*. Uncommon: 1 recorded daily at UC; 1 at CIon 15 Feb.

Short-billed Pigeon *Columba nigrirostris*. Fairly common: 1-4 recorded on most dates; present at all sites.

Blue Ground-Dove *Claravis pretiosa*. Rare: 1 heard by Miller on 22 Feb at Uc..

Gray-fronted Dove *Leptotila rufitxilla*. Uncommon: 1 each near C2 on 17 Feb, near C3 on 19 Feb, and berween C3 and C:2 on 20 Feb; several unidentified *Leptotila* periodically flushed from the trails may have been, at least in part, this species.

Gray-chested Dove *Leptotila cassini*. Uncommon: 1 near C3 on 20 Feb; 1 daily at UC 22-24 Feb; several unidentified *Leptotila* periodically flushed from the trails were either this, *rufitxilla*, or both.

Ruddy Quail-Dove *Gf,.otrygonmontana*. Fairly common: 1-3 recorded almost daily from vicinity ofUC, Cl, and C3; not recorded at C2 and SUo

Brown-hooded Parrot *Pionopsitta haematotis*. Rare: 1 at UC on 22 Feb.

White-crowned Parrot *Pionus senilis*. Uncommon: IndiV'iduals seen flying ovet UC on 22 and 23 Feb; possibly another along trail between C3 and CIon 20 Feb.

Mealy Parrot *Amazona fitrinosa*. Common: Recorded daily from all camps.

Squirrel Cuckoo *Piaya cayana*. Common at UC (2-4 daily); uncommon at Cl and C2; possibly recorded at C3; unrecorded at SUo

Pheasant Cuckoo *Dromococcyx phasianellus.* Rare: 1 was heard and tape recorded near SU at dawn on 11 Feb.

Vermiculated Screech-Owl *Otus quatemalae.* Uncommon: 1 recorded daily at SU may have been nesting near HLS 500; 1 or more at C3.

Crested Owl *Lophostrix cristata.* Uncommon; 1 responded to tape recording at CIon 14 Feb; 1 heard at UC on 22 Feb (Miller).

Spectacled Owl *Pulsatrix perspicillata.* Rare; 1-2 heard on 15 Feb at Cl..

Central American Pygmy-Owl *Glaucidium griseiceps.* Uncommon; 1 each recorded at SU (11 Feb), Cl (15 Feb), and UC (23 Feb).

Mottled Owl *Ciccaba virgata.* Uncommon: 1 each heard at SU (10 Feb), Cl (15 and 21 Feb), and UC (22 Feb); also probably heard at C3 on 19 and 20 Feb.

White-collared Swift *Cypseloides cryptus.* Fairly common: 1 over SU on 11 Feb and flock of 30-35 there on 12 Feb; flock of 60-70 over UC on 22 Feb. These are the only two sites with clearings.

Vaux's Swift *Chaetura vauxi.* Common at UC and Cl; recorded once at C3.

Lesser Swallow-tailed Swift *Panyptila cayennensis.* Rare: 2-4 seen over UC on 22 Feb.

Long-billed Hermit *Phaethornis longirostris.* Uncommon to fairly common: 1-2 individuals each recorded at SU, UC, and Cl..

Stripe-throated Hermit *Phaethornis striigularis.* Uncommon: 1 each at C2 on 17 Feb and UC on 23 Feb.

Wedge-tailed Sabrewing *Campylopterus curvipennis.* Common at SU, fairly common at UC and Cl: 1-2 seen daily at UC; recotded twice at Cl..

Violet Sabrewing *Campylopterus hemileucurus.* Common at Cl and C2; unrecorded elsewhere.

White-necked Jacobin *Florisuga mellivora.* Uncommon: 1 each (both males) at CIon 21 Feb and UC on 23 Feb.

Brown Violet-ear *Colibri delphinae.* Fairly common at SU; not recorded elsewhere.

Black-crested Coquette *Lophornis helenae.* Uncommon. 1 each (both males) at SU on 14 Feb and CIon 21 Feb.

White-bellied Emerald *Amazilia candida.* Fairly common; 1-3 each recorded at UC and Cl; 2-4 daily at C3.

Azure-crowned Hummingbird *Amazilia cyanocephala.* Common at SU (1-5 daily); fairly common at Cl (4 on 21 Feb).

Rufous-tailed Hummingbird *Amazilia tzacatl.* Uncommon to fairly common: Recorded at SU, UC, and Cl. Bird attending a nest at Uc..

Stripe-tailed Hummingbird *Eupherusa eximia.* Very common at SU (30-40 daily); common to very common elsewhere (2-25 daily).

Purple-crowned Fairy *Heliothryx barroti.* Rare: 1 seen at C3 on 19 Feb.

Violaceous Trogon *Trogon violaceus.* Common: 1-3 recorded almost daily at all five camps.

Collared Trogon *Trogon collaris.* Common at lower camps; fairly common at SU: 2-4 recorded most days at all five camps.

Slaty-tailed Trogon *Trogon massena.* Common at lower camps (1-6 daily); recorded once at SU.

Tody Motmot *Hylomanes momotula.* Uncommon: Recorded once each at SU, Cl, and C2, twice at Uc..

Blue-crowned Motmot *Momotus momota.* Fairly common: 1-5 recorded most days at all but C2.

Keel-billed Motmot *Electron carinatum.* Uncommon: 1-2 birds at UC and Cl; possibly heard once at su..

Green Kingfisher *Chloroceryle americana.* Uncommon: 1-3 seen daily at Cl.

White-whiskered Puffbird *Malacoptila panamensis.* Rare: 1 at Cion 16 Feb.

Rufous-tailed Jacamar *Galbula rujicauda.* Uncommon: 2-3 recorded on two dates at Cl; recorded once at Uc..

Emerald Toucanet *Aulacorhynchus prasinus.* Common on SU; seen once at Uc..

Collared Aracari *Pteroglossus torquatus.* Uncommon at three of four lower camps; absent from SU.

Keel-billed Toucan *Ramphastos sulfuratus.* Common at lower camps (1-10 daily); less common at Su..

Black-cheeked Woodpecker *Centurus pucherani.* Uncommon: Recorded once at Cl, twice at C2.

Yellow-bellied Sapsucker *Sphyrapicus varius.* Rare: 1 female at SU on 11 Feb.

Smoky-brown Woodpecker *Veniliornis fumigatus.* Uncommon: Recorded twice each at Cl and C2.

Golden-olive Woodpecker *Piculus rubiginosus.* Common on SU (1-3 daily); uncommon elsewhere (recorded once each at Cl, C3, and trail between Cl and UC).

Chestnut-colored Woodpecker *Celeus castaneus.* Uncommon; Recorded, twice near Uc..

Lineated Woodpecker *Dryocopus lineatus.* Uncommon: Heard once at SU and twice at uc..

Pale-billed Woodpecker *Campephilus quatemalensis.* Uncommon: Recorded twice each at UC and Cl..

Buff-throated Foliage-gleaner *Automolus ochrolaemus.* Common: 1-5 recorded daily.

Plain Xenops *Xenops minutus.* Status difficult to assess because of the vocal similarities of this and Olivaceous Woodcreeper, but probably common: Recorded at all camps except, possibly, SU.

