THE COLUMBIA RIVER FOREST RESERVE

Little Quartz Ridge Expedition

A Biological Assessment

Edited by:
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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 area 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 al., 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 but assumed to average over 2,540 mm (100 inches) per year (Hartshorn et al, 1984), but 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 but consists mostly of limestone and associated karst features (see Holland in this volume). A unique feature of the Columbia River Forest Reserve is Little Quartz Ridge, an isolated mountainous 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) flow into 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 plentiful 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 out 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 relationships between rock-soil-plant communities, and placed on record in the Land Use Survey report (Wright et al., 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 this 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 al., 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 attempted to regulate the ongoing logging activities in the Forest Reserve but 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 (NRI/FPMP), and with assistance from Conservation International (CI), 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 expeditions 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, although, 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 with 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 (CI).

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 southern Maya Mountains.

Sharon Matola, Director of the Belize Zoo and Tropical Education Center, was not only instrumental in organizing the 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 Center and San José 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 plant identification 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 relevant 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 present.

Columbia River Forest Reserve

The Columbia River Forest Reserve is located in southern Belize along the southeastern margin of the Maya Mountains. 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 development 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 continental 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 development 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 adjacent 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 first 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 of late Paleozoic (Carboniferous-Permian) sedimentary 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 Ridge. Dixon (ibid.) also recognized the extensive quartz veining in the Carboniferous and Permian sedimentary 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 recent 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 active (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 deposition 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 the southern margin of the Maya Mountains. The Maya Mountains represent an uplifted fault block of pre-Cretaceous basement 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 southern 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 plate boundary demarcated by the Belize barrier reef escarpment (Lara, 1993; Pindell, 1994 and references therein).

Karstification

The late Cretaceous limestones within the Columbia River Forest Reserve, like limestones within the Chiquibul Forest Reserve immediately north of the Columbia River Forest Reserve, are intensely karstified. This process has taken place throughout much of the Tertiary (65 million years) following uplift of this part of southern Belize in the early Tertiary. Karstification has modified the surface 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 southwestern Belize are recognized as being amongst the largest in the world (Miller, 1996). The large-scale solution 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 data). Due to erosion and solution effects, (map 2) one can expect thickness of these limestones to be much less in the Columbia River Forest Reserve.

Areas comprising the Columbia River Forest Reserve

Field work and a study of the topographic 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. Southern 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 southeast 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.

Outcrops 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 are 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, probably 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 presumed 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 erosion; 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 Cretaceous 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 eastwards.

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 Quartz 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 trees were recorded. Foliage closure (vertical layering), canopy closure and soil pH were assessed at 10 m 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, etc.) was also assessed for each site. The data 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 species 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) that were restricted to the plot). As only four sites were sampled, these statistics cannot be interpreted meaningfully. They do, however, provide an indication of the general level 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 part 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 Wright system, and four of the subtypes (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 the 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 vegetation 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 dendrograms produced by a cluster analysis on the BHFLRF dataset, using a range of different clustering algorithms, 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 vegetation 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 subtypes 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, the 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 were *Chamaedorea* sp. and *Euterpe 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 plot. 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 ridge, 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 plot 1 on 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 regeneration 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^{-1}). This plot, which is in an area of relatively undisturbed forest, 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 of the sites surveyed on the wider FPMP survey has been ranked in order of importance for three attributes: conservation importance, the diversity of useful taxa, 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 trees, 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 the scores for foliage closure were detected for the sites surveyed. The overall importance score for structural diversity at plot 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 the 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 about 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 just two species: *Euterpe precatoria* (frequency 158) and *Colpothrinax cookii* (frequency 34). These two 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 *Manilkara 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 but general conclusions about 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 two vegetation types surveyed. These data indicate that the plot surveyed at the top of the Little 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.

As far as BHFLRF is concerned, plot 2 has emerged as the most species rich and most distinct of the 16 sites surveyed so far by FPMP within this vegetation type (13 of which occur in the CRFR). The available maps indicate that the 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 attention 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 al. (1959) and Iremonger-Brokaw (1995). The two 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 Wright 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 out 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. total 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	111	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 zapota	13.36%
4	Alchornea latifolia	20.87%

Appendix A

Plot 1-MPFOV (Top of Little Quartz Ridge)

Name	sp.#	#
Chamaedorea sp.	73	958
Euterpe precatoria var. *longivaginata*	128	158
Psychotria elata	295	81
Inga sp.	169	71
Miconia impetiolaris	216	58
Critonia sexangularis	95	39
Danaea elliptica	107	39
Lindsaea sp.	186	38
TreeFern	357	37
Colpothrinax cookii	89	34
Dryopteridaceae	275	34
Roupala montana	314	32
Myrcia splendens	231	30
Dendropanax sp. 1 *(arboreus ?)*	*109*	*27*
Cyathea ? Thelypteris?	102	26
Trlchomanes 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 latifolia	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

Name	sp.#	#
Miconia laevigata	218	2
Morinda panamensis	224	2
Nectandra coriacea	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 sp.4	75	1
Clidemia sp.	81	1
Eugenia farameoides	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
Psychotria poeppigiana	297	1
Pterocarpus officinalis	301	1
Roupala sp.	315	1
Scutellaria orichalcea	324	1
Sloanea 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
Unknown #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 precatoria var. *longivaginata*	128	86
Astrocaryum mexicanurn	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
Ouratea 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
Acanthaceae	3	19
Faramea occidentalis	131	18
Sloanea tuerckheimii	337	17
Sideroxylon floribundum subsp. *belizense*	329	17
Aspidosperma cruentum	29	12
Lacistema 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
Chameodora 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
Euphorbiaceae	127	4
Ilex belizensis	166	4
Melasomataceae	211	4
Psychotria nervosa	296	4
Stemmadenia donnell-smithii	342	4
Symphonia globulifera	348	4
Trichospermum grewiifolium	361	4
Unknown #45	415	4
Virola koschnyi	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 alicastrum subsp. *alicastrum*	44	2
Bunchosia lindeniana	46	2
Calyptranthes megistophylla	52	2
Cordia alliodora	90	2
Cordia sp.	93	2
Dendropanax sp. *(arboreus?)*	109	2
Guarea 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 laevigata	49	1
Clusia sp.	82	1
Coccoloba acapulcensis	85	1
Coccoloba tuerckeimii	87	1
Croton draco	96	1
Cymbopetalum mayanum	104	1
Desmonchus orthacanthos	111	1
Licania hypoleuca	179	1
Learia sp.	185	1
Matayba apetala	209	1
Miconia hondurensis	215	1
Miconia lacera	217	1

Name	sp.#	#
Miconia laevigata	218	1
Miconia sp.	219	1
Mosquitoxylum jamaicense	225	1
Myrsinaceae	232	1
Picramnia antidesma subsp. *antidesma*	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	sp.#	#
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
Unknown #44	414	1
Unknown #46	416	1
Unknown #47	417	1
Unknown #896	442	1
Unknown #979	445	1
Xylopia frutescens	460	1

Plot 3-BHFLRF (Near Camp 3)

Name	sp.#	#
Unknown #29	395	1468
Eugenia capuli	121	297
Chamaedorea sp.	73	278
Calophyllum brasiliense var. *rekoi*	51	200
Cryosophila stauracantha	99	197
Ourarea lucens	248	163
Astrocaryum mexicanum	31	133
Pouteria reticulata	282	110
Cupania belizensis	100	99
Inga sp.	169	70
Manilkara zapota	206	51
Cassipourea guianensis	63	49
Trichilia moschata subsp. *moschata*	358	49
Nectandra sp.	239	39
Trophis racemosa	262	35
Protium copal	286	33
Acanthaceae	3	32
Fern #7	136	32
Euterpe precaroria var. *longivaginata*	128	29
Pouteria campechiana	281	28
Drypetes brownii	115	22
Lindsaea sp.	186	22
Pseudolmedia spuria	290	21
Strychnos panamensis	345	21
Faramea occidentalis	131	18

Name	sp.#	#
Piper sp.	265	18
Desmoncus orthacanthos	111	16
Unknown #628	434	13
Matayba apetala	209	12
Trichospermum grewiifolium	361	12
Guarea sp. (2 species)	146	10
Gleicheniadaceae *(Sticherus?)*	344	10
Cymbopetalum mayanum	104	9
Virola koschnyi	452	8
Lacistema aggregatum	173	7
Piper sp. 2 (S)	267	7
Bunchosia lindeniana	46	6
Calyptranthes megistophylla	52	6
Psychotria nervosa	296	6
Sideroxylon floribundum subsp. *belizense*	329	6
Cynometra retusa	105	5
Sebastiana tuerckheimiana	327	5
Stemmadenia donnell-smithii	342	5
Terminalia amazonia	352	5
Vochysia hondurensis	455	5
Ardisia sp.	26	4
Clusia sp.	82	4
Coccoloba belizensis	86	4
Costus sp.	194	4
Dendropanax sp. 1 *(arboreus?)*	109	4

Name	sp.#	#
Guettarda elliptica	150	4
Miconia impetiolaris	216	4
Sloanea tuerckheimii	337	4
Annona reticulata	17	3
Heisteria media	156	3
Olyra sp.	243	3
Piper sp.1 (M)	266	3
Trichomanes sp.	360	3
Aheis yucatanensis	11	2
Bauhinia divaricata	35	2
Danaea 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 alliodora	90	1
Erythroxylum guatemalense	120	1
Fern #815	138	1
Guatteria sp. (2 species)	147	1
Guatteria combsii	149	1

Name	sp.#	#
Ilex belizensis	166	1
Malpighiaceae	196	1
Miconia hondurensis	215	1
Moraceae Type 1	223	1
Palicourea guianensis	250	1
Pera 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 macrophylla	347	1
Symphonia globulifera	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
Calophyllum brasiliense var. *rekoi*	51	98
Guatteria sp. (2 species)	147	72
Euterpe precatoria var. *longivaginata*	128	48
Psychotria elata	295	38
Protium copal	286	31
Cupania belizensis	100	29
Inga sp.	169	24
Cryosophila stauracantha	99	22
Sloanea tuerckheimii	337	22
Piper sp.	265	21
Lacistema aggregatum	173	20
Traphis racemosa	362	19
Miconia impetiolaris	216	16

Name	sp.#	#
Pseudolmedia spuria	290	16
Dendropanax sp. *(arboreus?)*	109	15
Nectandra sp.	239	15
Rubiaceae	316	14
Faramea occidentalis	131	13
Terminalia amazonia	352	13
Faramea sp.	132	12
Manilkara zapota	206	12
Xylopia sp.	461	11
Virola koschnyi	452	10
Ourarea lucents	248	10
Cyclanthaceae	103	8
Mouriri 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
Heisteria media	156	6
Achornea latifolia	8	5
Aspidosperma cruentum	29	5
Costus sp.	94	5
Garcinia intermedia	142	5
Licania hypoleuca	179	5
Lindsaea sp.	186	5
Pouteria reticulata	282	5
Trichilia moschata subsp. *moschata*	385	5
Dialium guianense	112	4
Pouteria amygdalina	280	4
Symphonia globulifera	348	4
Unknown #628	434	4
Cordia sp.	93	3
Drypetes brownii	115	3
Sideroxylon floribundum subsp. *belizense*	329	3
Acanthaceae	3	2
Cyathea? Thelypteris?	102	2

Name	sp.#	#
Desmonchus orthacanthos	111	2
Psychotria nervosa	296	2
Unknown #1951	383	2
Vochysia hondurensis	455	2
Annona reticulata	17	1
Aspidosperma megalocarpon	30	1
Cassipourea guianensis	63	1
Clethra occidentalis	80	1
Clidemia sp.	81	1
Clusia sp.	82	1
Croton draco	96	1
Eugenia capuli	121	1
Ilex 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 collected 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 Assessment Program (RAP) trip are also included here (Holst collection numbers 3864 to 4515) with updated identifications. Some of these come from areas along the main trail from San José, 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 listed 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 see Shawe (2003) in this volume.

OBSERVATIONS

A strong similarity between the summit of Little 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 somewhat 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

(granite, volcanic, limestone and others), relatively high rainfall, and low degree of human disturbance. While there are no known endemic plants on Little Quartz Ridge (with 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 parts of their range have been heavily disturbed by agricultural activities. While we made no attempt 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.; Pteridophytes, 41 spp.; Bryophytes, 53 spp. These are indicated in the 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 restricted 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.). Pteridophyte 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, but patchily distributed *Colpothrinax cookii*. Until the early 90's, this species was believed to be restricted to Guatemala (Alta Verapaz) and eastern 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. *longivaginata* (previously identified as *E. macrospadix* in Belize), and *Synechanthus fibrosus*. The rare *Chamaedorea schippii* (previously identified as *C. graminifolia* in Belize) was found on two different rocky limestone ridges neighboring the Little Quartz. Common palms in lower areas were *Calyptrogyne ghiesbreghtiana*, *Chamaedorea* spp., and *Astrocaryum mexicanum*.

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. *Tillandsia 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*-looking *Tillandsia multicaulis* (Bromeliaceae) was also abundant at higher elevations, though in more protected areas. The large presence of "gray" *Tillandsia* 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 obtusifolius* (Araliaceae), *Rhipsalis baccifera* (Cactaceae), *Clusia* spp. (Clusiaceae), *Asplundia labela* (Cyclanthaceae), *Satyria warszewiczii*, *Sphyrospermum cordifolium* (Ericaceae), *Columnea sulfurea* (Gesneriaceae), *Blakea cuneata* (Melastomataceae), *Ficus* spp. (Moraceae), *Dichaea* spp., *Encyclia* spp., *Elleanthus* spp., *Epidendrum* spp., *Maxillaria* spp., *Pleurothallis* spp., and *Scaphyglottis* 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 (Allen *in* Matola 1995), was also slightly extended. We found *Brunellia mexicana* along deep, shaded, cool canyons on the southeastern slopes of Little Quartz Ridge. It had only been known in Belize previously from the highest parts of the Maya Mountain Divide (and was first found there only in 1993).

A relatively high number of vascular plants (41 taxa, including 1 family, 5 genera, 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 Little Quartz Ridge, or from the deep, shaded, cool canyons on the southwestern 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		
Cyclanthaceae	*Cyclanthus bipartitus* Poit.	Holst 5823 (but also recorded in Meerman & Williams (1995).
Flacourtiaceae	*Macrohasseltia macroterantha* (Standl. & L.O. Wms.) L.O. Wms.	Holst 5840
Lophosoriaceae	*Lophosoria quadripinnata* (J.F. Gmel.) C. Chr. [var. *quadripinnata*]	Hawkins 1541
Tectariaceae	*Megalastrum lunense* (H. Christ) A.R. Sm. & R.C. Moran	Holst 5820
Urticaceae	*Phenax mexicanus* Weddell	Holst 5721
New Species for Belize		
Araceae	*Monstera dubia* (Kunth) Engl. & K. Krause	Holst 5947
Asteraceae	*Mikania pyramidata* Donn. Sm.	Hawkins 1468
Begoniaceae	*Begonia manicata* Brongn. ex Cels.	Hawkins 1347
Bromeliaceae	*Tillandsia orogenes* Standl. & L.O. Wms.	Hawkins 1533; Holst 5869
Bromeliaceae	*Tillandsia tricolor* Schltdl. & Cham. [var. *melanocrater* (L.B. Sm.) L.B. Sm.]	Holst 5986 (live)
Clusiaceae	*Clusia stenophylla* Standl.	Hawkins 1371; Holst 4184, 4408
Dryopteridaceae	*Stigmatopteris sordida* (Maxon) C. Chr.	Holst 5897
Gentianaceae	*Voyria truncata* (Standl.) Standl. & Steyerm.	Hawkins 1416
Hymenophyllaceae	*Hymenophyllum sieberi* (C. Presl) Bosch	Holst 5974
Loganiaceae	*Strychnos panurensis* Sprague & Sandwith	Holst 4272
Lomariopsidaceae	*Bolbitis hastata* (E. Fourn.) Hennipman	Holst 5757
Lomariopsidaceae	*Elaphoglossum decursivum* Mickel	Holst 5924
Melastomataceae	*Miconia glaberrima* (Schltdl.) Naudin	Hawkins 1484, 1520
Melastomataceae	*Miconia gracilis* Triana	Holst 5752, 5768, 5901
Melastomataceae	*Miconia nutans* Donn. Sm.	Hawkins 1404; Holst 5925
Moraceae	*Ficus apollinaris* Dugand	Holst 4190
Myrsinaceae	*Gentlea venosissima* (Ruiz & Pavon) Lundell	Holst 5795
Orchidaceae	*Epidendrum phragmites* A.H. Heller & L.O. Wms.	Holst 5793
Orchidaceae	*Oncidium cheirophorum* Rchb.f.	Holst 5694
Orchidaceae	*Pelexia callifera* (C. Schweinf.) Kuntze	Holst 4017
Passifloraceae	*Passiflora helleri* Peyr.	Holst 5690, 5823 (but also recorded in Meerman & Williams (1995)

Piperaceae	*Peperomia emarginella* (Sw. ex Wikstr.) C. DC.	Holst 4066
Piperaceae	*Peperomia matlalucaensis* C. DC.	Holst 4426
Pteridaceae	*Adiantum trichochlaenum* Mickel & Beitel	Holst 5873
Rubiaceae	*Coussarea mediocris* Standl. & Steyerm.	Holst 5749
Rubiaceae	*Psychotria epiphytica* K. Krause	Hawkins 1431
Rubiaceae	*Psychotria orchidearum* Standl.	Holst 5777
Sapindaceae	*Paullinia fibrigera* Radlk.	Holst 4158
Sapindaceae	*Paullinia glomerulosa* Radlk.	Holst 4109
Symplocaceae	*Symplocos limoncillo* Humb. & Bonpl.	Holst 4058
Thelypteridaceae	*Thelypteris decussata* (L.) Proctor [var. *costaricensis* A.R. Sm.]	Holst 5819, 5919
Thelypteridaceae	*Thelypteris leprieurii* (Hook.) R.M. Tryon [var. *subcostalis* A.R. Sm.]	Hawkins 1537
Thelypteridaceae	*Thelypteris sancta* (L.) Ching	Holst 5968
Thelypteridaceae	*Trichomanes radicans* Sw.	Holst 5815, 5816
Verbenaceae	*Aegiphila martinicensis* Jacq.	Holst 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 Holst April 4—15, 1992. Plants were collected in paper bags and air-dried either 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 reported as new records for Belize.