Tawny-throated Leaftosser *Sclerurus mexicanus.* Fairly common on SU; not recorded elsewhere (see discussion in text).

Scaly-throated Leaftosser *Sclerurus guatemalensis.* Common: Recorded at all camps but SUO.

Tawny-winged Woodcreeper *Dendrocinala anabatina.* Uncommon: Recorded rhree times in vicinity of *C2.*

Ruddy Woodcreeper *Dendrocinala homochroa.* Uncommon to fairly common: 1-2 seen on four dates at *Cl, C2, C3,* and possibly Uc..

Olivaceous Woodcreeper *Sittasomus griseicapillus.* Probably fairly common: This and Plain Xenops seen with about equal frequency; vocalizations of one or the other heard daily, except at *C3.*

Wedge-billed Woodcreeper *Glyphorynchus spirurus.* Uncommon: Recorded only at Cl and C2 on 16 and 17 Feb, respectively.

Northen Barred-Woodcreeper *Dendrocolaptes sanctihomae.* Uncommon: Recorded only at Cl where 1 was heard at dawn almost daily.

Ivory-billed Woodcreeper *Xiphorhynchus flavigaster.* Rare: 1 seen near C2 on 20 Feb.

Spotted Woodcreeper *Xiphorhynchus erythropygius.* Common: 1-7 seen or heard daily.

Russet Antshrike *Thamnistes anabatinus.* Fairly common around *Cl, C2,* and *C3;* not recorded at UC or SUo

Plain Antvireo *Dysithamnus mentalis.* Common ar lower camps where recorded daily; not recorded at SUo

Slaty Antwren *Myrmotherula schisticolor.* Fairly common, but only in vicinity of *C2:* 1 male and 5-6 females seen on 16 Feb; 3-4 females seen on 17 Feb; male and female seen together on trail between C2 and C3 on 20 Feb.

Dot-winged Antwren *Microrhopias quixensis.* Uncommon: Small group (~8) in second growth tangles beside stream ar CIon several dates; 2-3 near UC on 23 Feb.

Dusky Antbird *Cercomacra tyrannina.* Uncommon and local: 1-2 in tangles beside stream near CIon 20 and 21 Feb; 1 on edge of clearing at UC on 23 and 24 Feb.

Black-faced Antthrush *Formicarius rnoniliger.* Common: 1-12 recorded daily.

Tyrannulet sp. Fairly common: Single-note "peea" calls attributed to either Paltry *(Zimmerius vilissimus)* or Yellow-bellied *(Ornithion semiflavum)* or both were heard periodically in vicinity of *Cl,* C3, and uc. . Neither species was seen, but both are known to be present.

Greenish Elaenia *Myiopagis viridicata.* Fairly common at lower camps; unreco;ded at SUo

Sepia-capped Flycatcher *Leptopogon amaurocephalus.* Fairly common at lower camps; unrecorded at SUo

Northern Bentbill *Oncostoma cinereigulare.* Common: 1-3 recorded daily at all camps.

Eye-ringed Flatbill *Rhynchocyclus brevirostris.* Fairly common ar lower camps; unrecorded at SUo

Yellow-olive Flycatcher *Tolrnomyias sulphurescens.* Common at lower camps; unrecorded at SUo

Stub-tailed Spadebill *Platyrinchus cancrominus.* Fairly common at lower camps; unrecorded at SUo

Royal Flycatcher *Onychorhynchus coronatus.* Rare: 1 seen at C3 on 19 Feb; an old nest was found hanging over stream at Cl..

Ruddy-tailed Flycatcher *Terenotriccus erythrurus.* Uncommon: 1-2 at CIon 15 Feb; 1 between C3 and C2 on 20 Feb.

Sulphur-rumped Flycatcher *Myiobius sulphureipygius.* Common: 2-6 recorded daily at lower camps; unrecorded at SUo

Olive-sided Flycatcher *Contopus cooperi.* Uncommon: 1 heard on SU on 11 Feb; 1 at C3 on 18 Feb; 1 at UC daily from 21-23 Feb.

Tropical Pewee *Contopus cinereus.* Uncommon: 1 heard on 15 Feb at Cl, 1 heard on the trail near C2 on 20 Feb, and 2 heatd at CIon 21 Feb.

Yellow-bellied Flycatcher *Empidonax flaviventris.* Common: 1-6 daily at all lower camps; unrecorded at SUO

Least Flycatcher *Empidonax minimus.* Rare: 1 at UC on 22 and 24 Feb.

Bright-rumped AttilaAttila *spadiceus.* Fairly common: 1-2 heard most days.

Rufous Mourner *Rhytipterna holerythra.* Fairly common: 1-3 heard most days at lower camps; unrecorded from SUo

Dusky-capped Flycatcher *Myiarchus tuberculiftr.* Fairly common: 1-3 heard on six dates, but only once at SUo

Social Flycatcher *Myiozetetes sirnilis.* Rare: 1 in second-growth opening along stream at CIon 20-21 Feb.

Cinn~mon Becard *Pachyramphus cinnamomeus.* Rare: 1-2 heard near Clan 21 Feb.

Rufous Piha *Lipaugus unirufus.* Common: 1-7 recorded daily at lower camps; unrecorded from SUo

Lovely Cotinga *Cotinga amabilis.* Rare: 1 male seen in top of leafless tree at UC on 2~ Feb.

Thrush-like Schiffornis *Schiffirnis turdinus.* Common at lower camps (1-4 daily); uncommon ar SUo

Red-capped Manakin *Pipra mentalis.* Common at lower camps (1-15 daily); once at SUo

Purple Martin *Progne subis.* Uncommon migrant: 3 males were seen over HLS 500 (SU) by Meerman on 21 Feb; a female-plumaged *Progne* sp. was seen over clearing at UC on 24 Feb.

Mangrove Swallow *Tachycineta albi/inea.* Rare: 1-2 seen over clearing at bend in stream at CIon 20 Feb; 1 seen by (J. Lee) over UC on 24 Feb.

Northern Rough-winged Swallow *Stelgidopteryx serripennis.* Fairly common to common in clearings at SU and UC: These were the dark resident race (or species) *ridgwayi.* The

diagnostic, bur hard to see, small white forehead patch was seen on 1 individual at Uc. .

Band-backed Wren *Campylorhynchus zonatus.* Uncommon: A group of 5-6 was seen at Cl on 20 and 21 Feb; on 21 Feb they were observed participating in building a nest..

Spot-breasted Wren *Thryothorus maculipectus.* Common: 1-6 recorded daily.

White-breasted Wood-Wren *Henicorhina leucosticta.* Very common: 4-20 recorded daily.

Nightingale Wren *Microcerculus philomela.* Fairly common: 1-3 most days, but only recorded once at Uc. .

Long-billed Gnatwren *Ramphocaenus melanurus.* Fairly common: 1-2 recorded most days at lower camps; unrecorded at SUo

Tropical Gnatcatcher *Polioptila plumbea.* Fairly common at Cl, C2, and C3; common at UC;, not tecorded at SUo

Slate-colored Solitaire *Myadestes unicolor.* Common to very common: 2-22 recorded daily.