New Records of Bryophytes for Belize

New Families for Belize		
Ephemeraceae	*Ephemerum spinulosum* Bruch & W.P. Schimper	Allen 19082, 19094
New Genera for Belize		
Brachytheciaceae	*Aerolindigia capillacea* (Hornschuch) Menzel	Allen 18687
Hookeriaceae	*Actinodontium standleyi* E.B. Bartram	Allen 18760, 19003, 19021, 19024
Dicranaceae	*Leucophanes molleri* C. Müller	Allen 18775
Hypnaceae	*Ectropothecium leptochaeton* (Schwägrichen) W.R. Buck	Allen 18696, 18763
Lejeuneaceae	*Lepidolejeunea involuta* Grolle	Allen 18926
Neckeraceae	*Thamnobryum tumidicaule* (K.A. Wagner) F.D. Bowers	Allen 18685
New Species for Belize		
Bryaceae	*Brachymenium spirifolium* (C. Müller) Jaeger	Allen 18761
Calypogeiaceae	*Calypogeia peruviana* Nees & Montagne	Allen 18714
Daltoniaceae	*Daltonia pulvinata* Mitten	Allen 18660, 18677

Fissidentaceae	*Fissidens asplenioides* Hedwig	Allen 18708
Fissidentaceae	*Fissidens curvatus* Hornschuch	Allen 18875
Fissidentaceae	*Fissidens dubius* Palisot de Beauvois	Allen 18526, 19055
Fissidentaceae	*Fissidens lagenarius* Mitten	Allen 18621, 18808, 18899, 18975, 18991, 19007, 19012
Fissidentaceae	*Fissidens oblongifolius* W.J. Hooker & Wilson	Allen 18609, 18610A, 18637
Frullaniaceae	*Frullania gibbosa* Nees	Allen 19079
Hookeriaceae	*Callicostella vatteri* E.B. Bartram	Allen 18865A
Hookeriaceae	*Cyclodictyon erubescens* E.B. Bartram	Allen 18635, 18650
Hookeriaceae	*Hookeriopsis cruegeriana* (C. Müller) Jaeger	Allen 18726
Hookeriaceae	*Hookeriopsis cuspidata* Jaeger	Allen 18545, 18610, 18869, 19054, 19061
Hookeriaceae	*Hookeriopsis guatemalensis* E.B. Bartram	Allen 18504, 18578, 18717A, 18880, 8891
Hookeriaceae	*Hookeriopsis subfalcata* (Hampe) Jaeger	Allen 18781
Hookeriaceae	*Lepidopilum cubense* (Sullivant) Mitten	Allen 18601
Hookeriaceae	*Lepidopilum muelleri* (Hampe) Spruce	Allen 18675
Hookeriaceae	*Lepidopilum surinamense* C. Müller	Allen 18712
Hookeriaceae	*Lepidopilum tortifolium* Mitten	Allen 18759, 18896
Hypnaceae	*Taxiphyllum ligulaefolium* (E.B. Bartram) W.R. Buck	Allen 18552
Hypnaceae	*Vesicularia vesicularis* var. *portoricensis* (Bridel) W.R. Buck	Allen 18514
Lejeuneaceae	*Cheilolejeunea decurviloba* (Stephan) He Xiao-lan	Allen 18842
Lepidozoaceae	*Kurzia flagellifera* (Stephan) Grolle	Allen 18830
Meteoriaceae	*Squamidium macrocarpum* (Spruce ex Mitten) Brotherus	Allen 18646, 18689, 18788, 18795, 18885
Orthotrichaceae	*Macromitrium leprieurii* Montagne	Allen 18704, 18737, 18882, 18985
Pilotrichaceae	*Pilotrichum fendleri* C. Müller	Allen 18513, 18579, 18584, 18588, 18623, 18748, 18765, 18794, 19033
Pilotrichaceae	*Pilotrichum ramosissimum* Mitten	Allen 18748B
Pottiaceae	*Barbula arcuata* Griffith	Allen 18724, 18797, 18867, 19059
Radulaceae	*Radula husnotii* Castle	Allen 18680
Sematophyllaceae	*Trichosteleum bernoullianum* (C. Müller) Brotherus	Allen 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 (C1), 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 Limestone 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 to 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.	*Holst 4051*	UC
Justicia albobracteata Leonard	*Holst* 5643	UC
Justicia bartlettii (Leonard) D.N. Gibson	*Hawkins* 1415; *Holst* 5642	C2, UC
Justicia breviflora (Nees) Rusby	*Holst* 4025, 4243, 4245	UC
Justicia candelariae (Oerst.) Leonard	*Hawkins* 1411	C2
Justicia fimbriata (Nees) V.A.W. Graham	*Holst* 5892	C1
Justicia pectoralis Jacq.	*Hawkins* 1436	C3
Louteridium donnell-smithii S. Watson	*Hawkins* 1387; *Holst* 4045	C1, UC, GC
Odontonema albiflorum Leonard	*Hawkins* 1439; *Holst* 5767	C2, C3
Odontonema callistachyum (Schltdl. & Cham.) Kuntze	*Holst* 3871	UC
Odontonema hondurensis (Lindau) D.N. Gibson	*Hawkins* 1373; *Holst* 3873, 5939	C1, 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 & Urb.	*Shawe*	BH
Spondias mombin	*Shawe*	BH
ANNONACEAE		
Anaxagorea guatemalensis Standl.	*Holst* 5843	SL
Annona reticulata	*Shawe*	BH
Annona scleroderma Saff.	*Holst* 4007	UC
Annona squamosa	*Shawe*	BH
Cymbopetalum mayanum Lundell	*Holst* 4177, 4195, *Shawe*	UC, BH
Guatteria amplifolia Triana & Planch.	*Holst* 4198, 4207, 4280, 5666	C1, SU, UC
*Malmea depressa (*Baill.) R.E. Fries	*Holst* 4115	UC
Sapranthus campechianus	*Shawe*	BH
Xylopia frutescens	*Shawe*	BH
APOCYNACEAE		
Aspidosperma cruentum Woodson	*Holst* 4134, *Shawe*	UC, BH
Aspidosperma megalocarpon	*Shawe*	BH
Cameraria latifolia	*Shawe*	BH
Plumeria rubra	*Shawe*	BH
Stemmadenia donnell-smithii (Rose ex Donn. Sm.) Woodson	*Holst* 4114, *Shawe*	UC, BH
Tabernaemontana amygdalifolia Jacq.	*Holst* 4200	UC
Tabernaemontana arborea Rose	*Holst* 5913	SL
Thevetia ahouai (L.) A. DC.	*Holst* 5934	C1
AQUIFOLIACEAE		
Ilex belizensis	*Shawe*	BH
Ilex guianensis (Aubl.) Kuntze	*Holst* 4288, 5789, 5905	SL, SU
ARACEAE		
Anthurium bakeri Hook.f.	*Holst* 3888, 5630	UC
Anthurium flexile Schott subsp. *flexile*	*Holst* 4470	GC
Anthurium interruptum Sodiro	*Hawkins* 1408; *Holst* 4024	C2, UC
Anthurium lucens Standl.	*Holst* 4241, 5910, 5998	SL, UC
Anthurium pentaphyllum var. bombacifolium (Schott) Madison	*Holst 4116*	UC
Anthurium scandens (Aubl.) Engl. subsp. *scandens*	*Hawkins* 1480; *Holst* 4396	SU, UC
Anthurium schlechtendalii Kunth subsp. *schlechtendalii*	*Holst* 4069	UC
Monstera acuminata K. Koch	*Holst* 4121, 4382	UC
Monstera dubia (Kunth) Engl. & K. Krause	*Holst* 5947	C1
Philodendron aurantiifolium Schott	*Holst* 4437	GC
Philodendron hederaceum (Jacq.) Schott	*Holst* 4422	GC
Philodendron radiatum Schott	*Holst* 4303	SU
Philodendron sagittifolium Liebm.	*Hawkins* 1466; *Holst* 4499	C3, GC
Philodendron smithii Engl.	*Hawkins* 1465	C3

Philodendron tripartitum (Jacq.) Schott	*Hawkins* 1449; *Holst* 4388	UC, C3
Rhodospatha wendlandii Schott	*Holst* 4401, 4446	GC
Spathiphyllum blandum Schott	*Holst* 4366, 5904	SL, UC
Syngonium macrophyllum Engl.	*Holst* 4201	UC
Syngonium podophyllum Schott	*Holst* 4057	UC
Xanthosoma cf. mexicanum Liebm.	*Holst* 4497	GC
ARALIACEAE		
Dendropanax arboreus (L.) Decne. & Planch.	*Holst* 4149, 4216	UC
Oreopanax obtusifolius L.O. Wms.	*Hawkins* 1365; *Holst* 4087, 4491	UC, GC
Schefflera morototoni (Aubl.) Maguire, Steyerm. & Frodin	*Observed, Shawe*	UC, BH
ARECACEAE		
Astrocaryum mexicanum Liebm.	*Holst* 4044	UC, GC
Attalea cohune Mart.	*Shawe*	Observed in many localities around base of LQR, but not on slopes or summit, BH
Bactris major. var. *major*	*Shawe*	BH
Bactris mexicana Mart.	*Holst* 4501	GC
Calyptrogyne ghiesbreghtiana H. Wendl.	*Hawkins* 1337; *Holst* 4002, *Shawe*	UC, BH
Chamaedorea adscendens	*Shawe*	BH
Chamaedorea ernesti-augusti H. Wendl.	*Holst* 4005	UC
Chamaedorea geonomiformis H. Wendl.	*Holst* 3879, 3898, 4326, 5957, *Shawe*	UC, BH
Chamaedorea oblongata Mart.	*Holst* 4104, 5969	UC
Chamaedorea pinnatifrons (Jacq.) Oerst.	*Hawkins* 1329, 1337, 1450A; *Holst* 3885, 4104A, 4344, 5890, *Shawe*	C1, C3, UC, BH
Chamaedorea schippii Burret	*Hawkins* 1397; *Holst* 4330	C1, UC
Chamaedorea tepejilote Liebm.	*Holst* 4387, 4409	UC, GC
Colpothrinax cookii Read	*Holst* 4333, 5747, *Shawe*	SL, SU, BH
Cryosophila stauracantha (Heynh.) R. Evans	*Holst* 4210, *Shawe*	UC, GC, BH
Desmoncus orthacanthos	*Shawe*	BH
Desmoncus sp.	*Holst* 4098	UC
Euterpe precatoria var. *longivaginata* (Mart.) Henderson	*Holst* 4003, *Shawe*	SU, UC, BH
*Geonoma interrupta (*Ruiz & Pavon) Mart.	*Holst* 5891	C1
Reinhardtia gracilis (H. Wendl.) Burret	*Holst* 4500	GC
Sabal mauritiiformis	*Shawe*	BH
Synechanthus fibrosus H. Wendl.	*Hawkins* 1362, 1448; *Holst* 3893	C1, C3, UC
ARISTOLOCHIACEAE		
Aristolochia schippii Standl	*Meerman*	BH
ASCLEPIADACEAE		
Marsdenia laxiflora Donn. Sm.	*Hawkins* 1549	SL

ASTERACEAE		
Acourtea belizeana B.L. Turner	*Hawkins* 1395	C1
Baccharis trinervis Pers	*Holst* 5963	UC
Bidens squarrosa Kunth	*Holst* 5937	C1
Calea jamaicensis (L.) L.	*Hawkins* 1498	SU
Chromolaena odorata (L.) King & H. Rob.	*Holst* 6010	UC
Critonia sexangularis (Klatt) King & H. Rob.	*Hawkins* 1492; *Holst* 4269, 5726, *Shawe*	SL, SU, BH
Fleischmannia pratensis (Klatt) King & H. Rob.	*Holst* 6019	UC
Koanophyllon pittieri	*Shawe*	BH
Mikania houstoniana (L.) B.L. Rob.	*Hawkins* 1354	C1
Mikania micrantha H.B.K.	*Hawkins* 1354A	C1
Mikania pyramidata Donn. Sm.	*Hawkins* 1468	SU
Neurolaena lobata (L.) R. Br.	*Holst* 6011, *Shawe*	UC, BH
Sinclairia polyantha (Klatt) Rydb.	*Hawkins* 1479; *Holst* 4126	SU, UC
Smallanthus maculatus (Cav.) H. Rob.	*Holst* 6013	UC
Verbesina oerstediana Benth.	*Hawkins* 1473A	UC

BEGONIACEAE		
Begonia glabra Aubl.	*Hawkins* 1349, 1552; *Holst* 5817	C1, SL
Begonia heracleifolia Schltd. & Cham.	*Holst* 3901	GC
Begonia manicata Brongn. ex Cels.	*Hawkins* 1347	C1
Begonia nelumbiifolia Schltdl. & Cham.	*Holst* 4373, 5999	UC
Begonia sericoneura Liebm.	*Holst* 4035	UC

BIGNONIACEAE		
Anemopaegma chrysanthum Dugand	*Holst* 4356	UC
Arrabidaea i naequalis (DC. ex Splitg.) K. Schum.	*Holst* 4225, 4434	UC, GC
Arrabidaea podopogon A.H. Gentry	*Holst* 4262	UC
Arrabidaea verrucosa (Standl.) A.H. Gentry	*Holst* 4165, 4490	UC, GC
Arrabidaea viscida (Donn. Sm.) A.H. Gentry	*Holst* 4420	GC
Martinella obovata (Kunth) Bureau & K. Schum.	*Holst* 4118	UC
Mussatia hyacinthina (Standl.) Sandwith	*Holst* 4315	UC
Paragonia pyramidata (Rich.) Bureau	*Holst* 4371, 4406	UC, GC
Pithecoctenium crucigerum (L.) A.H. Gentry	*Holst* 4484	GC
Stizophyllum riparium (Kunth) Sandwith	*Holst* 4319	UC
Tabebuia chrysantha subsp. *chrysantha*	*Shawe*	BH
Tabebuia guayacan	*Shawe*	BH
Tabebuia rosea	*Shawe*	BH
Tynanthus guatemalensis Donn. Sm.	*Holst* 4468	GC

BIXACEAE		
Bixa orellana	*Shawe*	BH

BOMBACACEAE		
Bernoullia flammea	*Shawe*	BH
Bombacopsis quinata (Jacq.) Dugand	*Holst* 4242	UC
Ceiba pentandra	*Shawe*	BH
Ochroma pyramidale	*Shawe*	BH

Pachira aquatica Aubl.	*Holst* 4151	UC
Pseudobombax ellipticum	*Shawe*	BH
Quararibea funebris	*Shawe*	BH
Quararibea yunckeri Standl. subsp. *Yunckeri*	*Holst* 4062	UC

BORAGINACEAE

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

BROMELIACEAE

Aechmea lueddemanniana (K. Koch) Brongn. ex Mez	*Holst* 4004, 4028	UC
Androlepis skinneri Brongn. ex Houllet	*Holst* 4085	UC
Guzmania lingulata (L.) Mez	*Holst* 5715	C1
Guzmania nicaraguensis Mez & C.F. Baker ex Mez	*Holst* 5663	C1
Pitcairnia imbricata (Brongn.) Regel	*Holst* 4162, 5634	SU, UC
Racinaea sp.	*Holst* 5997	C1
Tillandsia anceps Lodd.	*Holst* 4046, 5983 *(live)*	UC
Tillandsia bulbosa Hook.	*Hawkins* 1396; *Holst* 4054	C1, UC
Tillandsia cf. butzii Mez	*Holst* 3874	UC
Tillandsia excelsa Griseb.	*Holst* 5679	C1
Tillandsia festucoides Brongn. ex Mez	*Holst* 3872, 3887, 4071, 4379	UC
Tillandsia filifolia Schltdl. & Cham.	*Holst* 4076, 5982	UC
Tillandsia juncea (Ruiz & Pavon) Poir.	*Holst* 5981 *(live)*	C1
Tillandsia leiboldiana Schltdl.	*Holst* 4053A, 5659	UC
Tillandsia monadelpha (E. Morren) Baker	*Holst* 4140, 4430, 5720	C1, UC, GC
Tillandsia multicaulis Steud.	*Holst* 4279, 5745	SL, SU
Tillandsia orogenes Standl. & L.O. Wms.	*Hawkins* 1532; *Holst* 5869	SU
Tillandsia pruinosa Sw.	*Holst* 4072	UC
Tillandsia punctulata Schltdl. & Cham.	*Holst* 5725	SL
Tillandsia tricolor var. *melanocrater* (L.B. Sm.) L.B. Sm.	*Holst* 5986 *(live)*	UC
Vriesea heliconioides (Kunth) Hook. ex Walp.	*Holst* 5714	C1
Werauhia viridiflora (Regel) J.R. Grant	*Holst* 5713	C1
Werauhia vittata (Mez & Wercklé ex Mez) J.R. Grant	*Holst* 5801	SL

BRUNELLIACEAE

Brunellia mexicana Standl.	*Holst* 5899	SL

BURMANNIACEAE

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

BURSERACEAE

Bursera simaruba (L.) Sarg.	*Observed, Shawe*	UC, BH
Protium cf. *glabrum* (Rose) Engl.	*Holst* 4152, 4391	UC
Protium copal (Schltdl. & Cham.) Engl.	*Shawe*	BH
Protium schippii Lundell	*Holst* 4079	UC
Tetragastris panamensis (Engl.) Kuntze	*Shawe*	BH
Tetragastris stevensonii Standl.	*Shawe*	BH

CACTACEAE		
Epiphyllum crenatum (Lindl.) D. Don	*Holst* 4483	GC
Epiphyllum oxypetalum (DC.) Haw.	*Holst* 4039	UC
Rhipsalis baccifera (J.S. Muell.) Stearn	*Holst* 4427	GC
CAESALPINIACEAE		
Bauhinia divaricata	*Shawe*	BH
Bauhinia guianensis Aubl.	*Holst* 4352	UC
Cynometra retusa	*Shawe*	BH
Dialium guianense (Aubl.) Sandwith	*Holst* 4168, 4170, *Shawe*	UC, GC, BH
Schizolobium parahybum (Vell.) S.F. Blake	*Shawe*	BH
Senna atomaria	*Shawe*	BH
CAMPANULACEAE		
Hippobroma longiflora (L.) G. Don	*Holst* 6014	UC
Lobelia sp., sect. *Revolutella* E. Wimm.	*Holst* 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*	*UC*
CELASTRACEAE		
Crossopetalum eucymosum (Loes. & Pittier) Lundell	*Holst* 4032, 4033, 4314, 4365	UC
Maytenus guatemalensis Lundell	*Holst* 5973	UC
Maytenus schippii Lundell	*Holst* 4053	UC
Wimmeria bartlettii Lundell	*Holst* 4251	UC
Zinowiewia pallida Lundell	*Shawe*	BH
CHLORANTHACEAE		
Hedyosmum mexicanum C. Cordem.	*Hawkins* 1501; *Holst* 4273, 5681, 5810, *Shawe*	C1, C2, SU, BH
CHRYSOBALANACEAE		
Hirtella americana L.	*Holst* 4237, *Shawe*	UC, BH
Hirtella racemosa var. *hexandra*	*Shawe*	BH
Hirtella triandra Sw. subsp. *triandra*	*Holst* 4167, 5677	C1, UC
Licania hypoleuca Benth.	*Holst* 5732, *Shawe*	SL, BH
Licania 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 Donn. Sm.	*Hawkins* 1360, 1364, 1407	C1, C2
Clusia cf. *lundellii* Standl.	*Holst* 4378	UC
Clusia flava Jacq.	*Holst* 4180	UC
Clusia guatemalensis Hemsl.	*Hawkins* 1453	C3
Clusia minor L.	*Holst* 3865	UC
Clusia salvinii Donn. Sm.	*Hawkins* 1481	SU
Clusia stenophylla Standl.	*Hawkins* 1371; *Holst* 4184, 4408	C1, UC, GC
Garcinia cf. *intermedia* (Pittier) Hammel	*Holst* 4175, *Shawe*	UC, BH
Symphonia globulifera L.f.	*Holst* 4185, *Shawe*	UC, BH
*Tovomitopsis nicaraguensis (*Oerst.) Planch. & Triana	*Holst* 4013, 4189, 4407	UC, GC
Vismia camparaguey Sprague & L. Riley	*Holst* 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.	*Holst* 4458	GC
Tripogandra grandiflora (Donn. Sm.) Woodson	*Hawkins* 1351; *Holst* 4137	C1, UC
CONVOLVULACEAE		
Ipomoea setosa Ker Gawl.	*Holst* 4374	UC
Maripa nicaraguensis Hemsl.	*Holst* 4203, 4487	UC, GC
COSTACEAE		
Costus pulverulentus C. Presl	*Holst* 4332	UC
CUCURBITACEAE		
Gurania makoyana (Lem.) Cogn.	*Hawkins* 1341; *Holst* 4232, 4263, 4392	C1, UC
Melothria pendula L.	*Hawkins* 1550; *Holst* 5723	C1, SL
Sicydium sp.	*Holst* 4136, 4462	UC, GC
Sicyos sp.	*Holst* 4064	UC
CYCLANTHACEAE		
*Asplundia labela (*R.E. Schult.) Harling	*Holst* 4178, 4212	SU, UC
Cardulovica palmata	*Shawe*	BH
Cyclanthus bipartitus Poit.	*Holst 5823*	SL

CYPERACEAE		
Carex polystachya Sw. ex Wahlenb.	*Holst* 5655	UC
Rhynchospora cephalotes (L.) Vahl	*Holst* 5790	SL
Rhynchospora exaltata Kunth	*Hawkins* 1514	SU
Rhynchospora radicans (Schltdl. & Cham.) Pfeiffer subsp. *radicans*	*Holst* 6002	UC
Rhynchospora watsonii (Britton) Davidse	*Holst* 5697	C1
Scleria latifolia Sw.	*Hawkins* 1405, 1516; *Holst* 4060, 4278	C2, SU, UC
Scleria secans (L.) Urban	*Holst* 4300	SU
CYRILLACEAE		
Cyrilla racemiflora L.	*Holst* 4299	SU
Purdiaea belizensis (A.C. Sm. & Standl.) J.L. Thomas	*Holst* 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		
*Sloanea laurifolia (*Benth.) Benth.?	*Holst* 5787	SL, SU
Sloanea meianthera	*Shawe*	BH
Sloanea tuerckheimii Donn. Sm.	*Holst* 4293, *Shawe*	SU, BH
ERICACEAE		
Satyria warszewiczii Klotzsch? (or *S. meiantha* Donn. Sm.?)	*Hawkins* 1445; *Holst* 4042, 4182, 4282, 5695	C1, C3, SU, UC
Sphyrospermum cordifolium Benth.	*Hawkins* 1369; *Holst* 3868	C1, UC
ERYTHROXYLACEAE		
Erythroxylum guatemalense	*Shawe*	BH
EUPHORBIACEAE		
Acalypha diversifolia Jacq.	*Holst* 4418	GC
Acalypha gummifera Lundell	*Hawkins* 1399; *Holst* 5710	C1
Acalypha macrostachya	*Shawe*	BH
Alchornea latifolia Sw.	*Hawkins* 1544; *Holst* 4093, 4267, 5682, 5825, *Shawe*	C1, SL, SU, UC, BH
Bernardia interrupta (Schltdl.) Muell. Arg.	*Holst* 4112, 4421, *Shawe*	UC, GC, BH
Cleidion castaneifolium Muell. Arg.	*Holst* 4009, 4099, 4174, 4223, 5811	C2, UC

Cnidoscolus multilobus	*Shawe*	BH
Croton draco	*Shawe*	BH
Croton glabellus	*Shawe*	BH
Drypetes brownii Standl.	*Shawe*	BH
Euphorbia cf. *lancifolia* Schltdl.	*Holst* 5649	UC
Hyeronima alchorneoides Allemão	*Holst* 4204	UC
Hyeronima oblonga (Tul.) Muell. Arg.	*Shawe*	BH
Jatropha curcas	*Shawe*	BH
Pera barbellata Standl.	*Shawe*	BH
Sapium sp.	*Holst* 5686	C1
Sebastiana confusa	*Shawe*	BH
Sebastiana cuspidata	*Shawe*	BH
Sebastiania tuerckheimiana (Pax & K.Hoffm.) Lundell	*Holst* 4056	UC
Tragia mexicana Muell. Arg.	*Hawkins* 1344	C1

FABACEAE

Acosmium panamense (Benth.) Yakovlev	*Shawe*	BH
Andira inermis (W. Wright) DC	*Shawe*	BH
Centrosema plumieri (Turpin ex Pers.) Benth.	*Holst* 6015	UC
Dalbergia cubilquitzensis (Donn. Sm.) Pittier	*Holst* 4148	UC
Dalbergia stevensonii	*Shawe*	BH
Desmodium intortum (Mill.) Urban	*Holst* 4398	UC
Erythrina berteroana	*Shawe*	BH
Erythrina folkersii Krukoff & Mold.	*Holst* 4080, 4450	UC, GC
Erythrina standleyana	*Shawe*	BH
Gliricidia sepium	*Shawe*	BH
Lonchocarpus castilloi	*Shawe*	BH
Machaerium cf. riparium Brandegee	*Holst* 4250	UC
Mucuna argyrophylla Standl.	*Holst* 4471	GC
Ormosia folkersi ?	*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) Standl.	*Shawe*	BH
Tephrosia sp.	*Holst* 4451	GC
Vatairea lundellii (Standl.) Killip ex Record	*Holst* 4504, *Shawe*	GC, BH

FAGACEAE

Quercus cortesii Liebm.	*Holst* 4307	SU
Quercus insignis M. Martens. & Gal.	*Hawkins* 1413	C2
Quercus sp. (hybrid?)	*Hawkins* 1520	SU

FLACOURTIACEAE

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

Casearia commersoniana Cambess.	*Holst* 5805	C2
Casearia corymbosa	*Shawe*	BH
Casearia sylvestris Sw.	*Hawkins* 1377; *Holst* 5962	C1, UC
Casearia tremula (Griseb.) Griseb. ex C. Wright	*Holst* 4092, 4214, 4218	UC
Hasseltia floribunda	*Shawe*	BH
Laetia procera	*Shawe*	BH
Laetia thamnia L.	*Holst* 4111, 4259, *Shawe*	UC, BH
Macrohasseltia macroterantha (Standl. & L.O. Wms.) L.O. Wms.	*Holst* 5840	SL
Pleuranthodendron lindenii (Turcz.) Sleumer	*Holst* 4466, *Shawe*	GC, BH
Xylosma characanthum Standl.	*Holst* 4353	UC
Xylosma oligandrum Donn. Sm.	*Hawkins* 1380	C1
Zuleania guidonia	*Shawe*	BH
GENTIANACEAE		
Voyria parasitica (Schltdl. & Cham.) Ruyters & Maas	*Hawkins* 1458; *Holst* 4010	C3, UC
Voyria tenella Hook.	*Hawkins* 1456; *Holst* 5741	C3, SL
Voyria truncata (Standl.) Standl. & Steyerm.	*Hawkins* 1416	C2
GESNERIACEAE		
Besleria laxiflora Benth.	*Holst* 5896	SL
Columnea purpurata J. Hanst.	*Holst* 5929	SL
Columnea sulfurea Donn. Sm.	*Hawkins* 1379; *Holst* 4068, 5669, 5788	C1, SL, UC
HELICONIACEAE		
Heliconia aurantiaca Ghiesbr. ex Lem.	*Hawkins* 1346; *Holst* 3884, *Shawe, Meerman*	C1, UC, BH
Heliconia bourgaeana O.G. Peters. (syn. H. champneiana)	Observed: American Camp, *Shawe, Meerman*	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, Meerman*	BH
Heliconia wagneriana O.G. Peters	*Meerman*	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
Sisyrinchium tinctorium Kunth	*Holst* 5951	UC

LACISTEMATACEAE		
Lacistema aggregatum (P.J. Bergius) Rusby	*Hawkins* 1511; *Holst* 4020, 5736, 5812, *Shawe*	C2, SL, SU, UC, BH
LAMIACEAE		
Hyptis capitata Jacq.	*Holst* 6012	UC
Salvia miniata Fernald	*Holst* 4022, 5895	C1, UC
Scutellaria longifolia Benth.	*Hawkins* 1504, 1528; *Holst* 4301	SU
Scutellaria orichalcea Donn. Sm.	*Holst* 4016, 5654, 5785, *Shawe*	SL, UC, BH
LAURACEAE		
Beilschmiedia hondurensis Kosterm.	*Holst* 4435	GC
Licaria capitata	*Shawe*	BH
Licaria peckii (I.M. Johnst.) Kosterm.	*Holst* 4128, *Shawe*	UC, BH
Nectandra coriaceae	*Shawe*	BH
Nectandra cuspidata Nees & Mart.	*Hawkins* 1557; *Holst* 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; *Holst* 4043, 4342	C1, C2, UC
Strychnos brachistantha Standl.	*Holst* 4211, 4328	UC
Strychnos panamensis	*Shawe*	BH
Strychnos panurensis Sprague & Sandwith	*Holst* 4272	SU
Strychnos peckii B.L. Rob.	*Holst* 5739	SL
LORANTHACEAE		
Oryctanthus cordifolius (Presl) Urban	*Holst* 6000	UC
Phoradendron crassifolium (Pohl ex DC.) Eichler	*Holst* 4205	UC
Phoradendron chrysocladon A. Gray	*Holst* 5856	SU
LYTHRACEAE		
Cuphea appendiculata Benth.	*Holst* 6005	UC
Cuphea hyssopifolia H.B.K.	*Holst* 3877, 5954	UC

MAGNOLIACEAE		
Magnolia yoroconte Dandy	*Hawkins* 1553; *Holst* 4266, 5907	SL, SU
MALPIGHIACEAE		
Bunchosia guatemalensis	*Shawe*	BH
Bunchosia lindeniana A. Juss.	*Holst* 4416, *Shawe*	GC, BH
Tetrapterys sp.	*Holst* 4493	GC
MALVACEAE		
Hampea stipitata	*Shawe*	BH
Malvaviscus arboreus Cav.	*Holst* 6001, *Shawe*	UC, BH
MARANTACEAE		
Calathea crotalifera S. Watson	*Holst* 4472	GC
Calathea micans (Mathieu) Koern.	*Holst* 4372	UC
MARCGRAVIACEAE		
Marcgravia schippii Standl.	*Holst* 4067	UC
Souroubea sp.	*Holst* 4309	SU
MELASTOMATACEAE		
Aciostis rostellata (Naudin) Triana	*Shawe*	BH
Arthrostemma parvifolium Cogn.	*Holst* 5949	UC
Blakea cuneata Standl.	*Holst* 3878, 4183, 5704	C1, SU, UC
Clidemia involucrata DC.	*Hawkins* 1473; *Holst* 4271, 5735	SL, SU
Graffenrieda galeottii (Naudin) L.O. Wms.	*Holst* 5852	SU
Miconia centrodesma Naudin	*Holst* 5766	C2
Miconia desmantha Benth.	*Holst* 6006	UCSL, SU
Miconia dodecandra (Desr.) Cogn.	*Hawkins* 1478; *Holst* 4268, 5737, 5866	SL, SU
Miconia glaberrima (Schltdl.) Naudin	*Hawkins* 1483, 1519	SU
Miconia gracilis Triana	*Holst* 5752, 5768, 5901	C2, SL
Miconia holosericea (L.) DC.	*Holst* 5794, *Shawe*	SL, BH
Miconia hondurensis	*Shawe*	BH
Miconia impetiolaris (Sw.) D. Don var. *impetiolaris*	*Holst* 4001, 4414, *Shawe*	UC, GC, BH
Miconia lacera	*Shawe*	BH
Miconia laevigata	*Shawe*	BH
Miconia mirabilis (Aubl.) L.O. Wms.	*Holst* 4061	UC
Miconia nutans Donn. Sm.	*Hawkins* 1404; *Holst* 5925	C2, SL
Miconia oinocrophylla Donn. Sm.	*Hawkins* 1482; *Holst* 5730	SL, SU
Miconia prasina (Sw.) DC.	*Hawkins* 1471; *Holst* 5798	SL, SU
Miconia tomentosa	*Shawe*	BH
Mouriri exilis Gleason	*Holst* 4290, *Shawe*	SU, BH
Ossaea micrantha (Sw.) Macfad. ex Cogn.	*Hawkins* 1391; *Holst* 4447	C1, GC