Wood Thrush *Hylocichla mustelina.* Surprisingly uncommon: 1 recorded on 5 dates and 2 on 23 Feb; not recorded at SUo

White-throated Robin *Turdus assimilis.* Very common everywhere but UC where no more than 2 seen on anyone date.

Gray Catbird *Dumetella carolinensis.* Rare: 1 was in tangle by stream near CIon 20-21 Feb.

Plumbeous Vireo *Vireo plumbeus.* Fairly common at lower camps; not recorded on SUo

Yellow-throated Vireo *Vireo flavifrons.* Rare: 1 heard at UC on 22 Feb.

Warbling Vireo *Vireo gilvus.* Rare: 1 seen briefly at SU on 12 Feb (see discussion in text).

Tawny-crowned Greenlet *Hylophilus ochraceiceps.* Common: 2-8 daily; 20 on 16 Feb.

Lesser Greenlet *Hylophilus decurtatus.* Common to very common at lower camps: 3-24 daily; not recorded at SUo

Green Shrike-Vireo *Vireolanius pulchellus.* Common at lower camps, fairly common at SU: 1-9 most days.

Blue-winged Warbler *Vermivora pinus.* Rare: 1 seen by]. Lee at CIon 22 Feb.

Golden-winged Warbler *Vermivora chrysoptera.* Rare: 1 seen at UC on 22 Feb.

Tennessee Warbler *Vermivora peregrina.* 1 seen poorly at SU on 13 Feb was probably this.

Tropical Parula *Parula pitiayumi.* Fairly common: 1-5 heard singing almost daily at all lower camps; not recorded at SUo

Chestnut-sided Warbler *Dendroica pensylvanica.* Uncommon: Individuals recorded 3 times at Cl (same bird?) and twice at Uc. .

Magnolia Warbler *Dendroica magnolia.* Uncommon: 2 at CIon 21 Feb; 1 at UC on 22 Feb and 2 there on 23 Feb.

Black-throated Green Warbler *Dendroica virens.* Fairly common: 1-3 recorded on all but two days.

Yellow-throated Warbler *Dendroica dominica.* Rare: 1 recorded on 11 Feb at Su. .

Black-and-white Warbler *Mniotilta varia.* Fairly common: 1-3 recorded most days.

American Redstart *Setophaga ruticilla.* Fairly common: 1-3 recorded most days.

Worm-eating Warbler *Helmitheros vermivorus.* Rare: 1 seen at Cl by]. Lee on 22 Feb.

Northern Waterthrush *Seiurus noveboracensis.* Uncommon: 1 each on 4 dates at Cl, C2, and C3.

Louisiana Waterthrush *5eiurus motacilla.* Fairly common at lower camps: 1-3 almost daily.

Kentucky Warbler *Oporornis ftrmosus.* Surprisingly uncommon: Single birds heard on abour 7 dates, 2 on 23 Feb.

Common Yellowthroat *Geothlypis trichas.* Rare: 1 male seen at CIon 15 Feb.

Hooded Warbler *Wilsonia citrina.* Fairly common at SU (1-4 on three dates): Surprisingly uncommon elsewhere: 1-2 birds recorded on 6 dates only at Uc, , Cl, and C2.

Wilson's Warbler *Wilsonia pusilla.* Uncommon: 1 at SU on 13 Feb; 1 at CIon 20 and 21 Feb.

Golden-crowned Warbler *Basileuterus culicivorus.* Common at SU and UC (2-7 daily); very common elsewhere (12-30 daily).

Bananaquit *Coereba flaveola.* Very common at SU (10-20 daily); common at lower camps (1-8 daily).

Golden-hooded Tanager *Ttmgara larvata.* Uncommon to fairly common at lower camps (1-2 on five of ten dates); not recorded at SU or C3.

Green Honeycreeper *Chlorophanes spiza.* Fairly common at lower camps: 1-5 recorded most days; 1 at SU on 10 Feb.

Shining Honeycreeper *Cyanerpes lucidus.* Uncommon: 1 seen at SU on 11 Feb; 2 seen at C3 on 19 Feb; 2 seen between C2 and CIon 20 Feb and 3 seen at CIon 20 Feb.

Red-legged Honeycreeper *Cyanerpes cyaneus.* Uncommon: 1-6 seen on 4 dates at SU, UC, and Cl. .

Yellow-throated Euphonia *Euphonia hirundinacea.* Uncommon: Definitely recorded only at Uc, , bur several unidentified *Euphonia* vocalizations elsewhere may have been this species.

Elegant Euphonia *Euphonia elegantissima.* Rare: 2 heard and rape-recorded near C2 on 17 Feb; another possibly heard between C3 and C2 on 20 Feb.

Olive-backed Euphonia *Euphonia gouldi.* Fairly common to common: 1-9 recorded nearly every day.

White-vented Euphonia *Euphonia minuta.* Rare: 1 male seen well at DC on 22 Feb.

Yellow-winged Tanager *Thraupis abbas.* Rare: 1 seen at SU on 11 Feb.

Black-throated Shrike-Tanager *Lanio aurantius.* Common at

lower camps (2-13 daily); unrecorded at Su..

Red-crowned Ant-Tanager *Rabia rubica.* Common: 2-23 recorded daily.

Red-throated Ant-Tanager *Rabia fUscicauda.* Fairly common: 1-8 recorded most days; however, 2 on 11 Feb were the only ones recorded on SUo

Summer Tanager *Piranga rubra.* Fairly common: 1-3 recorded most days at all camps.

White-winged Tanager *Piranga leucoptera.* Uncommon to fairly common: 1-3 recorded on 5 dates at SU, UC, and Cl..

Common Bush-Tanager *Chlorospingus ophthalmicus.* Very common at SU (15-40 daily); uncommon elsewhere: 6 near Cion 16 Feb; group of 12-14 between Cl and UC on 21 Feb.

Buff-throated Saltator *Saltator maxim us.* Rare: 1 seen at Cl on 22 Feb by J. Lee.

Black-faced Grosbeak *Caryothraustes poliogaster.* Uncommon: 1-4 seen on seven dates at all camps but C3.

Blue-black Grosbeak *Cyanocompsa cyanoides.* Uncommon: 1-2 recorded daily at Uc..

Indigo Bunting *Passerina cyanea.* Rare: 1 recorded at UC on 22 and 24 Feb.

Orange-billed Sparrow *Arremon aurantiirostris.* Fairly common at lower camps (1-6 on most days); 1 at SU on 12 Feb.

Baltimore Oriole *Icterus galbula.* Rare: Group of 3 seen at C3 on 19 Feb.

Columbia River Forest Reserve Expedition 17-23 February, 1997, Bat Survey

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Introduction:

Bats are a critically important but frequently neglected component of neotropical ecosystems (Wilson, 1996). The order Chiroptera is second only to rodents in diversity: 17 families, approximately 174 genera and 913 species (Koopman, 1994). Nine families occur in the New World, six of which only occur in the Neotropics. Approximately 28% of all bat species occur in the Neotropics. In Belize, 79 species are known or suspected to occur. The sheer number of individuals and the myriad of food habits represented further support the significant contribution by this group to neorropical systems.