MELIACEAE		
Carapa guianensis	*Shawe*	BH
Dedrela odorata	*Shawe*	BH
Guarea glabra Vahl	*Holst* 4425	GC
Guarea grandifolia DC.	*Holst* 4169, 5837	SL, UC
Swietenia macrophylla King	*Holst* 4192, *Shawe*	UC, BH
Trichilia erythrocarpa Lundell	*Holst* 4052, 4248	UC
Trichilia moschata subsp. moschata	*Shawe*	BH
Trichilia pallida Sw.	*Holst* 4432	GC
MENISPERMACEAE		
Abuta panamensis (Standl.) Krukoff & Barneby	*Holst* 4286	SU
Cissampelos sp.	*Holst* 4355	UC
Disciphania calocarpa Standl.	*Holst* 4150, 4164	UC
MIMOSACEAE		
Acacia collinsi Saff.	*Shawe*	BH
Calliandra belizensis	*Shawe*	BH
Calliandra houstoniana (Mill.) Standl.	*Holst* 5711	C1
Cojoba arborea (L.) Britton & Rose	*Holst* 4055, *Shawe*	SU, UC, BH
Cojoba donnell-smithii Britton & Rose	*Holst* 4231	UC
Inga acrocephala Steud.	*Holst* 5958	UC
Inga affinis	*Shawe*	BH
Inga cocleensis Pittier	*Holst* 4215	UC
Inga davidsei M. Sousa	*Holst* 4304	SU
Inga multijuga Benth.	*Holst* 4383	UC
Inga thibaudiana DC.	*Holst* 5824	SL
Lysiloma acapulcense	*Shawe*	BH
Lysiloma latisiliquum	*Shawe*	BH
MONIMIACEAE		
Mollinedia guatemalensis Perkins	*Holst* 5927, *Shawe*	SL, BH
Siparuna thecaphora (Poepp. & Endl.) A. DC.	*Hawkins* 1537; *Holst* 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 (Aubl.) Huber	*Holst* 5781	SL
Castilia elastica subsp. elastica	*Shawe*	BH
Dorstenia contrajerva L.	*Holst* 4481	GC
Dorstenia lindeniana Bureau	*Holst* 3891, 5625	UC
Ficus apollinaris Dugand	*Holst* 4190	UC
Ficus colubrinae Standl.	*Hawkins* 1365A; *Holst* 5936	C1

Ficus crassiuscula Warb. ex Standl.	*Holst* 4063	UC
Ficus guajavoides Lundell	*Holst* 4173	UC
Ficus popenoei	*Shawe*	BH
Poulsenia armata (Miq.) Standl.	*Shawe*	BH
Pseudolmedia glabrata (Liebm.) C.C. Berg	*Holst* 4172, 5786	SL, UC
Pseudolmedia spuria (Sw.) Griseb.	*Holst* 4260, *Shawe*	UC, BH
Trophis mexicana (Liebm.) Bureau	*Hawkins* 1327, 1390; *Holst* 3886, 4124, 5680, 5706, 5966	C1, UC
Trophis racemosa	*Shawe*	BH

MYRISTICACEAE		
Compsoneura sprucei (A. DC.) Warb.	*Holst* 4424	GC
Virola koschnyi Warb.	*Holst* 5809, *Shawe*	C2, BH

MYRSINACEAE		
Ardisia compressa H.B.K.	*Holst* 4084, 5644	UC
Ardisia guianensis (Aubl.) Mez	*Holst* 4015	UC
Ardisia nigrescens Oerst.	*Holst* 4240	UC
Ardisia nigropunctata Oerst.	*Holst* 4393	UC
Ardisia paschalis Donn. Sm.	*Holst* 4107, *Shawe*	UC, BH
Ardisia schippii	*Shawe*	BH
Gentlea micranthera (Donn. Sm.) Lundell	*Holst* 5863	SU
Gentlea venosissima (Ruiz & Pavon) Lundell	*Holst* 5795	SL
Parathesis sessilifolia Donn. Sm.	*Hawkins* 1331, 1332; *Holst* 4096, 4358, 5946	C1, UC

MYRTACEAE		
Calyptranthes cf. chytraculia (L.) Sw.	*Holst* 4160, 4348	UC
Calyptranthes cuneifolia Lundell	*Holst* 5796	SL
Calyptranthes megistophylla Standl.	*Holst* 4157, 4227, 5696, *Shawe*	C1, UC, BH
Chamguava gentlei	*Shawe*	BH
Chamguava schippii	*Shawe*	BH
Eugenia capuli	*Shawe*	BH
Eugenia coloradensis	*Shawe*	BH
Eugenia farameoides	*Shawe*	BH
Eugenia origanoides O. Berg	*Holst* 5952	UC
Eugenia sp.	*Holst* 5885	C1
Myrcia splendens (Sw.) DC.	*Holst* 4291, *Shawe*	SU, BH
Myrciaria cf. *floribunda* (West ex Willd.) O. Berg	*Holst* 3895, 4247	UC
Pimenta dioica (L.) Merr.	*Holst* 4113, *Shawe*	UC, BH
Psidium sartorianum	*Shawe*	BH

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

OCHNACEAE		
Ouratea lucens	*Shawe*	BH
Ouratea sp.	*Holst* 5774	SL
OLACACEAE		
Heisteria media S.F. Blake	*Holst* 4486, *Shawe*	GC, BH
OLEACEAE		
Chionanthus oblanceolatus (B.L. Rob.) P.S. Green	*Hawkins* 1441; *Holst* 4120, 4411, 5676, 5678; *Shawe*	C1, C3, UC, GC, BH
ORCHIDACEAE		
Beloglottis sp.	*Holst* 4369	UC
Coelia bella (Lem.) Rchb.f.	*Holst* 4129	UC
Cranichis sylvatica A. Rich. & Galeotti	*Holst* 5671	C1
Cyclopogon sp.	*Holst* 5719	C1
Dichaea glauca (Sw.) Lindl.	*Hawkins* 1488	SU
Dichaea panamensis Lindl.	*Holst* 5970, *Meerman*	UC, BH
Elleanthus caricoides Nash	*Hawkins* 1444; *Holst* 5938	C1, C3
Elleanthus graminifolius (Barb. Rodr.) Lojtnant	*Holst* 3896	UC
Encyclia cf. *abbreviata* (Schltr.) Dressler	*Holst* 4163	UC
Encyclia baculus (Rchb.f.) Dressler & G.E. Pollard	*Holst* 5783	SL
Encyclia cochleata (L.) Lemée	*Holst* 5894, *Meerman*	C1, BH
Encyclia polybulbon (Sw.) Dressler	*Holst* 4101	UC
Epidendrum isomerum Schltr.	*Hawkins* 1426	C2
Epidendrum nitens Rchb.f.	*Hawkins* 1522	SU
Epidendrum paranthicum Rchb.f.	*Hawkins* 1485, 1527; *Holst* 5848	SU
Epidendrum phragmites A.H. Heller & L.O. Wms.	*Holst* 5793	SL
Epidendrum rigidum	*Meerman*	BH
Gongora sp.	*Hawkins* 1417	C2
Kegeliella kupperi Mansf.	*Holst* 4019	UC
Lacaena sp. [cf.]	*Holst* 4274	SU
Lockhartia hercodonta Rchb.f. ex Kraenzl.	*Hawkins* 1489	SU
Maxillaria aciantha Rchb.f.	*Holst* 4103; 5990 *(live)*	UC
Maxillaria cf. *elatior* Rchb.f.	*Holst* 4130	UC
Maxillaria cucullata Lindl.	*Hawkins* 1464, 1524; *Holst* 5802	C3, SL, SU
Maxillaria densa Lindl.	*Hawkins* 1434	C3
Maxillaria fulgens (Rchb.f.) L.O. Wms.	*Holst* 5778	SL
Maxillaria uncata Lindl.	*Holst* 4197	UC
Maxillaria variabilis Bateman ex Lindl.	*Holst* 5803	C3
Myoxanthus octomerioides	*Meerman*	BH
Oncidium ascendens	*Meerman*	BH
Oncidium cheirophorum Rchb.f.	*Holst* 5694	C1
Ornithocephalus gladiatus Hook.	*Holst* 4086	UC
Pelexia callifera (C. Schweinf.) Kuntze	*Holst* 4017	UC
Pelexia laxa (Poepp. & Endl.) Lindl.	*Holst* 4476	GC
Pelexia richardiana (Schltr.) Garay	*Holst* 4026	UC

Platythelys cf. querceticola (Lindl.) Garay	*Holst* 5717	C1
Platythelys vaginata (Hook.) Garay	*Holst* 5718	C1
Pleurothallis cardiothallis Rchb.f.	*Hawkins* 1381	C1
Pleurothallis cobanensis Schltr.	*Holst* 5799	SL
Pleurothallis erinacea Rchb.f.	*Hawkins* 1510	SU
Pleurothallis pansamalae Schltr.	*Hawkins* 1493	SU
Polystachya foliosa (Lindl.) Rchb.f. [vel sp. aff.]	*Holst* 4254	UC
Ponera striata Lindl.	*Holst* 4238	UC
Prescottia stachyodes (Sw.) Lindl.	*Holst* 5692	C1
Psygmorchis sp.	*Hawkins* 1339	UC
Scaphyglottis leucantha Rchb.f.	*Hawkins* 1423	C2
Scaphyglottis lindeniana (A. Rich. & Galeotti) L.O. Wms.	*Hawkins* 1546; *Holst* 5800	SL, SU
Scaphyglottis longicaulis S. Watson	*Holst* 5994 *(live)*	UC
Scaphyglottis prolifera Cogn.	*Holst* 4139	UC
Trichosalpinx blaisdellii (S. Watson) Luer	*Holst* 4166	UC
Trigonidium egertonianum Bateman ex Lindl.	*Holst* 4181	UC
Vanilla hartii Rolfe	*Hawkins* 1462	C3
Vanilla planifolia Jacks. ex Andrews [vel sp. aff.]	*Holst* 4234	UC

PASSIFLORACEAE

Passiflora ambigua Hemsl.	Observed San Jose to American Camp, *Meerman*	BH
Passiflora biflora Lam.	Observed Union Camp, *Meerman*	UC, BH
Passiflora guatemalensis S. Watson	*Holst* 4138, *Meerman*	UC, BH
Passiflora helleri Peyr.	*Holst* 5690, *Meerman*	C1, BH
Passiflora lancetillensis (Sp. Nov. Ined. J.M. MacDougal)	*Holst* 4144	UC
Passiflora obovata Killip	*Holst* 4194, 4455, 5691	C1, UC, GC
Passiflora oerstedii var. choconiana (S. Watson) Killip	*Holst* 4345	UC
Passiflora pittieri Masters	Observed American Camp to Union 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 claytonioides Kunth	*Hawkins* 1424; *Holst* 5959	C2, UC
Peperomia deppeana Schltdl. & Cham.	*Holst* 4415	GC
Peperomia distachya (L.) A. Dietr.	*Hawkins* 1374; *Holst* 5878	C1
Peperomia emarginella (Sw. ex Wikstr.) C. DC.	*Holst* 4066	UC
Peperomia hirta C. DC.	*Holst* 5808	C2
Peperomia maculosa (L.) Hook.	*Holst* 5627	UC
Peperomia matlalucaensis C. DC.	*Holst* 4426, 5620	GC, UC
Peperomia obtusifolia (L.) A. Dietr.	*Hawkins* 1335, 1367	C1, UC
Peperomia petrophila C. DC.	*Hawkins* 1412; *Holst* 5701	C1, C2
Peperomia urocarpa Fisch. & C.A. Mey.	*Hawkins* 1447; *Holst* 5674, 5880	C1, C3

Peperomia spp. (ca. 5 additional species)		
Piper aequale Vahl	*Holst* 4294	SU
Piper arboreum Aubl.	*Holst* 5903	SL
Piper glabrescens (Miq.) C. DC.	*Holst* 4361	UC
Piper pseudofuligineum C. DC.	*Holst* 6007	UC
Piper sanctum Schltdl. ex Miq.	*Hawkins* 1442	C3
Piper spp. (ca. 5 additional species)		
POACEAE		
Ichnanthus pallens (Sw.) Munro ex Benth.	*Hawkins* 1432; *Holst* 5916	C3, SL
Isachne pubescens Swallen	*Hawkins* 1467	SU
Lasiacis sorghoidea (Desv.) Hitchc. & Chase	*Hawkins* 1334	UC
Olyra glaberrima Raddi	*Holst* 3892	UC
Olyra latifolia L.	*Hawkins* 1409; *Holst* 4155, 5908, 5955	C2, SL, UC
Oplismenus burmannii (Retz.) P. Beauv.	*Holst* 4351	UC
Oplismenus hirtellus (L.) P. Beauv. subsp. hirtellus	*Hawkins* 1356	C1
PODOCAPACEAE		
Podocarpus guatemalensis var. pinetorum Buchh. & n.E.Gray	*Shawe*	BH
POLYGONACEAE		
Coccoloba acapulcensis Standl.	*Holst* 4239, *Shawe*	UC, BH
Coccoloba belizensis Standl.	*Holst* 4156, *Shawe*	UC, BH
Coccoloba diversifolia Jacq.	*Hawkins* 1455	C3
Coccoloba tuerckheimii Donn. Sm.	*Holst* 4228, *Shawe*	UC, 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 Kunth	*Shawe*	BH
Chiococca alba (L.) Hitchc.	*Holst* 4249	UC
Coccocypselum herbaceum P. Browne	*Hawkins* 1503	SU
Coccocypselum hirsutum Bartl. ex DC.	*Holst* 5855	SU
Coussarea mediocris Standl. & Steyerm.	*Holst* 5749	C1

Diodia sarmentosa Sw.	*Holst* 6016	UC
Faramea occidentalis (L.) A. Rich.	*Holst* 4419, *Shawe*	GC, BH
Guettarda combsii	*Shawe*	BH
Guettarda elliptica	*Shawe*	BH
Guettarda macrosperma Donn. Sm.	*Holst* 5807	C2
Hamelia calycosa Donn. Sm.	*Holst* 4413	GC
Hamelia patens Jacq.	*Hawkins* 1548, *Shawe*	SU, BH
Hillia panamensis Standl.	*Holst* 4292, 5841	SL, SU
Hoffmannia discolor (Lem.) Hemsl.	*Holst* 4399, 4448	UC, GC
Morinda panamensis Seem.	*Shawe*	BH
Hoffmannia ghiesbreghtii (Lem.) Hemsl.	*Holst* 4322, 4461, 5622	UC, GC
Palicourea guianensis	*Shawe*	BH
Palicourea padifolia (Willd. ex Roem. & Schult.) C.M. Taylor & Lorence	*Hawkins* 1554; *Holst* 4031, 4346	UC
Psychotria acuminata Benth.	*Hawkins* 1352; *Holst* 5933, *Shawe*	C1, BH
Psychotria capitata	*Shawe*	BH
Psychotria chiapensis Standl.	*Holst* 4433	GC
Psychotria costivenia Griseb.	*Holst 3*867, 4261, *Shawe*	UC, BH
Psychotria deflexa DC.	*Hawkins* 1328, 1437; *Holst* 4074, 5731	C3, SL, UC
Psychotria elata (Sw.) Hammel	*Hawkins* 1469; *Holst* 4295, 4296, 5733, 5839, *Shawe*	SL, SU, BH
Psychotria epiphytica K. Krause	*Hawkins* 1431	C3
Psychotria guadalupensis (DC.) R.A. Howard	*Hawkins* 1494	SU
Psychotria nervosa	*Shawe*	BH
Psychotria officinalis (Aubl.) Raeusch. ex Sandwith	*Hawkins* 1454	C3
Psychotria orchidearum Standl.	*Holst* 5777	SL
Psychotria panamensis Standl.	*Hawkins* 1440; *Holst* 4302	C3, SU
Psychotria pleuropoda Donn. Sm.	*Holst* 4404	GC
Psychotria poeppigiana Muell. Arg.	*Hawkins* 1518; *Holst* 4011, 4284, 5665, *Shawe*	C1, SU, UC, BH
Psychotria quinqueradiata	*Shawe*	BH
Psychotria simiarum Standl.	*Holst 4*021, 4176, 4405, *Shawe*	UC, GC, BH
Psychotria tenuifolia Sw.	*Holst* 4081, 4452	UC, GC
Psychotria trichotoma	*Shawe*	BH
Psychotria uliginosa Sw.	*Hawkins* 1547; *Holst* 5864	SU
Randia cf. *gentlei* Lundell	*Holst* 4133	UC
Randia matudae Lorence & Dwyer	*Hawkins* 1533; *Holst* 4281, 5867	SU
Rehdera penninervia	*Shawe*	BH
Rudgea cornifolia (Kunth) Standl.	*Holst* 4479	GC
Sabicea panamensis Wernham	*Hawkins* 1543	SU
Simira salvadorensis	*Shawe*	BH

RUTACEAE

Zanthoxylum juniperinum Poepp.	*Holst* 4123	UC
Zanthoxylum riedelianum	*Shawe*	BH

SAPINDACEAE

Allophyllus cf. *psilospermus* Radlk.	*Holst* 4119	UC
Allophyllus campsachys	*Shawe*	BH

Cupania belizensis	*Shawe*	BH
Cupania macrophylla A. Rich.	*Holst* 4488	GC
Cupania rufescens Triana & Planch.	*Holst* 4208	UC
Cupania spectabilis	*Shawe*	BH
Matayba apetala (Macfad.) Radlk.	*Holst* 4257, *Shawe*	UC, BH
Paullinia costata Schltdl. & Cham.	*Holst* 4193	UC
Paullinia fibrigera Radlk.	*Holst* 4158	UC
Paullinia glomerulosa Radlk.	*Holst* 4109	UC
Sapindus saponaria L.	*Shawe*	BH
SAPOTACEAE		
Chrysophyllum mexicanum Brandegee ex Standl.	*Holst* 4390, Shawe	UC, BH
Manilkara chicle	*Shawe*	BH
Manilkara zapota (L.) P. Royen	*Holst* 4082, *Shawe*	SU, UC, BH
Pouteria amygdalina	*Shawe*	BH
Pouteria campechiana	*Shawe*	BH
Pouteria durlandii (Standl.) Baehni	*Holst* 4008	UC
Pouteria izabalensis (Standl.) Baehni	*Holst* 4088	UC
Pouteria reticulata (Engl.) Eyma subsp. *reticulata*	*Holst* 4246, *Shawe*	UC, BH
Pouteria sapota	*Shawe*	BH
Pouteria torta	*Shawe*	BH
Sideroxylon floribundum subsp. *belizense* (Lundell) Penn.	*Shawe*	BH
Sideroxylon foetidissimum Grieseb.	*Shawe*	BH
Sideroxylon stevensonii (Standl.) Penn.	*Shawe*	BH
SIMAROUBACEAE		
Picramnia antidesma subsp. *antidesma* W. Thomas	*Shawe*	BH
Simarouba glauca DC.	*Holst* 4147, Shawe	SU, UC, BH
SMILACACEAE		
Smilax luculenta Killip & C.V. Morton	*Holst* 4127	UC
SOLANACEAE		
Cestrum nocturnum L.	*Holst* 4222, 4436	UC, GC
Cestrum racemosum	*Shawe*	BH
Lycianthes hypoleuca Standl.	*Holst* 4125	UC
Lycianthes nitida Bitter	*Holst* 4386, 5923	SL, UC
Lycianthes purpusii (Brandegee) Bitter	*Holst* 4389	UC
Solanum bicolor	*Shawe*	BH
Solanum erythrotrichum	*Shawe*	BH
Solanum lepidotum Dunal	*Holst* 5900	SL
Witheringia solanacea L'Hér.	*Holst* 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	*Holst* 4255	UC
Ternstroemia tepezapote Schltdl. & Cham.	*Holst* 4306	SU
THEOPHRASTACEAE		
Deherainia smaragdina subsp. *smaragdina*	*Shawe*	BH
TILIACEAE		
Heliocarpus americanus L.	*Holst* 5709, 5953, *Shawe*	C1, UC, BH
Luehea speciosa Willd.	Shawe	BH
Muntingia calabura L.	Shawe	BH
Trichospermum grewiifolium (A. Rich.)	*Holst* 5915, Shawe Kosterm.	SL, BH
TURNERACEAE		
Erblichia odorata Seem.	*Holst* 4145	UC, GC
ULMACEAE		
Ampelocera hottlei (Standl.) Standl.	*Shawe*	BH
URTICACEAE		
Boehmeria ramiflora Jacq.	*Holst* 4018	UC
*Myriocarpa longipe*s Liebm.	*Hawkins* 1332; *Holst* 4463	GC
Myriocarpa obovata Donn. Sm.	*Holst* 4108, 4238A	UC
Phenax mexicanus Weddell	*Holst* 5721	C1
Pilea ecbolophylla Donn. Sm.	*Holst* 4106	UC
Urera baccifera	*Shawe*	BH
VERBENACEAE		
Aegiphila martinicensis Jacq.	*Holst* 5664	C1
Aegiphila monstrosa	*Shawe*	BH
Citharexylum caudatum L.	*Holst* 5813	C2
Stachytarpheta cayennensis (Rich.) M. Vahl	*Holst* 4364	UC
Vitex gaumeri	*Shawe*	BH

VIOLACEAE		
Orthion malpighiifolium (Standl.) Standl. & Steyerm.	*Holst* 4423	GC
Rinorea guatemalensis (S. Watson) Bartlett	*Holst* 4006, 4065, *Shawe*	UC, BH
Rinorea hummelii Sprague	*Holst* 4412, *Shawe*	GC, BH

VITACEAE		
Cissus biformifolia Standl.	*Holst* 4110	UC
Vitis tiliifolia Humb. & Bonpl. ex Roem. & Schult.	*Holst* 4191	UC

VOCHYSIACEAE		
Vochysia hondurensis	*Shawe*	BH

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

PTERIDOPHYTES		
Adiantum capillus-veneris L.	*Holst* 4014, 5636	UC
Adiantum macrophyllum Sw.	*Holst* 4226, 4377	UC
Adiantum pulverulentum L.	*Holst* 4503	GC
Adiantum tenerum Sw.	*Holst* 4142	UC
Adiantum tetraphyllum Humb. & Bonpl. ex Willd.	*Holst* 4360, 5881	C1, UC
Adiantum trichochlaenum Mickel & Beitel	*Holst* 5873	C1
Alsophila firma (Baker) D.S. Conant	*Hawkins* 1363	C1
Alsophila salvinii Hook.	*Holst* 5854	SU
Anemia adiantifolia (L.) Sw.	*Hawkins* 1393	C1
Anetium citrifolium (L.) Splitg.	*Holst* 5940	C1
Antrophyum ensiforme Hook.	*Holst* 4143, 5941	C1, UC
Asplenium auritum Sw.	*Hawkins* 1368; *Holst* 5883	C1
Asplenium cirrhatum Rich. ex Willd.	*Holst* 5755	C2
Asplenium crassifolium (L.) Lellinger	*Holst* 3889	UC
Asplenium cristatum Brack.	*Holst* 4397, 4480	UC, GC
Asplenium juglandifolium Lam.	*Hawkins* 1446, 1452; *Holst* 4027, 4289	C3, SU, UC
Asplenium monodon Liebm.	*Holst* 4038, 4224	UC
Asplenium pseudoerectum Hieron.	*Holst* 5821, 5918	SL
Blechnum gracile Kaulf.	*Holst* 4316	UC
Blechnum occidentale L.	*Holst* 6009	UC
Bolbitis hastata (E. Fourn.) Hennipman	*Holst* 5757	C2
Bolbitis hemiotis (Maxon) Ching?	*Holst* 5759	C2
Bolbitis pergamentacea (Maxon) Ching	*Holst* 4464	GC
Campyloneurum angustifolium (Sw.) Fée	*Hawkins* 1348	C1
Campyloneurum costatum (Kunze) C. Presl	*Holst* 4359	UC
Campyloneurum repens (Aubl.) C. Presl	*Holst* 4385	UC
Cochlidium linearifolium (Desv.) Maxon ex C. Chr.	*Hawkins* 1561; *Holst* 5693	C1

Cochlidium serrulatum (Sw.) L.E. Bishop	*Hawkins* 1401, 1517	C2, SU
Ctenitis excelsa (Desv.) Proctor	*Hawkins* 1438	C3
Ctenitis interjecta (C. Chr.) Ching	*Holst* 4502	GC
Ctenitis melanosticta (Kunze) Copel.	*Holst* 4368	UC
Ctenitis salvinii (Baker) Stolze	*Hawkins* 1378, 1402; *Holst* 3890	C1, C2, UC
Cyathea divergens var. tuerckheimii (Maxon) R.M. Tryon	*Hawkins* 1507, 1513	SU
Cyathea multiflora Sm.	*Hawkins* 1457, 1502; *Holst* 3883, 4217, 5782	C3, SL, SU, UC
Cyathea myosuroides (Liebm.) Domin	*Hawkins* 1499; *Holst* 4285	SU
Cyathea schiedeana (C. Presl) Domin	*Holst* 5911	SL
Danaea elliptica Sm.	*Hawkins* 1539; *Holst* 4305, 5845	SL, SU
Dennstaedtia bipinnata (Cav.) Maxon	*Holst* 4474	GC
Didymochlaena truncatula (Sw.) J. Sm.	*Hawkins* 1355; *Holst* 4394, 5945	C1, UC
Diplazium plantaginifolium (L.) Urban	*Hawkins* 1375; *Holst* 5758	C1, C2
Diplazium riedelianum (Bong. ex Kuhn) Kuhn ex C. Chr.	*Holst* 4317	UC
Diplazium striatastrum Lellinger	*Holst* 4473	GC
Diplazium verapax (Donn. Sm.) Hieron.	*Holst* 5712	C1
Diplazium werckleanum H. Christ	*Holst* 4317A, 4323, 5877	C1, UC
Elaphoglossum decursivum Mickel	*Holst* 5924	SL
Elaphoglossum glaucum T. Moore	*Holst* 3869	UC
Elaphoglossum guatemalense (Klotzsch) T. Moore	*Hawkins* 1366	C1
Elaphoglossum herminieri (Bory ex Fée) T. Moore	*Holst* 3870, 4402	UC, GC
Elaphoglossum latifolium (Sw.) J. Sm.	*Holst* 5672	C1
Elaphoglossum latum (Mickel) Atehortúa ex Mickel	*Holst* 3875, 5862	SU, UC
Elaphoglossum peltatum (Sw.) Urban	*Holst* 3894, 5700	C1, UC
Elaphoglossum piloselloides (C. Presl) T. Moore	*Holst* 5670	C1
Huperzia dichaeoides (Maxon) Holub	*Hawkins* 1529	SU
Huperzia linifolia (L.) Trevis.	*Hawkins* 1487	SU
Huperzia pithyoides (Schltdl. & Cham.) Holub	*Holst* 4381	UC
Hymenophyllum polyanthos (Sw.) Sw.	*Holst* 5762	C2
Hymenophyllum pulchellum Schltdl. & Cham.	*Holst* 4041	UC
Hymenophyllum sieberi (C. Presl) Bosch	*Holst* 5974	UC
Lellingeria mitchellae (Baker ex Hemsl.) A.R. Sm. & R.C. Moran	*Hawkins* 1398	C1
Lindsaea klotzschiana Moritz	*Hawkins* 1476; *Holst* 4265, 5728, 5870	SL, SU
Lindsaea lancea (L.) Bedd.	*Hawkins* 1474; *Holst* 4283, 5675, 5909	C1SL, SU
Lomariopsis recurvata Fée	*Holst* 4417	GC
Lomariopsis vestita E. Fourn.	*Holst* 4171	UC
Lophosoria quadripinnata (J.F. Gmel.) C. Chr. var. *quadripinnata*	*Hawkins* 1540	SU
Lycopodiella cernua (L.) Pic. Serm.	*Hawkins* 1472	SU
Lygodium heterodoxum Kunze	*Holst* 4153, 5942	C1, UC
Megalastrum lunense (H. Christ) A.R. Sm. & R.C. Moran	*Holst* 5820	SL
Microgramma lycopodioides (L.) Copel.	*Hawkins* 1419	C2
Microgramma percussa (Cav.) de la Sota	*Hawkins* 1370; *Holst* 4000, 4141, 4403, 5886, 6004	C1, UC, GC
Micropolypodium taenifolium (Jenman) A.R. Sm.	*Hawkins* 1526	SU
Nephrolepis multiflora (Roxb.) F.M. Jarrett ex C.V. Morton	*Hawkins* 1559	UC
Nephrolepis rivularis (Vahl) Mett. ex Krug	*Hawkins* 1425	C2
Niphidium crassifolium (L.) Lellinger	*Holst* 4354, 5917	SL, UC

Oleandra articulata (Sw.) C. Presl	*Hawkins* 1542	SU
Olfersia cervina (L.) Kunze	*Holst* 5930	SL
Ophioglossum palmatum L.	*Holst* 5935	C1
Pecluma divaricata (E. Fourn.) Mickel & Beitel	*Hawkins* 1496; *Holst* 4460	SU, GC
Pleopeltis astrolepis (Liebm.) E. Fourn.	*Holst* 5792	SL
Polybotrya osmundacea Humb. & Bonpl. ex Willd.	*Hols*t 4048, 4049	UC
Polybotrya polybotryoides (Baker) H. Christ	*Hawkins* 1406; *Holst* 4047	C2, UC
Polypodium dissimile L.	*Hawkins* 1490; *Holst* 4034	UC, SU
Polypodium fallax Schltdl. & Cham.	*Hawkins* 1461; *Holst* 5763	C2, C3
Polypodium fraxinifolium Jacq.	*Hawkins* 1429	C3
Psilotum nudum (L.) P. Beauv.?	*Holst* 5772	C2
Pteridium caudatum (L.) Maxon	*Holst* 6018	UC
Pteris altissima Poir.	*Hawkins* 1353, 1551; *Holst* 4395	C1, UC
Pteris pungens Willd.	*Holst* 3864	UC
Pteris quadriaurita Retz [s.l.]	*Holst* 3900	GC
Radiovittaria stipitata E.H. Crane	*Holst* 5943	C1
Salpichlaena volubilis (Kaulf.) J. Sm.	*Holst* 4287	SU
Schizaea sp.	*Holst* 5673	C1
Selaginella guatemalensis Baker	*Holst* 4030, 4311, 5703, *Shawe*	C1, UC, BH
Selaginella huehuetenangensis Hieron.	*Holst 5948*	C1
Selaginella pallescens (C. Presl) Spring	*Holst* 3881	UC
Selaginella sertata Spring	*Holst* 4029, 4341, 5707, 5961	C1, UC
Sphaeropteris horrida (Liebm.) R.M. Tryon	*Hawkins* 1383, 1430; *Holst* 4213	C1, C3, UC
Sticherus palmatus (J.H. Schaffn. ex Underw.) Copel.	*Holst* 4270, 5797, 5906	SL, SU
Stigmatopteris sordida (Maxon) C. Chr.	*Holst* 5897	SL
Tectaria heracleifolia (Willd.) Underw.	*Hawkins* 1451; *Holst* 3880, 4318, 5702	C1, C3, UC
Tectaria incisa Cav.	*Holst* 4478	GC
Tectaria mexicana (Fée) C.V. Morton	*Holst* 4475	GC
Terpsichore asplenifolia (L.) A.R. Sm.	*Hawkins* 1508; *Holst* 5764	C2, SU
Terpsichore mollissima (Fée) A.R. Sm.	*Holst* 4040	UC
Thelypteris blanda (Fée) C.F. Reed	*Hawkins* 1357; *Holst* 4312, 4477, 5882	C1, UC
Thelypteris decussata (L.) Proctor var. costaricensis A.R. Sm.	*Holst* 5819, 5919	SL
Thelypteris falcata (Liebm.) R.M. Tryon	*Holst* 5791	SL
Thelypteris ghiesbreghtii (Hook.) C.V. Morton	*Holst* 4320	UC
Thelypteris kunthii (Desv.) C.V. Morton	*Holst* 6020	
Thelypteris leprieurii var. *subcostalis* A.R. Sm.	*Hawkins* 1536	SU
Thelypteris nicaraguensis (E. Fourn.) C.V. Morton	*Holst* 4324	UC
Thelypteris obliterata (Sw.) Proctor	*Holst* 6008	UC
Thelypteris patens var. *patens* (Sw.)	*Holst* 5976	UC
Thelypteris paucipinnata (Donn. Sm.) C.F. Reed	*Holst* 4343, 5887	C1, UC
Thelypteris sancta (L.) Ching	*Holst* 5968	UC
Thelypteris sp. nov.	*Holst* 5756	C2
Thelypteris toganetra A.R. Sm.	*Holst* 4132	UC
Trichomanes capillaceum L.	*Holst* 5829	SL
Trichomanes collariatum Bosch	*Hawkins* 1350; *Holst* 4196, 4313, 5753	C1, C2, UC
Trichomanes crispum L.	*Hawkins* 1475; *Holst* 4023, 5771	C2, SU, UC
Trichomanes diaphanum Kunth	*Holst* 5853, 5912	SL, SU
Trichomanes galeottii E. Fourn.	*Hawkins* 1505	SU
Trichomanes krausii Hook. & Grev.	*Holst* 5716	C1
Trichomanes polypodioides L.	*Hawkins* 1459; *Holst* 5668,5921	C1, C3, SL