Because Neotropical rainforest bat communities are very diverse and include many elusive species, major commitments of time and effort are necessary to obtain asymptotic species lists (Voss and Emmons, 1996). Histotically the study of bats away from roost sites has relied ptimarily on the use of nets and traps (Kunz and Kurta, 1988). Not all bat species, and not all individuals within a species, are equally susceptible to capture. The small relative size of collecting surfaces and the ability of bats to detect these collection devices further limit the effectiveness of these techniques and require that inventory efforts be limited to roost sites, water sources, or along foraging flyways. To compound the sampling problem, a given location may not be used every nighr by the same species assemblage. Standard capture techniques require relatively expensive equipment and constant tending, limiring the number of localities that can be sampled simultaneously.

In the Neotropics, mist netting has been particularly effective fot leaf-nosed bats (family Phyllostomidae) and traps more effective for other families (LaVal and Pirch, 1977; Turtle, 1976). Most surveys for bats in the Neotropics, including Belize, have used mist nets; thus more is known about phyllostomids than other families of bats. Ground-level nets sample less than 10% of the flight space under a typical rainforest canopy and seldom capture molossids or other high flying taxa (Voss and Emmons, 1996) which may be detected using acoustic techniques (Kalko et al. 1996; Ochoa et al., 2000; O'Farrell and Gannon 1999; O'Farrell and Miller, 1997; O'Farrell and Miller, 1999).

Electronic acoustic devices (bat detectors) have been developed to allow investigators to hear and/or visualize rhe ultrasonic echolocation calls of bats (Fenton, 1988). Echolocation calls of many species of bats are distilKtive (Simmons et al., 1979; Fenton and Bell, 1981; O'Farrell, 1997; O'Farrell et al., 1999). Echolocation calls of some neotropical members of the family Emballonuridae have been described (Barclay, 1983; Kalko, 1995; O'Farrell and Miller, 1997). Currently 26 of the 31 species of non-phyllostomid bats known to occur in Belize are identifiable by diagnostic features of the time-frequency structure of echolocation calls. In general,, each family and many genera are recognizable by call structure patterns and species separated by frequency range parameters (O'Farrell and Miller, 1999).

Voss and Emmons (1996) reviewed 10 Neotropical rainforest mammal inventories and found that species accumulation curves were not asymptotic for any fauna sampled, suggesting thar nowhere in the New World tropics is there a complete listing of mammalian species diversity. Miller and Miller (1995) identified existing distributional knowledge

gaps of taxa and geogtaphic areas in Belize where biological inventory surveys are necessary to fill these gaps. With the development of the National Biodiversity Strategy Plan there is an increasing need for information that only new biological surveys can provide. It has been proposed that such surveys should be a national conservation priority.

Recently, acoustic methods have added significantly to the knowledge of occurrence and distriburion of free-flying insectivorous species (Kalko *et al.*, 1996; O'Farrell and Gannon, 1999; O'Farrell and Miller, 1999). These methods have rapidly contributed new information for many previously well studied sites. Kalko *et al.* (1996) added acoustical monitoring techniques to surveys of Barro Colorado Island in Panama, which has one of the best known bat faunas in the Neotropics. Acoustic methods added five additional species previously unrecorded by traditional sampling methods that spanned more than a decade. Using vocal signature libraries compiled in Belize, short-term acoustic surveys conducted in four Venezuelan protected areas added from 2 to 9 species to previous lists increasing the known species richness of these areas (Ochoa *et aI., 2000).*

This paper presents results of a rapid survey of non-phyllostomid bats conducted at three locations in the Columbia River Forest Reserve (Camp 1, Camp 2, Union Camp) from 17-23 February 1997. Sampling focused on acoustic methods and the use of a double-framed harp trap. Mist nets were used to augment sampling. To date, at every new location where I have used acoustic sampling it has provided new distribution information and contributed not only to the knowledge of the area but to the broad zoogeography of Belize. This expedition was no exception.

Methods

At each locality, acoustic sampling was supplemented by standard capture techniques using mist nets and a double-frame harp trap (Austbat Research Equipment, Lower Plenty, Victoria, Australia). Mist nets and the harp trap were placed where bat activity was anticipated. The harp trap was operated through the night.. Mist nets were deployed across trails, streams or other areas where bat activity would be expected. Mist nets were used both on their own and as baffles to channel bats toward a double-frame harp trap. Mist nets were opened at each site just prior to dusk each night and closed by 23:00, and were tended constantly. All sites were sampled with a double-frame harp trap (Austbat Research Equipment, Victoria, Australia), presenting a 4.2 m^2 collection surface. Like mist nets, the trap was placed across trails, streams or in other areas where bat activity would be expected. The harp trap was deployed each night prior to sunset and was functional each night during the survey. The trap was checked for captures several times each evening and again at first light.. Captured bats were released after recording species, sex, reproductive condition and age.

Acoustic sampling was conducted using Anabat II bat detectors (Titley Electronics, Ballina, New South Wales, Australia) linked to an IBM-compatible laptop computer by means of a Zero-crossings Analysis Interface Module. Bat activity was monitored in real time providing a display of the time-frequency structure of calls. After examination of incoming signals, complete sequences were saved as binary files directly to the computer. Methods for monitoring and establishing identity of species followed those of O'Farrell *et al. (1999).* Acoustic sampling entailed moni toring forest trails, streams, and other areas with the potential of concentrated bat activity. During daylight hours the area around each camp was surveyed for roost sites.

Results

In spite of the limited sampling opporrunity imposed by unfavorable weather during the expedition that coincided with an unfavorable moon phase that may have depressed bat activity (Morrison, 1978; Reith, 1982), eleven bat species were documented. Eight of these represent new records for this area of Belize (Table 1).

Table 1. Species of bats recorded for each sampling location by all methods during the survey. A= acoustic, N= mist net, T= harp trap.

Species	Camp 1	Camp 2	Union Camp
Centronycteris centralis	A		
Peropteryx macrotis			A
Pteronotus davyi	T A	T	
Pteronotus parnellii	A		
Artibeus watsoni	N	N	
Carollia brevicauda		N	
Glossophaga soricina	N		
Lasiurus ega			A
Lasiurus intermedius			A
Myotis keaysi	T A	T	
Myotis sp.	A	A	
Molossus molossus			A

Emballonuridae: Sac-winged Bats

The shaggy bat (*Centronycteris centralis*) has been considered rare throughout its range (Sanborn, 1937; Gardner et al., 1970; LaVal, 1977; McCarthy and Ochoa-G., 1991). Historically the presence of this species in Belize was based upon a single record from Double Falls (Sanborn, 1941). Using double-frame harp traps and acoustic methods, this species is now considered locally common in northwestern Belize (Miller, unpublished data). This species uses enclosed forest trails and stream courses, generally foraging from 2–4 m above ground level, areas not readily sampled by mist nets or harp traps. Each individual appears to maintain a separate, linear feeding territory.

At Camp 1, at least one individual was recorded on two mornings as it foraged over the stream after the moonset and before sunrise. Although both a harp trap and mist nets were deployed, the species was not captured. Acoustic sampling provided the diagnostic vocal signatures of *C. centralis* as it foraged at mid-story level (3 m) over a stream well above the nets and trap. This new distribution information coupled with other data gathered on the species in Belize will perhaps provide clues to habitat use and needs of this previously poorly known species.