Trichomanes punctatum subsp. *sphenoides* (Kunze) Wess. Boer	*Holst* 4496	GC
Trichomanes pyxidiferum L.	*Holst* 4310	UC
Trichomanes radicans Sw.	*Holst* 5815, 5816	SL
Trichomanes rigidum Sw.	*Hawkins* 1538; *Holst* 5773	C2, SU
Vittaria graminifolia Kaulf.	*Hawkins* 1325, 1509; *Holst* 3876	UC, SU
Vittaria stipitata Kunze	*Holst* 4070	UC

BRYOPHYTES

MOSSES

Acroporium estrellae (C. Müller) W.R. Buck & Schäfer-Verwinp	*Allen* 18510, 18653, 18656, 18661, 18945	C1, SU, UC
Acroporium longirostre (Bridel) W.R. Buck	*Allen* 18641, 18657, 18779,18992	C1, C2, SU
Acroporium pungens (Hedwig) Brotherus	*Allen* 18864, 18912, 18928, 18932, 18935	C2, SU
*Actinodontium standley*i E.B. Bartram	*Allen* 18760, 19003, 19021, 19024	C2, SU
Aerolindigia capillacea (Hornschuch in Mart.) Menzel	*Allen* 18687	C1
Barbula agraria Hedwig	*Allen* 19092B	UC
Barbula arcuata Griffith	*Allen* 18724, 18797, 18867, 19059	C2, UC
Barbula ehrenbergii (Lorentz) Fleisher	*Allen* 19081	UC
Barbula indica (W.J. Hooker) Sprengel	*Allen* 19092	UC
Brachymenium spirifolium (C. Müller) Jaeger	*Allen* 18761	C2,
Brachymenium wrightii (Sullivant) Brotherus	*Allen* 18515, 18620, 18700, 18884, 18967	C1, C2, SU,
Bryum billarderi Schwägrichen	*Allen* 18560, 19067	C1, UC
Bryum pseudocapillare Bescherelle	*Allen* 18521, 18541, 19049, 19068A	UC
Callicostella depressa (Hedwig) Jaeger	*Allen* 18649, 18739, 18976	C1, C2, SU
Callicostella grossiretis E.B. Bartram	*Allen* 18590, 18715	C1, C2,
Callicostella pallida (Hornschuch) Ångström	*Allen* 19025	SU
Callicostella rivularis (Mitten) Jaeger	*Allen* 18565, 18716, 18865, 18886A	C1, C2
Callicostella vatteri E.B. Bartram	Allen 18865A	C2
Calymperes afzelii Swartz	Allen 18543, 19074	UC
Calymperes lonchophyllum Schwägrichen	Allen 18512, 18525,18528, 18749, 18784, 18961	C2, SU, UC
Calymperes nicaraguense Renauld & Cardot	*Allen* 18771, 18815	C2, SL
Calymperes palisotii Shcwägrichen	*Allen* 19076, 19078, 19069	UC
Campylopus arctocarpus (Hornschuch) Mitten	*Allen* 18799, 18911, 18948, 19023, 19035	C2, SL, SU
Crossomitrium patrisiae (Bridel) C. Müller	*Allen* 18564, 18619, 18665, 18658, 18662, 18676, 18722, 18751, 18954	C1, C2, SU
Cyclodictyon albicans (Hedwig) Kuntze	*Allen* 18553, 18556, 18890	C1, C2, UC
Cyclodictyon erubescens E.B. Bartram	*Allen* 18635, 18650	C1
Cyclodictyon humectatum Cardot	*Allen* 18577, 18719	C1, C2
Cyclodictyon varians (Sullivant) Kuntze	*Allen* 18582	C1
Cyrtohypnum minutulum (Hedwig) W.R. Buck & H. Crum	*Allen* 18629, 18638, 19040	C1, SL
Daltonia longifolia Taylor	*Allen* 18656A, 18958	C1, SU
Daltonia pulvinata Mitten	*Allen* 18660, 18677	C1
Ectropothecium leptochaeton (Schwägrichen) W. R. Buck	*Allen* 18696, 18763	C2
Ephemerum spinulosum Bruch & W.P. Schimper	*Allen* 19082, 19094	UC
Fissidens asplenioides Hedwig	*Allen* 18708	C2
Fissidens curvatus Hornschuch	*Allen* 18875	C2
Fissidens dibius Palisot de Beauvois	*Allen* 18526, 19055	UC
Fissidens dissitifolius Sullivant	*Allen* 18757	C2

Fissidens elegans Bridel	*Allen* 18551, 18555, 18600, 18626, 18627, 18723, 18787, 18804, 18871, 19043	C1, C2, SL, UC
Fissidens flaccidus Mitten	*Allen* 18670, 18707, 18725, 18881, 18886	C1, C2
Fissidens lagenarius Mitten	*Allen* 18621, 18808, 18899, 18975, 18991, 19007, 19012	C1, SL, SU
Fissidens minutus Thwaites & Mitten	*Allen* 19088	UC
Fissidens neglectus H. Crum	*Allen* 18732	C2
Fissidens oblongifolius W.J. Hooker & Wilson	*Allen* 18609, 18610A, 18637	C1
Fissidens pellucidus Hornschuch	*Allen* 18615, 18711, 18747, 18817, 18861, 18906, 19041	C1, C2, SL, SU
Fissidens polypodioides Hedwig	*Allen*18750, 18840	C2, SL
Fissidens radicans Montagne	*Allen* 18694	C2
Fissidens santa-clarensis Thériot	*Allen* 18536	UC
Fissidens serratus C. Müller	*Allen* 18536A, 19077	UC
Fissidens weirii Mitten var. weirii	*Allen* 18572, 18628, 18691, 18923	C1, SU
Fissidens zollingeri Montagne	*Allen* 18557, 18617, 18639, 19090	C1, UC
Groutiella mucronifolia (W.J. Hooer & Greville) H. Crum & Steere	*Allen* 18508, 18666, 18802, 18949	C1, C2, SU, UC
Groutiella tomentosa (Hornschuch) Wijk & Margadant	*Allen*18613, 18803	C1, C2
Groutiella tumidula (Mitten) Vitt	*Allen* 19068, 19093	UC
Hildebrandtiella guyanensis (Montagne) W.R. Buck	*Allen* 18495, 18900	SU, UC
Holomitrium arboreum Mitten	*Allen* 18614, 18677, 18764, 18792; *Holst* 4438, 4444	C1, C2, GC
Homalia glabella (Hedwig) B.S.G.	*Allen* 18573; *Holst* 4338B, 4339	C1, UC
Hookeriopsis cruegeriana (C. Müller) Jaeger	*Allen* 18726	C2
Hookeriopsis cuspidata Jaeger	*Allen* 18545, 18610, 18869, 19054, 19061	C1, C2, UC
Hookeriopsis guatemalensis E.B. Bartram	*Allen* 18504, 18578, 18717A, 18805, 18880, 18891	C1, C2, SL, UC
Hookeriopsis incurva (Hornschuch) Brotherus	*Allen* 18575A, 18596, 18652, 18791	C1, C2
Hookeriopsis subfalcata (Hampe) Jaeger	*Allen* 18781	C2
Hymenostylium recurvirostre (Hedwig) Dixon	*Allen* 18866, 18878	C2
Hyophila involuta (W.J. Hooker) Jaeger	*Allen* 18720, 18727, 18796	C2
Hypopterygium tamariscinum (Hedwig) Bridel	*Allen* 18630	C1
Isodepanium lentulum (Wilson) Britton	*Allen* 18743, 18774, 18903	C2, SU
Isopterygium tenerum (Swartz) Mitten	*Allen* 18618	C1
Lepidopilidium portoricense (C. Müller) H. Crum & Steere	*Allen* 18644, 18773, 18786, 18898, 18930, 18950, 18955, 19014; *Holst* 4335	C1, C2, SU
Lepidopilum brevipes Mitten	*Allen* 18672	C1
Lepidopilum cubense (Sullivant) Mitten	*Allen* 18601	C1
Lepidopilum muelleri (Hampe) Spruce	*Allen* 18675	C1
*Lepidopilum polytrichoides (*Hedwig) Bridel	*Allen* 18570, 18589, 18669	C1
Lepidopilum scabrisetum (Schwägrichen) Steere	*Allen* 18563, 18580, 18659, 18671, 18686, 18701, 18970	C1, C2, SU
Lepidopilum surinamense C. Müller	*Allen* 18712	C2
Lepidopilum tortifolium Mitten	*Allen* 18759, 18896	C2
Leucobryum antillarum W.P. Schimper ex Bescherelle	*Allen* 18625, 18946	C1, SU
Leucobryum martianum (Hornschuch) Hampe ex C. Müller	*Allen* 18800, 18828, 19038, 19045, 19048	C2, SL

Leucobryum polakowskyi (C. Müller ex Bescherelle)	*Allen* 18836, 18938	SL, SU
Leucoloma cruegerianum (C. Müller) Jaeger	*Allen* 18498, 18818, 18851, 18934	SL, SU, UC
Leucoloma mariaei Bescherelle	*Allen* 18980A	SU
Leucoloma serrulatum Bridel	*Allen* 18611, 18744, 18776, 18980	C1, C2, SU
Leucomium strumosum (Hornschuch) Mitten	*Allen* 18532, 18770, 19042	C2, SL, UC
Leucophanes molleri C. Müller	*Allen* 18775	C2
Macromitrium cirrosum (Hedwig) Bridell	*Allen* 18497, 18511, 18518, 18636, 18703, 18767, 18782, 18832, 18838, 18916, 18978, 18987, 19000, 19060	C1, C2, SL, SU, UC
Macromitrium contextum Hampe	*Allen* 19063, 19064; *Holst* 4340	UC
Macromitrium leprieurii Montagne	*Allen* 18704, 18737, 18882, 18985	C2, SU
Macromitrium punctatum (W.J. Hooker & Greville) Bridel	*Allen* 18634, 18766, 18892	C1, C2
Meteoridium remotifolium (C. Müller) Manuel	*Allen* 18681	C1
Meteorium illecebrum Sullivant	*Allen* 18640, 18654, 18697, 18742	C1, C2
Mittenothamnium reptans (Hedwig) Cardot	*Allen* 18509, 18674, 18752, 19019	C2, SU, UC
M*ittenothamnium salleanum* (Bescherelle) Cardot	*Allen* 18756, 19051	C2, UC
Neckeropsis undulata (Hedwig) Reichardt	*Allen* 18889; *Holst* 4440, 4514	C2, UC, GC
Octoblepharum cocuiense Mitten	*Allen* 18844A	SL
Octoblepharum erectifolium Mitten ex R.S. Wms.	*Allen* 18844, 19010	SL, SU
Octoblepharum pulvinatum (Dozy & Molkenboer) Mitten	*Allen* 18493, 18587, 18608, 18673, 18809	C1, SL, UC
Orthostichopsis tetragona (Swartz ex Hedwig) Brotherus	*Allen* 18648, 19052	C1, UC
Oxystegus tenuirostris (W.J. Hooker & Taylor) A.J.E. Smith	*Allen* 18522, 18544, 18872	C2, UC
Papillaria nigrescens (Swartz ex Hedwig) Jaeger	*Allen* 18647, 18754	C1, C2
Philonotis uncinata (Schwägrichen) Bridel	*Allen* 19091	UC
Phyllodon truncatulus (C. Müller) W.R. Buck	*Allen* 18887	C2
Phyllogonium viride Bridel	*Allen* 18762, 18822, 18829, 19011; *Holst* 4336	C2, SL, SU
Pilotrichella flexilis (Hedwig) Angström	*Allen* 18524, 18813, 18831, 18524, 19008, 19009, 19028	SL, SU, UC
Pilotrichella pentasticha (Bridel) Wijk & Margadant	Allen 18531, 18566, 18679, 18746, 18778, 19057; *Holst* 4515	C1, C2, UC
Pilotrichum evanescens (C. Müller) Crosby	*Allen* 18888; Holst 4512B	C2, UC
Pilotrichum fendleri C. Müller	*Allen* 18513, 18579, 18584, 18588, 18623, 18748, 18765, 18794, 19033	C1, C2, SL, UC
Pilotrichum ramosissimum Mitten	*Allen* 18748B	C2
Pireella angustifolia (C. Müller) Arzeni	*Allen* 18517, 18519, 18534, 18607, 18616, 18741, 18821, 18883, 18918, 18929, 18957, 18962, 19005; *Holst* 4337	C1, C2, SL, SU, UC
Porotrichum korthalsianum (Dozy & Molkenboer) Mitten	Allen 18870; Holst 4338	C2, UC
Porotrichum lindigii (Hampe) Mitten	*Allen*18736	C2
Porotrichum substriatum (Hampe) Mitten	*Allen* 18502, 18559, 18567, 18581, 18632, 18682, 18683, 18730, 18745, 18758, 18768, 18793, 18879, 18901	C1, C2, SU, UC
Puiggariopsis aurifolia (Mitten) Menzel	*Allen* 18640A	C1
Pyrrhobryum spiniforme (Hedwig) Mitten	*Allen* 18908	SU
Racopilum tomentosum (Hedwig) Bridel	*Allen* 18550, 18690; *Holst* 4445	C1, UC, GC
Rhynchostegiopsis flexuosa (Sullivant) C. Müller	*Allen* 18527, 18597, 18603, 18605, 18651, 18710, 18986, 19006	C1, C2, SU, UC
Rhynchostegiopsis lutescens Britton ex Broth.	*Allen* 18539	UC

Schlotheimia rugifolia (W.J. Hooker) Schwägrichen	*Allen* 18777	C2
Schlotheimia torquata (Swartz ex Hedwig) Bridel	*Allen* 18733, 18927	C2, SU
Sematophyllum adnatum (Michaux) Britton	*Allen* 19013	SU
Sematophyllum galipense (C. Müller) Mitten	*Allen* 19092A	UC
Sematophyllum subpinnatum (Bridel) Britton	*Allen* 19075, 19085	UC
Sematophyllum subsimplex (Hedwig) Mitten	*Allen* 18801, 18814, 18925, 19034, 19037	C2, SL, SU
Squamidium isocladum (Renauld & Cardot) Brotherus	*Allen* 18731, 18734, 18947, 18973	C2, SU
Squamidium macrocarpum (Spruce ex Mitten) Brotherus	*Allen* 18646, 18689, 18788, 18795, 18885	C1, C2
Squamidium nigricans (W.J. Hooker & Kunth) Brotherus	*Allen* 18705	C2
Syrrhopodon autotomaius W.D. Reese	*Allen* 18785, 18816, 18839, 18933, 18943, 18988	C2, SL, SU
Syrrhopodon circinatus (Bridel) Mitten	*Allen* 18549, 18783	C2, UC
Syrrhopodon gaudichaudii Montagne	*Allen* 18917, 18936, 18977	SU
Syrrhopodon incompletus Schwägrichen var. incompletus	*Allen* 19070	UC
Syrrhopodon incompletus var. *berteroanus* (Bridel) W.D. Reese	*Allen* 18699, 18972	C2, SU
Syrrhopodon parasiticus (Swartz ex Bridel) Paris	*Allen* 18876, 18944	C2, SU
Syrrhopodon prolifer var. *cincinnatus* (Hampe) W.D. Reese	*Allen* 19004	SU
Syrrhopodon prolifer var. *scaber* (Mitten) W.D. Reese	*Allen* 18586, 18798, 18825, 18833, 19031	C1, C2, SL
Taxiphyllum ligulaefolium (E.B. Bartram) W.R. Buck	*Allen* 18552	UC
Taxiphyllum taxirameum (Mitten) Fleischer	*Allen* 18678	C1
Taxithelium planum (Bridel) Mitten	*Allen* 19072	UC
Thamnobryum tumidicaule (K.A. Wagner) f. D. Bowers	*Allen* 18685	C1
Thuidium delicatulum (Hedwig) W.P. Schimper	*Allen* 18571	C1
Thuidium tomentosum W.P. Schimper	*Allen* 18501	UC
Tortella richardsii E.B. Bartram	*Allen* 18496, 18505, 19066	UC
Tortella tortuosa (Hedwig) Limpricht	*Allen* 18868	C2
Trichosteleum bernoullianum (C. Müller) Brotherus	*Allen* 19003B	SU
Trichosteleum fluviale (Mitten) Jaeger	*Allen* 18735	C2
Trichosteleum sentosum (Sullivant) Jaeger	*Allen* 18695, 18739A	C2
Vescicularia vesicularis (Schwägrichen) Brotherus	*Allen* 18548, 18592, 18688, 19084	C1, UC
Vesicularia vesicularis var. *portoricensis* (Bridel) W.R. Buck	*Allen* 18514	UC
Weissia controversa Hedwig	*Allen* 18655	C1
Zelometeorium patulum (Hedwig) Manuel	*Allen* 18561, 18606, 18631, 18674A, 18772, 19046	C1, C2, SL