Like many Emballonurids, *C. centralis* begins foraging activity before darkness during the period of civil twilight. This species was either not present or not detected at either Camp 2 or Union Camp. Possibly this was due to an overall depressed bat activity attributed to continuing heavy rains throughout the nights during the sampling period.

The lesser dog-like bat (*Peropteryx macrotis*) was recorded at Union Camp. The species is widespread and has been found in all districts of Belize. Away from roost sites it is rarely captured, but readily detected acoustically. This represents the first record for the species in the Columbia River Forest Reserve.

Mormoopidae: Mustached and Naked-backed bats

The naked-backed bat (*Pteronotus davyi*) was recorded at two sites, Camp 1 and Camp 2. This species was recorded both by harp trap captures and by acoustical monitoring. This is the first record of this species in the Columbia River Forest Reserve. Parnell's mustached bats (*P. parnellii*) were recorded only acoustically at one location (Camp 1) while foraging at the canopy level of the forest. Both species are habitat generalists and range throughout virtually all habitats in Belize and were anticipated to be found during this survey. Although McCarthy (1987) documented Wagner's mustached bat (*P. personatus*) occurring in the Columbia River Forest Reserve, it was not detected during this survey.

Phyllostomidae: Leaf-nosed bats

Although the focus of this survey was on non-phyllostomid bats, three species of phyllostomids were caught in mist nets. These included Thomas' fruit-eating bat (*Artibeus watsoni*), the Silky Short-tailed fruit bat (*Carollia brevicauda*) and the common long-tongued bat (*Glossophaga soricina*). These are widespread species in Belize and have been reported for the area previously (Appendix 1).

Vespertilionidae: Evening or Plain-nosed bats

Echolocation calls of four species in this family were recorded during the survey (Table 1). Both the southern yellow bat *(Lasiurus ega)* and the northern yellow bat *(Lasiurus intermedius)* detected ar Union Camp represent new records for the Columbia River Forest Reserve. These species appear to be widespread and readily detected by acoustic surveys.

Two species of *Myotis* were recorded ar Camp 1 and Camp 2. The hairy-legged myotis *(Myotis keaysi)* was recorded from harp-trap captures and acoustical surveys at Camp 1 and Camp 2. At Camp 1 an unknown species of *Myotis* was recorded acoustically while foraging over the stream. There were a number of individuals of this *Myotis* foraging simultaneously with the hairy-legged myotis. This species' vocal signature does not match either the hairy-legged myotis or the elegant myotis *(M. elegans)*. The elegant myotis is abundant, and its call structure is well known from the northern half of Belize. Although it was initially hypothesized that these calls could have been from the black myotis *(Myotis nigricans)*, that was ruled out by comparing with known calls of this species recorded in Venezuela (Ochoa *et al.*, 2000). This clearly represents a new species of myotis for Belize, which remains yet unidentified. Based upon the sono type, it appears likely that this could be *M. albescens*.

Molossidae: Free-tailed or mastiff bats

Free-tailed bats of the family Molossidae are traditionally known only from collections at roost sites, or rarely from mist netting over streams. Molossids tend to fly high over the canopy in areas that cannot be sampled using conventional collection techniques. Acoustical methods are contributing to the knowledge of distributions of bats in this family wherever they are used (e.g., O'Farrell and Miller 1999; Ochoa *et al.*, 2000).

It was anticipated that data gathered during this expedition would provide new insights on molossid distributions. With the shortened sampling time due to unfavorable weather conditions and moon phase, rhis expectation was not realized. A single verified species was the little mastiff bat *(Molossus molossus)* recorded at Union Camp on the last night of the survey. Molossid-like echolocation call fragmenrs were detected at Camp 1, but the bats were well above the canopy and no identifiable vocal signatures were recorded.

Roost site surveys

During the day, areas surrounding the camps were inspected for potential bar roost sites. All species detected (Table 1) during this expedition can roost in hollow trees, tree buttresses or under loose bark. At Camp 2, seven hollow trees were examined; none of which contained signs of bat roosts, either active or abandoned. No caves were found near Camp 2.

At Camp 1, only one hollow tree was found, and it showed no evidence of a bat roost, either active or abandoned. However, a sizable cave near the survey area was examined. Although some discolored areas on the cave ceiling suggested use by bats in the past, there was no recent evidence of droppings or guano buildup.

At Union Camp, nine hollow trees were found, two with phyllostomid colonies. A small cave sourh of Union Camp appeared to have been recently used as a night roost.. The floor of the farthest section of the cave was littered with grasshopper wings and beetle elytra. A nocturnal examination of the cave found it empty. It is likely that this cave has been used, at least sporadically, by insect gleaning species of phyllosromids such as *Mimon* spp. or *Lonchorhina (zurita.*

Discussion

Although conditions were not optimal for bat surveys, eight species were recorded that represented new records for the reserve. The yet unidentified *Myotis* represents a new record for the country. The acoustical files have been archived, and in the future as the vocal signature library of known calls grows, it is only a matter of time before we can move this species from a "sonotype" to an identified species.

Most known distributions of bats within Belize have previously been based upon mist net or roost site sampling (McCarthy, 1987; McCarthy and Blake, 1987; McCarthy et aI., 1993). Advances in acoustic sampling methods pioneered in Belize (O'Farrell and Miller 1997, 1999; Miller, unpublished data) have resulted in new information on bat distributions, suggesting that previously known distributions based on traditional sampling methods present an incomplete picture.

Emmons (1993) and McCarthy (1987) provide previous bat records for the area of the Columbia River Forest Reserve encompassed by this expedition. These collections were primarily obtained by use of mist nets. Consequently, most recor is are of phyllostomids. By using combined acoustical methods and a double-frame harp trap, several species previously unreported were detected. Appendix 1 lists all species reported for the area.

There is an increasing demand for biological surveys to assist in the process of conserving biodiversity, bur there is little chance of significant increases in financial resources to carry

them out (Burbidge, 1991). Acoustic survey techniques using the Anabat system are proving to be powerful tools to address the need for comprehensive surveys for bats. As with all methods, acoustic sampling has limitations. It is not effective for bats with low-intensity vocalizations (e.g., phyllostomids). Complete inventories can only be accomplished using a range of sampling methods. Even with the constraints of unexpected bad weather and a bright moon, this technique has helped fill in knowledge gaps for the previously poorly known bat fauna.

As acoustic surveys continue throughout Belize, previously unknown species have been documented (e.g., *P gymnonotus* and *Molossops greenhalli).* Follow-up surveys using more harp traps and new passive units that provide for multiple all night acoustical surveys are a high priority, not only for the Little Quartz Ridge area, but the entire southern portion of Belize. Based upon experience, it is anticipated that many additional species will be documented in the Columbia River Forest Reserve. Identification of the new species with the *Myotis-like* call is a priority for such a future expedition.

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Appendix 1 List of bats recorded in Columbia River Forest Reserve

Six families, 24 genera, and 33 species have been recorded from the Columbia River Forest Reserve. Eight of these recorded during this survey represent new records for this protected area. M= this survey; Mc= McCarthy (1987), McCarthy *et al.* (1993), and McCarthy and Blake (1987); E= Emmons (1993)

Family	Species	Source
Emballonuridae		
	Centronycteris centralis	M
	Peropteryx macrotis	M
Mormoopidae		
	Pteronotus davyi	M
	Pteronotus personatus	Mc
	Pteronotus parnellii	Mc
Noctillionidae		
	Noctilio leporinus	Mc
Phyllostomidae		E
	Artibeus jamaicensis	E
	Artibeu toltecus	E
	Artibeus wastoni	E- M
	Carollia brevicauda	E- M
	Carollia perspicilatta	E
	Centurio senex	E
	Chrotopterus auritus	Mc
	Glossophaga soricina	E-M
	Lonchorhina aurita	Mc
	Micronycteris brachyotis	Mc
	Micronycteris megalotis	Mc
	Mimon bennettii	Mc
	Mimon crenulatum	Mc
	Phylloderma stenops	Mc
	Phyllostomus discolor	Mc
	Tonatia evotis	Mc
	Tonatia saurophila	Mc
	Trachops cirrhossus	E
	Vampyressa pusilla	Mc
	Vampryodes caraccioli	Mc
	Platyrrhinus helleri	Mc
Vespertillionidae		
	Bauerus dubiaquercus	Mc
	Lasiurus ega	M
	Lasiurus intermedius	M
	Myotis keasyi	M
	Myotis sp.	M
Molossidae		
	Molossus molossus	M

Mammals Recorded from the Columbia River Forest Reserve

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During the FebruaIY 1997 Rapid Assessment of the Little Quartz Ridge area, the only scientist dedicating some time to mammals was Bruce Miller (Bats, this volume). Other groups of mammals were not systematically recorded. During a separate expedition to a different part of the Columbia River Forest Reserve, some attention was paid to various mammals that were easily detected (Meerman, 1997). More importantly, mammal data exist from the 1992 Rapid Assessment to the Union Camp area (Emmons, 1993). This report serves to combine the data from these 3 separate expeditions.

Little Quartz Ridge Region

Most notable were the nocturnal calls from the "ringtail"' *Bassariscus sumichrasti.* Howler monkeys were also heard, but only infrequently. Signs of heavy hunting activities in this area may be the main cause for the observed scarcity of many mammals, including monkeys. Along the spur of the Little Quartz Ridge itself, tracks of White-lipped Peccaries *Tayassu pecari* were common, and on one occasion a large group of approximately 80 individuals was encountered. Only one mammal species *(Chironectes minimus)* could be added to the list of Emmons (1993).

Compartment 33/2

This location is situated in the eastern section of the Columbia River Forest Reserve. Through observations and searching for tracks, as many mammals as possible were identified. The amount of tracks found was surprisingly small.. Fruit eating mammals (bats, kinkajous, black howler monkeys) appeared to be plentiful. . At one time, four different groups of black howler monkeys were heard within the project area. This relative abundance was, no doubt, caused by the large number of fig trees *(Ficus* spp.) in the area, of which several wete fruiting during the time of the survey. These fig trees, no doubt, are a key element of the ecology of the survey area. Signs of hunting could not be detected during the June survey. However, "to facilitate logging activities in that area, a large access road was being created, and during a brief visit to the same area in October 1998, hunting signs were plentiful.. No new species were added to the list of Emmons (1993).

Table 1. Mammals recorded from the Columbia River Forest Reserve (exclusive of bats)

	Emmons (1993)	UC Feb. 1997	C1 Feb. 1997	SU Feb. 1997	C33/2 June 1997
DIDELPHIDAE – OPOSSUMS					
Micoureus alstoni	Collected				
Philander opossum	Recorded				
Didelphis marsupialis	Recorded				
Chironectes minimus			2 Seen		
CEBIDAE – MONKEYS					
Alouatta pigra	Recorded	Heard 22/2	Heard several times		1 group seen, total of 4 groups heard.
PROCYONIDAE – RACCOON FAMILY					
Potos flavus	Recorded				1 seen, many (> 8) heard.
Bassariscus sumichrasti	Recorded	Heard 22/2			
Nasua narica	Recorded		1 seen		
MUSTELIDAE – WEASEL FAMILY					
Eira barbara	Recorded				
FELIDAE – CATS					
Puma concolor or *Panthera onca*				Tracks + nocturnal observation	1 set of tracks found along entrance road.
Panthera onca	Recorded				
Felis sp. (small cat)	Tracks				
TAPIRIDAE – TAPIRS					
Tapirus bairdii	Recorded				1 set of tracks
TAYASSUIDAE – PECCARIES					
Tayassu tajacu	Recorded				
Tayassu pecari	Recorded		Tracks	Large group encountered	
CERVIDAE – DEER					
Mazama americana	Recorded		Skull found		
Odocoileus virginianus				1 seen	
SCIURIDAE – SQUIRRELS					
Sciurus sp.			2 small squirrels seen		2 seen. Small size makes *deppei* likely
Sciurus deppei	Confirmed				
GEOMYIDAE – POCKET GOPHERS					
Orthogeomys c.f. hispidus	Burrows seen				

(continued)	Emmons (1993L	UC Feb. 1997	Cl Feb. 1997	SU Feb. 1997	C3312 June 1997
HETEROMYIDAE - POCKET MICE					
Heteromys desmarestianus	Collected				
MURIDAE - RODENTS					
Oryzornp alfaroi	Collected				
Ototy!omys hatti	Collected				
Ty!ornys nudicaudus	Collected				
AGOUTIDAE - PACA					
Agouti pam	Recorded				1 seen, tracks scarce
DASYPROCTIDAE - AGOUTI					
Dtl,yprocta punctata	Recorded				