HEPATICS

Baania stolonifera Trevisan de Saint-Léon	*Allen* 18500, 18806, 18942	SL, SU, UC
Bryopteris filicina (Sw.) Nees	*Holst* 4441, 4513	UC, GC
Calypogeia peruviana Nees & Montagne	*Allen* 18714	C2
Cheilolejeunea decurviloba (Stephan) He Xiao-lan	*Allen* 18842	SL
Frullania caulisequa Nees	*Allen* 19044	SL
Frullania gibbosa Nees	*Allen* 19079	UC
Kurzia flagellifera (Stephan) Grolle	*Allen* 18830	SL
Lejeunea laetivirens Nees & Montagne	*Allen* 19080, 19087	UC
Lepidolejeunea involuta Grolle	*Allen* 18926	SU
Lepidopilum polytrichoides (Hedwig) Bridel	*Allen* 4495	GC
Micropterygium trachyphyllum Reimers	*Allen* 18834, 18939, *18956*	SL, SU
Odontoschisma denudatum (Nees in Mart.) Dumortier	*Allen* 18941	SU
Plagiochila disticha Lindenb.	*Allen* 4512	UC
Plagiochila sp.	*Holst* 4334	SU

Plagiochila superba Dumortier	*Allen* 18516, 19056	UC
Radula husnotii Castle	*Allen* 18680	C1
Stictolejeunea squamata (Willd. ex Web.) Schiffn.	*Holst* 4442	GC
Taxilejeunea sp.	*Holst* 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. Holst (SEL); Annonaceae-G.E. Schatz (MO), B. Holst (SEL); Apocynaceae-B. Holst (SEL); Aquifoliaceae-B. Holst (SEL); Araceae-T. Croat (MO), M. Grayum (MO); Araliaceae-B. Holst (SEL); Arecaceae-M. Grayum (MO), D. Hodel, R. Evans (MO), B. Holst (SEL); Aristolochiaceae-J. Meerman (BTFS); Asclepiadaceae-W.D. Stevens (MO); Asteraceae-H. Robinson (US), B. Holst (SEL), R. Noyes (MO); Begoniaceae-B. Holst (SEL); Bignoniaceae-A. Gentry (MO); Bombacaceae (Quararibea)-W. Alverson (WIS), B. Holst (SEL); Bromeliaceae-H. Luther (SEL), B. Holst (SEL); Burmanniaceae-B. Holst (SEL); Burseraceae-B. Holst (SEL); Cactaceae-J. Solomon (MO); Campanulaceae-B. Holst (SEL); Caesalpiniaceae-B. Holst (SEL); Caricaceae-B. Holst (SEL); Celastraceae-B. Holst (SEL); Chloranthaceae-B. Holst (SEL); Chrysobalanaceae-G. Prance (K), B. Holst (SEL); Clusiaceae-B. Hammel (MO), J. Pipoly (BRIT), B. Holst (SEL); Combretaceae-C. Stace (LTR), B. Holst (SEL); Commelinaceae-R. Faden (US), B. Holst (SEL); Convolvulaceae-M. Grayum (MO), B. Holst (SEL); Costaceae-B. Holst (SEL); Cucurbitaceae-B. Holst (SEL); Cyclanthaceae-B. Holst (SEL); Cyperaceae-G. Davidse (MO); Cyrillaceae-B. Holst (SEL); Dilleniaceae-B. Holst (SEL); Dioscoreaceae-O. Tellez (UNAM); Elaeocarpaceae-D. Smith, B. Holst (SEL); Ericaceae-B. Holst (SEL); Euphorbiaceae-B. Holst (SEL), G. McPherson (MO); Fabaceae-B. Holst (SEL), N. Zamora (INB); Fagaceae-B. Holst (SEL); Flacourtiaceae-B. Holst (SEL); Gentianaceae-P.J.M. Maas (U), B. Holst (SEL); Gesneriaceae-B. Holst (SEL); Heliconiaceae-J. Meerman (BTFS), B. Holst (SEL); Hippocrateaceae-B. Holst (SEL); Icacinaceae-B. Holst (SEL); Iridaceae-P. Goldblatt (MO); Lacistemataceae-B. Holst (SEL); Lamiaceae-B. Holst (SEL), A. Pool (MO); Lauraceae-B. Holst (SEL), H. v.d. Werff (MO); Loganiaceae-B. Holst (SEL); Loranthaceae-B. Holst (SEL), J. Kuijt (UVIC); Lythraceae-B. Holst (SEL); Magnoliaceae-B. Holst (SEL); Malpighiaceae-W. Anderson (MICH); Malvaceae-B. Holst (SEL); Marantaceae-B. Holst (SEL), H. Kennedy (UBC); Marcgraviaceae-B. Holst (SEL); Melastomataceae-F. Almeda (CAS); Meliaceae-B. Holst (SEL), T. Pennington (K), W. Palacios (MO); Mimosaceae-B. Holst (SEL), M. Sousa (UNAM), N. Zamora (INB); Monimiaceae-B. Holst (SEL); Moraceae-C.C. Berg (BG), B. Holst (SEL); Myristicaceae-B. Holst (SEL); Myrsinaceae-J. Pipoly (BRIT), J. Ricketson (MO); Myrtaceae-B. Holst (SEL); Nyctaginaceae-B. Holst (SEL); Olacaceae-B. Holst (SEL); Oleaceae-B. Holst (SEL); Orchidaceae-J. Atwood (SEL), G. Carnevali (CICY), R. Dressler (FLAS), D. Szlachetko, A. Vasilijev (SEL); Passifloraceae-J. MacDougal (MO), J. Meerman (BTFS); Phytolacaceae-B. Holst (SEL); Piperaceae-R. Callejas (HUA); Poaceae-G. Davidse (MO); Polygonaceae-B. Holst (SEL); Proteaceae-B. Holst (SEL); Monotropaceae-B. Holst (SEL); Rhamnaceae-B. Holst (SEL); Rhizophoraceae-B. Holst (SEL); Rosaceae-B. Holst (SEL); Rubiaceae-C. Taylor (MO), D. Lorence (PTBG); Rutaceae-C. Reynel (MO); Sapindaceae-P. Acevedo-Rdgz. (US), B. Holst (SEL); Sapotaceae-T. Pennington (K); B. Holst (SEL); Simaroubaceae-B. Holst (SEL); Smilacaceae-B. Holst (SEL); Solanaceae-W. D'Arcy (MO), B. Holst (SEL); Symplocaceae-F. Almeda (CAS); Theaceae-B. Bartholomoew, B. Holst (SEL); Tiliaceae-B. Holst (SEL); Urticaceae-A. Pool (MO); Verbenaceae-A. Pool (MO), B. Holst (SEL); Violaceae-B. Holst (SEL); Vitaceae-J. 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-S. Churchill (MO); Pottiaceae-R. Magill (MO).

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

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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 to me that *P. obovata* has a scattered known distribution from Oaxaca in Mexico to 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 to the glanduliferous species of *Plectostemma*, and the very minute bracts, closely appressed to 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 *Plectostemma*, 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 Holst (1993) described finding abundant flowers of this species on the forest floor in the more remote areas of the Columbia River Forest Reserve. On the 9th of February, together with our Maya support team and 9 packhorses, we left the village of San Jose and started the hike into 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 Holst (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. serratifolia* and even *P. lancetillensis* (sp. nov. ined. MacDougal) and *P. pittieri,* but no *P. obovata*.

Once in Union Camp, my chances improved. After all, now we were more or less stationary and I had more time to look at the vegetation in greater detail. Sure enough, I found a tiny seedling vine growing 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 that 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 to 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 picture 8)! Definitely the largest Passionvine I have ever seen!

More interestingly, *P. obovata* appears to 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 into their burrows. The seeds they discard eventually germinate and grow out the burrow toward 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 structure 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 to 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 tendril 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 to 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 bark. 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 bark.

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 this shoot, I found the remains of a pupa which Dr. 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 discover more of the biology and ecology of this rare butterfly.

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 the case in most other *Passiflora* that I am familiar with. All these characteristics condemn the species to undisturbed, high forest. Secondary forest is simply unsuitable. Primary, high forest is getting increasingly scarce in Meso-America and the already disjunct distribution of *P. obovata* is likely to become even more fragmented in the near future.

Now that 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 River 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 history 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 International, an international environmental consulting company headquartered in California, USA. Other investigators contributing specimens to the survey effort were H. Lee Jones, Bruce Holst, 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 to 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 subcompartment 2 of compartment 33 by Meerman, was conducted from a single camp in the northeast corner of that subcompartment (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 netting, "log rolling", and beating of live foliage and dead or dying wood) and passive bait trapping during the day, and passive light attraction (with active specimen selection) at night. Bait trapping was with conventional hanging butterfly 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 capture was supplemented by observations made by the naked eye or with the aid of binoculars for species flying in the forest 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 interchanged with a 250-w bulb) reflecting against a custom-made 2.5 x 3.5-m white ripstop nylon "sheet" with ground apron, and powered by a 650 hp portable gasoline-driven generator. During the June survey, only a single 15-w ultraviolet tube, powered by a car battery was utilized. Generally, a minimum of 6, and as many as 12, investigator-hours was spent each day in active collecting. The light apparatus 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 collected regularly from dusk to midnight or later, and then at 2- to 3-hour intervals thereafter.

Insect taxa targeted 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 Saturniidae (Emperor moths). Odonata (dragonflies and damselflies) 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 herbivory; 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 "dry" 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 adults 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 May–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 two external factors, season and weather, were not ideal for insect surveying, i.e.: (1) internally "fixed" seasonal cycles of many nocturnal lepidoptera 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 encountered 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 two-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 the laboratory subsequent to the expedition. All specimen and species counts provided at 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 at 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 comprise 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
Saturniidae	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 three other relatively well research sites in Belize, the Shipstern Nature Reserve (Corozal District), Caracol (Cayo District) 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 (Shipstern) 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 diversity?) as intensive logging in parts 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, Euselasia aurantiaca, Eueides lineata, Heliconius 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. calliste,* is considered a rare species from high-elevation cloud forests in Meso-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. lineata,* generally a rare and localized species of Heliconinae which was suspected to occur in the area on the basis of the occurrence of a potential foodplant, *Passiflora lancetiliensis,* discovered in the area during a 1992 expedition (Holst, 1993).

Approximately 22 families are represented 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 walkeri, Manduca pellenia, Pachylia dargeta, Xylophanes zurcheri* and *Citheronia collaris.* 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 collecting experience in neighboring 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—short-horned grasshoppers	2
Gryllidae—crickets	4
Rhaphidophoridae—cave & camel crickets	3
Phasmatidae—walkingsticks	1
HEMIPTERA—TRUE BUGS	3
Pentatomidae—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
Cantharidae—soldier beetles	2
Lycidae—net-winged beetles	3
Ostomidae—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
Heterocera—Moths [4]	
Thyrididae—window-winged moths	
Pyralidae—pyralid moths	
Sesiidae—clear-winged moths	
Megalopygidae—flannel moths	
Cossidae—carpenter moths	
Dalceridae—dalcerid moths	
Limacodidae—slug caterpillar moths	
Tortricidae—tortricid moths	
Sematuridae—sematurid moths	5
Castnidae—castnid 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—tussock 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—ichneumonid 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 Collected	2,584

TABLE II

	No. of Specimens	American Camp	Union Camp (UC)	Camp 1 (C1)	Camp 2 (C2)	Camp 3 (C3)	LQR Summit (SU)	Camp. 33/2 (BH)
LEPIDOPTERA								
PAPILIONIDAE	12 species, 58 specimens							
Battus chalceus	1							June
Battus sp.	1		23-Feb					
Euritydes salvini	10							June
Heraclides anchisiades	1							June
Mimoides phaon	1							June
Parides childrenae	2				15-Feb			
Parides eurimedes	1			13-Feb				
Protographium agesilaus	6							June
Protographium calliste	25						20/21-Feb	
Protographium epidaus	6							June
Protographium philolaus	19							June
Protographium thyastes	3		23-Feb				20/21-Feb	
PIERIDAE	11 species, 71 specimens							
Aphrissa boisduvalli	5							June
Aphrissa statira	35							June
Appias drusilla	6							June
Charonias tereas	11		22-Feb	13-Feb	15-Feb	16-Feb		
Dismorphia amphiona	1		22-Feb					
Dismorphia theucharilla	2			13-Feb				
Eurema albula	1							June
Eurema sp.	1		22-Feb					
Itaballia pandosa	4							June
Phoebis argante	3							June
Phoebis sp.	2		22-Feb				14-Feb	
LYCAENIDAE	4 species 8 specimens							
Eumaeus toxea	3			13-Feb			20-Feb	
Electrostrymon denarius	1						21-Feb	
Everes comyntas	1		24-Feb					
"Thecla" sp.	3							June
RIODINIDAE	12 species, 31 specimens							
Calephelis sp.	1							June
Calospila sudias	1			14-Feb				

(continued)	Nr. of Specimens	American Camp	Union Camp (UC)	Camp 1 (C1)	Camp 2 (C2)	Camp 3 (C3)	LQR Summit (SU)	Camp. 33/2 (BH)
Charis sp.	3		22-Feb					
Eurybia patrona	2							June
Eusalesia aurantiaca	1			13-Feb				
Juditha molpe	2							June
Leucochimona nivalis	1			23-Feb				
Mesosemia gaudiolum	9		22-Feb	12/13-Feb	15-Feb			
Mesosemia lamachus	3			12/13-Feb				
Napaea umbra	1		22-Feb					
Thisbe irenea	5							June
Thisbe lycorias	2		23-Feb					
NYMPHALIDAE	50 species, 173 specimens							
Actinote guatemalena	1		23-Feb					
Adelpha sp.	2		23-Feb					
Anartia fatima	5		22-Feb				21-Feb	
Antirrhea miltiades	3					16-Feb		June
Archaeoprepona demophon	4		22-Feb					June
Biblis hyperia	1							June
Caligo uranus	5			13/21-Feb			June	
Castilia eranitis	1			13-Feb				
Castilia myia	1						21-Feb	
Chloreuptychia sericeella	4			12/13-Feb			20-Feb	
Chlosyne 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	
Euptychia westwoodi	1		23-Feb					
Godyris zavelata	3			19-Feb				June
Greta nero	7	9-Feb	22-Feb	12/22-Feb	6-Feb			
Greta oto	1						20-Feb	
Hamadryas guatemalena	1		22-Feb					
Hamadryas sp.	2							June
Heliconius charitonius	12		10-22-Feb			20/21-Feb	June	
Heliconius cydno	17	10-Feb		12/13-Feb	15-Feb	16-Feb	20-Feb	June
Heliconius hecalesia	2			13-Feb	16-Feb			
Heliconius ismenius	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 chiron	2							June
Melinaea ethris	2							June
Morpho peleides	5		10-Feb	13-Feb				

(continued)	Nr. of Speci-mens	Ameri-can Camp	Union Camp (UC)	Camp 1 (C1)	Camp 2 (C2)	Camp 3 (C3)	LQR Summit (SU)	Camp. 33/2 (BH)
Morpho theseus	8		23-Feb		15-Feb		21-Feb	June
Myscelia cyaniris	1							1
Nica flavilla	2		24-Feb					
Oleria paula	7			12/13-Feb				June
Opsiphanes cassina	3		22-Feb					June
Philaethria dido	5						20/21-Feb	
Pierella luna	10			12/13-Feb	15-Feb			June
Pteronymia cotytto	4		23-Feb	12-Feb				
Pyrrhogyra neaerea	1							June
Pyrrhogyra sp.	1		23-Feb					
Siproeta superba	1						14-Feb	
Taygetis andromeda	1		22-Feb					
Taygetis virgilia	1							June
Temenis laothoe	1							June
Tigridia aceste	1							June
SPHINGIDAE	37 species, 212 specimens							
Adhemarius gannascus	3		23-Feb					June
Adhemarius ypsilon	4							June
Amphimoea walkeri	6			13-Feb	15-Feb			
Callionima falcifera	1		23-Feb					
Callionima inuus	16							June
Callionima parce	4							June
Cautethia spuria	6		11-Feb					
Cocytius duponchel	1							June
Cocytius lucifer	1							June
Eumorpha anchemolus	5		10-Feb					June
Eumorpha obliquus	3							June
Eumorpha satellita	11							June
Eumorpha triangulum	62							June
Madoryx plutonius	1							June
Manduca albiplaga	4							June
Manduca florestan	8							June
Manduca lanuginosa	2							June
Manduca lichenea	2		10-Feb					
Manduca occulta	3							June
Manduca pellenia	3							June
Manduca rustica	2							June
Oryba kadeni	1							June
Pachylia dargeta	1		10-Feb					
Pachylia resumens	1		17-Feb		17-Feb			
Perigonia nr. lusca	5							June
Protambulyx strigilis	1							June
Protambulyx xanthus	1		23-Feb					June
Xylophanes amadis	9							June
Xylophanes anubus	7							June
Xylophanes belti	3							June
Xylophanes ceratomioides	4							June