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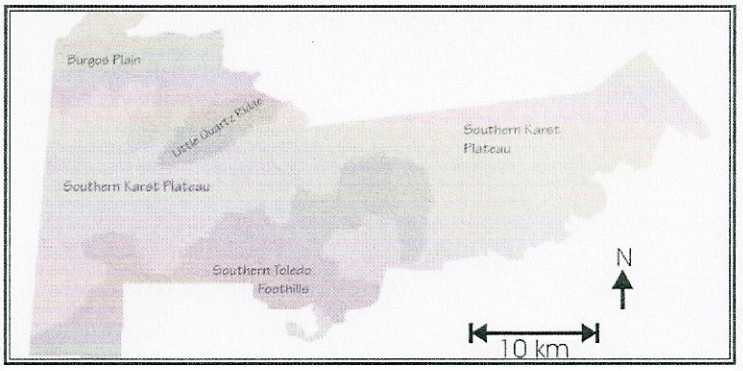
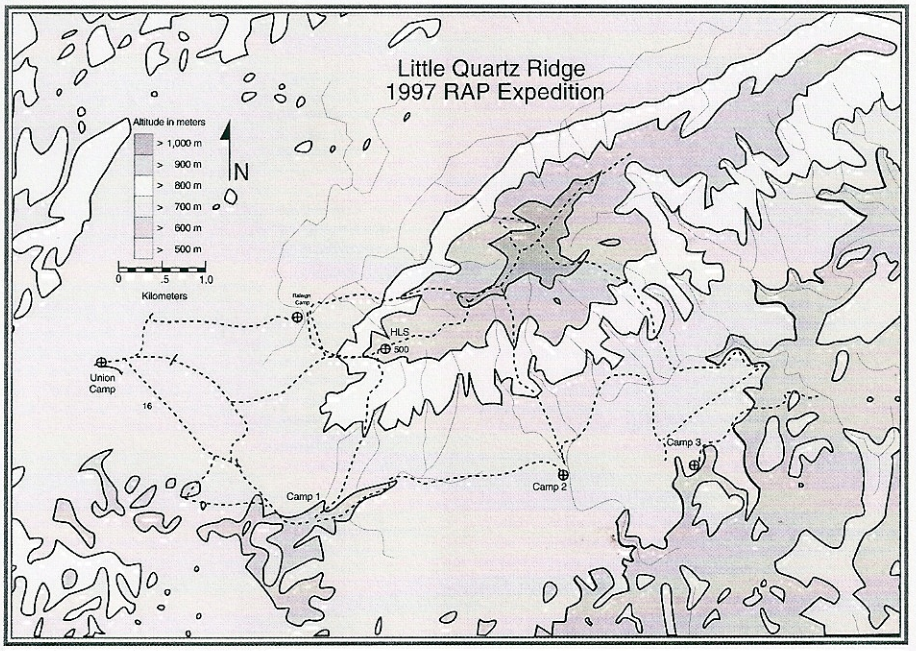
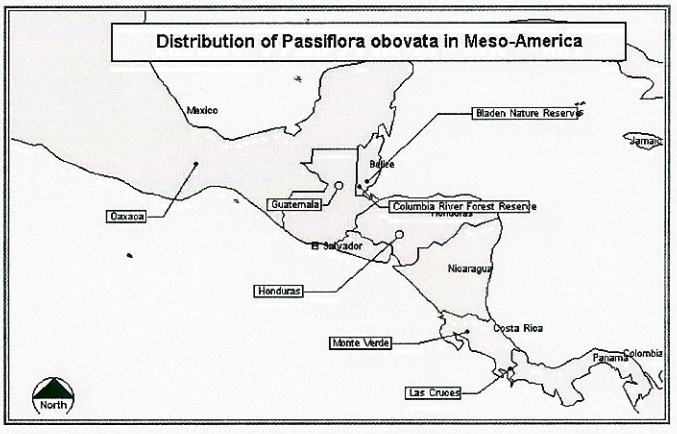
Map 1. Location of the Columbia River Forest Reserve (CRFR) in Belize.



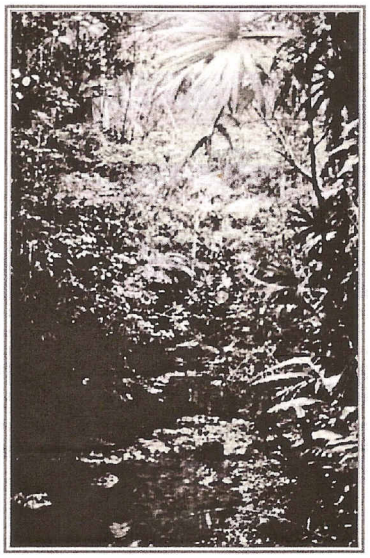
Map 2. Geological map of the Columbia River Forest Reserve with the four main geological regions indicated. For further explanation see text.



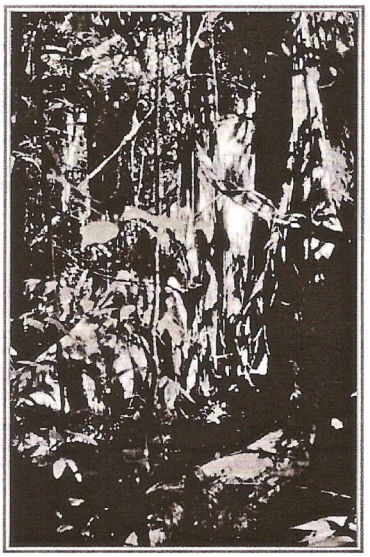
Map 3. Little Quartz Ridge area in the Columbia River Forest Reserve with February 1997 RAP expedition routes and camps indicated.



Map 4. Known distribution of *Passiflora obovata* in Meso-America.

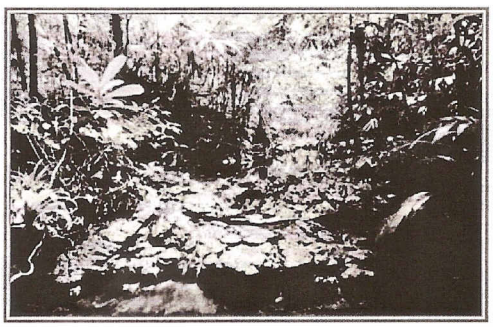


Picture 1. Habitat at Union Camp, Columbia River Forest Reserve. 11 Feb. 1997. J.C.. Lee



Picture 2. Habitat at Camp I, Columbia River Forest Reserve, 13 Feb. 1997. J.C.. Lee.

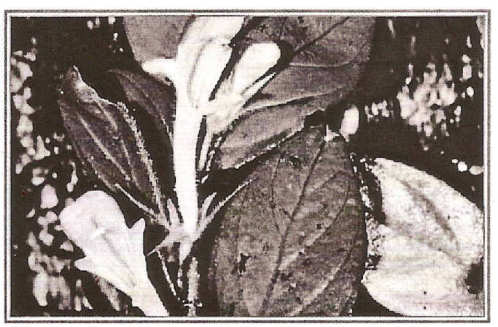
Picture 3. *Til/ant/sin mu/tiettulis.* Columbia River Forest Reserve, Feb. 1997. L.O. MUl\sey.



Picture 4. Stream habitat at Camp 1, Columbia River Forest Reserve, 13 Feb. 1997. L.O. Munsey.

Picture 5. B. Alien with moss collection on top of Li[nle Quartz Ridge. Columbia River Forest Reserve, Feb. 1997. S. Mamb.

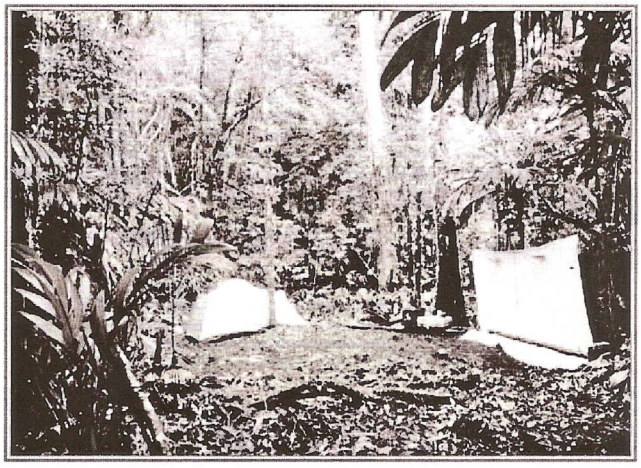
Picwre G. Bromdiads on f.111en(ree, Columbia River Fores(Reserve, 13. Feb, 1997. J.C., Lee.



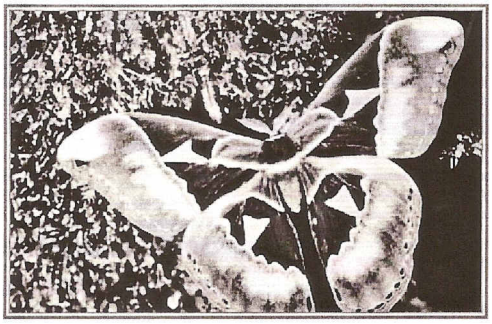
Picture 7. *Columnea SUlfurll.* Columbia River Fores[Reserve, Feb. 1997. L.O. MUl\sey.

Plate III

Picture 8. j.C.. t\.1eerman with *Plwiflom ObovTflta* vine. C~unp 2, Columbia River Forest Reserve, 14 Feb. 1997. IC. Lee.

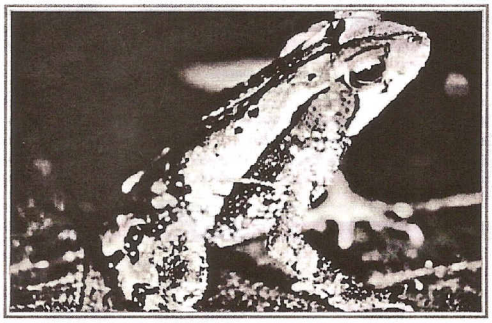


Picture 9. Moth collecting sheet at camp 1, Columbia River Forest Reserve, Feb. 1997. L.O. Muusey.

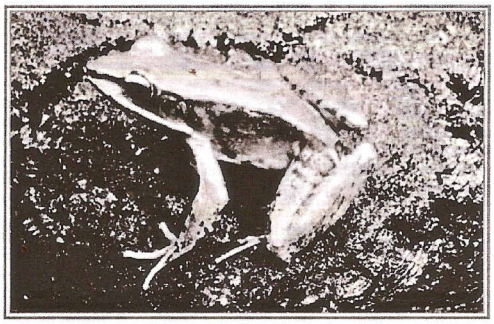


Pictllre 10. *Rothschildia roxana.* Columbia River Forest Reserve, Feb. 1997. L.O. Mllllsey.

Picture 11. *Eleutherodacrylus sp.* Camp 2, Columbia River Forest Reserve, Feb. 1997. L.O. Mllnsey.



Picture 12. *Bujb mmpbelli..* The most commonly encountercd amphibian. Columbia Rivcr Forest Reservc, Fcb. 1997. L.O. Munsey.



Picture 13. *Rana julianll.* An endcmic frog spccies with Littlc Quartz Ridge as its type locality. Camp 2, Columbia Rivcr Forest Reserve, 14 Feb. 1997.].c.. Lee.

Harpy Eagle reintroduction in Belize

Wether the Harpy Eagle maintains a bn popuplation in Belize remains undecidel February 2000, Rick Taylor found a Har Harpia harpyja, perched along the road miles north of Caracol in the Maya Mou western Belize, the first authenticated r the country since 1958. Kevin Loughlin rearranged the itinerary of a tour he wc to Belize to try to relocate the Harpy ar amazingly, succeeded. On 15 March 20 group watched the bird on a roadside p 50 minutes and later relocated it perch! 200 meters farther along the road (pho Loughlin).

Once present in lowland Neotropical forests ranging from southern Mexico to nort Argentina, Harpy Eagle (Harpia harpyja) populations have been severely reduced throughout much of their range due to forest fragmentation and indiscriminate hl humans. Now, The Peregrine Fund (TPF), Las Cuevas Research Station, the BelizE the Belizean government, are working together to begin restoring this majestic re into its former range.

The Peregrine Fund, based out of Boise USA is a non profit organization dedicat conservation of raptors and their habita the world. Having developed successful breeding and release techniques for Per Falcons, California Condors, and Aplom Falcons, TPF biologists developed a pro begin breeding Harpy Eagles in captivit' objective of this program is to restore t back to its historical range, wherever pi had been reduced or lost..

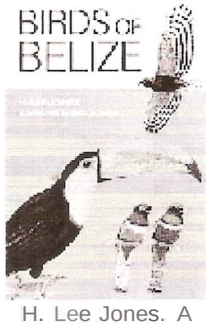
Despite painstaking efforts, however, such as bUildir)g special facilities for the Ha in an attempt to mimic some of the conditions of this species' natural habitat, fe, survived to hatchirLg age. Biologists believed that the differences in humidity, ter and sunlight betwee~Boise, Idaho and a Neotropical climate, were affecting the productivity among the captive breeding pairs. Realizing that in order to achieve highest production possible, the eagles needed to be placed in an area more in tl their natural habitat, The Peregrine Fund decided to build a captive breeding facil Panama, Central America. In 2001, The Peregrine Fund Panama (Fondo Peregrinl

What's New!

October 18, 2003 update on the the Harpy Eagle reintroduction by Sharon Matola

January, 2004 update on the the Harpy Eagle reintroduction by Sharon Matola

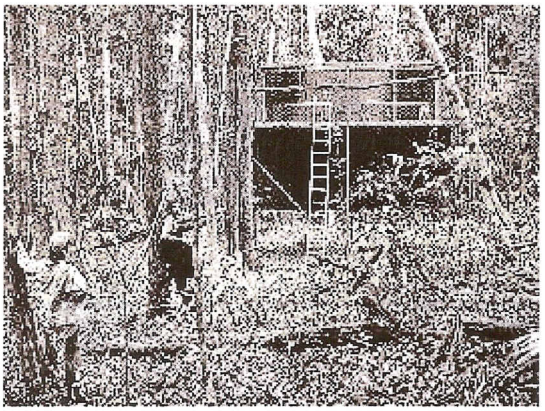
NEW RELEASE!
An notated checklist of the birds of Belize



H. Lee Jones. A Field Guide to the Birds of Belize. 56 calor plates by Dana Gardner. University of Texas Press.

Panama) and the Neotropical Raptor Center were born. To date, 19 captive bred Eagles have successfully hatched at this facility.

More Links



4 of these eagles, two males and two fE were recently successfully released into Chiquibul Forest of Belize, at the Las CL Research Station. The first two eaglets brought to Las Cuevas from Panama at March. Upon their arrival, the birds wer a specially designed aviary, called a ha< where they spent 3 weeks prior to their There, they were able to become accus the sights and sounds of the area, thus the chances that they will feel safe and their new surroundings once they are fr

At this time, volunteers were also able to observe the birds from a blind and collE their behavior. These harpies were released on the 12th of April. The second set arrived at Las Cuevas at the end of May. They were released on the 18th of June

All four harpies were released from the hack box at approximately 6 months of age. It will take them another 7 or 8 months before they begin hunting on their own. Until then, they are dependent upon Peregrine Fund volunteers for food. They are fed approximately 2 rats each per day. In order to keep these birds as wild as possible and to prevent them from becoming accustomed to humans, all their food is placed at night, under the cover of darkness, while the birds are roosting away from the feeding area.

Prior to their placement in the hack box harpies were fitted with two radio trans This allows Peregrine Fund volunteers a track the birds on a daily basis. Current birds are doing wonderfully. They all ha to explore the surrounding forest, while continuing to return to the hack site to

Photos by Angel Muela and Marta Curti

Read more about this project in the Oct 2003 and January 2004 updates by She Matola.