(continued)	Nr. of Specimens	American Camp	Union Camp (UC)	Camp 1 (C1)	Camp 2 (C2)	Camp 3 (C3)	LQR Summit (SU)	Camp. 33/2 (BH)
Xylophanes lybia	7							June
Xylophanes neoptelmus	1		23-Feb					
Xylophanes pluto	1							June
Xylophanes thyelia	3		11/24-Feb					
Xylophanes tyndarus	3							June
Xylophanes zurcheri	16		23-Feb	14/21-Feb				June
SATURNIIDAE	33 species, 216 specimens							
Adeloneivaia irrorata	4							June
Adeloneivaia isara	1		10-Feb					
Adeloneivaia jason	10			14-Feb	15-Feb			June
Arsenura armida	1							June
Automeris acutissima	1							June
Automeris banus	8				16-Feb			June
Automeris belti	8				15-Feb			June
Automeris gabriellae	1							June
Automeris moloneyi	5							June
Automeris montezuma	1							June
Automeris zozine	3							June
Caio championi	1							June
Citheronia collaris	4		24-Feb					June
Citheronia mexicana	7							June
Cithioica anthonilis	3							June
Copaxa escalantei	6		23-Feb	14-Feb	21-Feb			June
Copaxa rufinans	1			13-Feb				
Dysdaemonia boreas	15							June
Eacles imperialis	41							June
Eacles masoni	21							June
Eacles ormondei	7		10/23-Feb	14-Feb	16-Feb			June
Hylesia dalina	1		23-Feb					
Hylesia sp 1.	6							June
Hylesia sp 2.	14							June
Othorene purpurascens	12		10/11-Feb	14-Feb	15/16/18-Feb			June
Othorene verana	6		10-Feb	14-Feb	18-Feb			June
Periphoba arcaei	7		11-Feb	13-Feb				June
Rothschildia roxana	5		23-Feb		18-Feb			June
Rothschildia lebeau	9							June
Syssphinx colla colla	1							June
Syssphinx mexicana	1							June
Syssphinx molina	4							June
Syssphinx quadrilineata	1							June
CASTNIDAE	2 species, 7 specimens							
Cyanostola diva	2							June
Castnia licus	5							June
SEMATURIDAE	1 species, 5 specimens							
Nothus lunus	5			14-Feb	16-Feb			June

(continued)	Nr. of Specimens	American Comp	Union Camp (UC)	Camp 1 (C1)	Camp 2 (C2)	Camp 3 (C3)	LQR Summit (SU)	Camp. 33/2 (BH)
COLEOPTERA								
CERAMBYCIDAE	14 species, 17 specimens							
Adetus bacillarius	1		22-2					
Colobothea sp. *(parcens or vidua ?)*	1		24-2					
Furona (degenera ?)	3			21-2	14-2			
Haruspex inscriptus	1		22-2					
Leptostylus cf. albicinctus or *lazulinus*	1				14-2			
Megacyllene angulata	1			13-2				
Nealcidion cf. scutellatum	1		23-2					
Neocompsa cf. macrotricha, spinosa, & squalida	1				17-2			
Nyssodrysina haldemani	1		22-2					
Nyssodrysina leucopyga	1		22-2					
Parmenonta cf. valida	1			20-2				
Pygmodeon obtusum	1				15-2			
Schwarzerion holochlorum	1			20-2				
Trichalphus pilosus	1		22-2					
Urgleptes cf. bivittatus or *mixtus*	1				17-2			
ODONATA	12 species, 61 specimens							
ANISOPTERA-AESHNIDAE								
Aeshna psilus	1						21-2	
Triacanthagyna caribbea	1		22-2					
ANISOPTERA-LIBELLULIDAE								
Brechmorhoga nubecula	1			22-2				
Macrothemis pseudoimitans	5							June
Orthemis ferruginea	31			22-2				June
Pantala flavescens	3							June
ZYGOPTERA-CALYGOPTERIDAE								
Hetaerina capitalis	2			13-2				
Hetaerina pilula	1			13-2				
ZYGOPTERA-COENAGRIONIDAE								
Argia cuprea	2				14-2			
Argia ulmeca	6				13/22-2			
ZYGOPTERA-MEGAPODAGRIONIDAE								
Heteragrion alienum	2				14-2			June
ZYGOPTERA-PSEUDOSTIGMATIDAE								
Megaloprepus caerulatus	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. Toghether 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 incompatible 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 (JM, 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 (JL); 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 that 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 presently under study by Dr. 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 tentatively assigned to the *Eleutherodactylus gollmeri* group. The two specimens may actually represent 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 *K.acutum* and *K.leucostomum*, 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 freminvillei* 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 through the courtesy of Mr. Lee Jones, we will now have tape recordings of the advertisement call of this species available for sound analysis.

Prior to this field work, the tadpole of *Bufo campbelli* 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 *Bufo campbelli* (breeding congregations, eggs masses, tadpoles); *Hyalinobatrachium fleischmanni* (breeding congregations, gravid females, egg clutches); *Rana juliani* (gravid female, tadpoles); and *Rana vaillanti* (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 thus 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 streams, 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 palmipes* 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 al., 1993) revealed the presence of a small yellow treefrog *Hyla bromeliacia* and a rare fringe-limbed treefrog *Hyla valancifer* at Gloria Camp (reported as *Hyla minera* by Emmons and Meyer, 1993). We were disappointed not to find these species. In particular we had hoped to find the tadpole of *H. valancifer*, which is unknown.

Caecilians are known from only two 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 review 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 presently 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 two undescribed 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. Further field work will unquestionably 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; C1, C2, and C3 = Camps 1, 2, and 3, respectively; UC = Union Camp; SU = Little Quartz Ridge Summit; C33/2 = Compartment 33, subcompartment 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							
Bufo marinus							
*Bufo campbelli**	9-Feb	22-Feb	12-Feb	14-Feb		20-Feb	June

(continued)	AC	UC	C1	C2	C3	SU	C33/2
AMPHIBIA, LEPTODACTYLIDAE							
*Eleutherodactylus chac**	10-Feb	22-Feb	12-Feb	15-Feb	6-Feb	20-Feb	
Eleutherodactylus laticeps							
Eleutherodactylus leprus							
*Eleutherodactylus psephosypharus**		13-Feb					
*Eleutherodactylus "rugulosus"**	10-Feb	12-Feb	15-Feb				
*Eleutherodactylus sandersoni**		12-Feb	15-Feb				
Eleutherodactylus* sp. *"A"*			12-Feb				
Eleutherodactylus* sp. *"B"*			13-Feb				
AMPHIBIA, CENTROLENIDAE							
*Hyalinobatrachium fleischmanni**	9-Feb	10-Feb	12-Feb	15-Feb			June
AMPHIBIA, HYLIDAE							
*Agalychnis moreleti**				16-Feb			June
Agalychnis callidryas*							June
Hyla bromeliaca							
Hyla valancifer							
Smilisca baudinii*							June
*Smilisca cyanosticta**		10-Feb		16-Feb			June
AMPHIBIA, RANIDAE							
Rana juliani				12-Feb			
*Rana vaillanti**		10-Feb	12-Feb				June
REPTILIA, SAURIA, EUBLEPHARIDAE							
Coleonix elegans							
REPTILIA, SAURIA, GEKKONIDAE							
Sphaerodactylus glaucus							
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	14/15-Feb			June
*Anolis lemurinus**							June
*Anolis rodriguezi**				18-Feb			June
Anolis sagrei							
Anolis tropidonotus							
*Anolis uniformis**	9-Feb	22-Feb	12-Feb	14-Feb	16-Feb		June
REPTILIA, SAURIA, CORYTOPHANIDAE							
*Basiliscus vittatus**		24-Feb					
Corytophanes cristatus*							June
Laemanctus longipes							

(continued)	AC	UC	C1	C2	C3	SU	C33/2
REPTILIA, SAURIA, SCINCIDAE							
Eumeces schwartzei*							June
Sphenomorphus cherriei*				15-Feb			
REPTILIA, SAURIA, TEIIDAE							
*Ameiva festiva**		22-Feb		15-Feb			June
REPTILIA, SERPENTES, BOIDAE							
Boa constrictor							
REPTILIA, SERPENTES, COLUBRIDAE							
Amastridium veliferum*			13/21-Feb				June
Coniophanes fissidens*			12-Feb				
Coniophanes imperialis							
Dendrophidion vinitor*						21-Feb	
Drymarchon corais*				15-Feb			
Drymobius margaritiferus			?				
*Imantodes cenchoa**							June
*Leptophis ahaetulla**							June
Sibon nebulata							
Tantilla schistosa							
Stenorrhina degenhardtii*		24-Feb					
Urotheca elapoides							
Xenodon rabdocephalus*			12-Feb				
REPTILIA, SERPENTES, ELAPIDAE							
Micrurus* sp.			20-Feb				
REPTILIA, SERPENTES, VIPERIDAE							
*Atropoides nummifer**			1-Feb				
REPTILIA, TESTUDINES, KINOSTERNIDAE							
Kinosternon leucostomum*				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 elevation, 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 vocalizations 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 secretive 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 recorded 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 (*Lophostrix 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 vermivorus*), Ovenbird (*Seiurus aurocapillus*), Kentucky Warbler (*Oporornis formosus*), 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 (*Penelope purpurascens*) 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 pressure 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 recorded 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 possible 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 Spotted Wood-Quail were recorded only in the vicinity of Camp 2.

Species 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 not Jones or Gardner are indicated as such. Sites visited are as follows: Little Quartz Ridge Summit (SU), Union Camp (UC), Camp 1 (C1), 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 twice, but generally not more than 4-5 times.
> Rare: Recorded only once; or 1 individual recorded on 2 or more dates.

Great Tinamou *Tinamus major*. Fairly common: Recorded all five camps.
Slaty-breasted Tinamou *Crypturellus boucardi*. Uncommon: Recorded C1, C2, C3.
Gray-headed Kite *Leptodon cayanensis*. Rare: 1, possibly 2, at UC.
Swallow-tailed Kite *Elanoides forficatus*. Uncommon: Migrating individuals seen from clearings at SU and UC (1 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: 1 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 relatively 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*. Rare to uncommon: 1 at SU on 12 and 13 Feb; 1, either this or *Spizaetus ornatus*, heard at C1 on 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 ruficollis*. Uncommon: 1-2 heard daily at SU; 1 each heard at C1 on 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 between C1 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 other team members -6 near C2 on 15 Feb (Meerman); 1 between C1 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 of HLS 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 C1 on 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 rufaxilla*. Uncommon: 1 each near C2 on 17 Feb, near C3 on 19 Feb, and between C3 and C2 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, *rufaxilla*, or both.
Ruddy Quail-Dove *Geotrygon montana*. Fairly common: 1-3 recorded almost daily from vicinity of UC, C1, and C3; not recorded at C2 and SU.
Brown-hooded Parrot *Pionopsitta haematotis*. Rare: 1 at UC on 22 Feb.
White-crowned Parrot *Pionus senilis*. Uncommon: Individuals seen flying over UC on 22 and 23 Feb; possibly another along trail between C3 and C1 on 20 Feb.
Mealy Parrot *Amazona farinosa*. Common: Recorded daily from all camps.
Squirrel Cuckoo *Piaya cayana*. Common at UC (2-4 daily); uncommon at C1 and C2; possibly recorded at C3; unrecorded at SU.

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 C1 on 14 Feb; 1 heard at UC on 22 Feb (Miller).
Spectacled Owl *Pulsatrix perspicillata*. Rare: 1-2 heard on 15 Feb at C1.
Central American Pygmy-Owl *Glaucidium griseiceps*. Uncommon: 1 each recorded at SU (11 Feb), C1 (15 Feb), and UC (23 Feb).
Mottled Owl *Ciccaba virgata*. Uncommon: 1 each heard at SU (10 Feb), C1 (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 C1; 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 C1.
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 C1: 1-2 seen daily at UC; recorded twice at C1.
Violet Sabrewing *Campylopterus hemileucurus*. Common at C1 and C2; unrecorded elsewhere.
White-necked Jacobin *Florisuga mellivora*. Uncommon: 1 each (both males) at C1 on 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 C1 on 21 Feb.
White-bellied Emerald *Amazilia candida*. Fairly common: 1-3 each recorded at UC and C1; 2-4 daily at C3.
Azure-crowned Hummingbird *Amazilia cyanocephala*. Common at SU (1-5 daily); fairly common at C1 (4 on 21 Feb).
Rufous-tailed Hummingbird *Amazilia tzacatl*. Uncommon to fairly common: Recorded at SU, UC, and C1. 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, C1, 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 C1; possibly heard once at SU.
Green Kingfisher *Chloroceryle americana*. Uncommon: 1-3 seen daily at C1.
White-whiskered Puffbird *Malacoptila panamensis*. Rare: 1 at C1 on 16 Feb.
Rufous-tailed Jacamar *Galbula ruficauda*. Uncommon: 2-3 recorded on two dates at C1; 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 C1, twice at C2.
Yellow-bellied Sapsucker *Sphyrapicus varius*. Rare: 1 female at SU on 11 Feb.
Smoky-brown Woodpecker *Veniliornis fumigatus*. Uncommo n: Recorded twice each at C1 and C2.
Golden-olive Woodpecker *Piculus rubiginosus*. Common on SU (1-3 daily); uncommon elsewhere (recorded once each at C1, C3, and trail between C1 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 C1.
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 SU.
Tawny-winged Woodcreeper *Dendrocincla anabatina*. Uncommon: Recorded three times in vicinity of C2.
Ruddy Woodcreeper *Dendrocincla homochroa*. Uncommon to fairly common: 1-2 seen on four dates at C1, 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 C1 and C2 on 16 and 17 Feb, respectively.
Northen Barred-Woodcreeper *Dendrocolaptes sanctihomae*. Uncommon: Recorded only at C1 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 C1, C2, and C3; not recorded at UC or SU.
Plain Antvireo *Dysithamnus mentalis*. Common at lower camps where recorded daily; not recorded at SU.
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 at C1 on several dates; 2-3 near UC on 23 Feb.
Dusky Antbird *Cercomacra tyrannina*. Uncommon and local: 1-2 in tangles beside stream near C1 on 20 and 21 Feb; 1 on edge of clearing at UC on 23 and 24 Feb.
Black-faced Antthrush *Formicarius moniliger*. 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 C1, C3, and UC. Neither species was seen, but both are known to be present.
Greenish Elaenia *Myiopagis viridicata*. Fairly common at lower camps; unrecorded at SU.
Sepia-capped Flycatcher *Leptopogon amaurocephalus*. Fairly common at lower camps; unrecorded at SU.
Northern Bentbill *Oncostoma cinereigulare*. Common: 1-3 recorded daily at all camps.
Eye-ringed Flatbill *Rhynchocyclus brevirostris*. Fairly common at lower camps; unrecorded at SU.
Yellow-olive Flycatcher *Tolmomyias sulphurescens*. Common at lower camps; unrecorded at SU.
Stub-tailed Spadebill *Platyrinchus cancrominus*. Fairly common at lower camps; unrecorded at SU.
Royal Flycatcher *Onychorhynchus coronatus*. Rare: 1 seen at C3 on 19 Feb; an old nest was found hanging over stream at C1.
Ruddy-tailed Flycatcher *Terenotriccus erythrurus*. Uncommon: 1-2 at C1 on 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 SU.
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 C1, 1 heard on the trail near C2 on 20 Feb, and 2 heard at C1 on 21 Feb.
Yellow-bellied Flycatcher *Empidonax flaviventris*. Common: 1-6 daily at all lower camps; unrecorded at SU.
Least Flycatcher *Empidonax minimus*. Rare: 1 at UC on 22 and 24 Feb.
Bright-rumped Attila *Attila spadiceus*. Fairly common: 1-2 heard most days.
Rufous Mourner *Rhytipterna holerythra*. Fairly common: 1-3 heard most days at lower camps; unrecorded from SU.
Dusky-capped Flycatcher *Myiarchus tuberculifer*. Fairly common: 1-3 heard on six dates, but only once at SU.
Social Flycatcher *Myiozetetes similis*. Rare: 1 in second-growth opening along stream at C1 on 20-21 Feb.
Cinnamon Becard *Pachyramphus cinnamomeus*. Rare: 1-2 heard near C1 on 21 Feb.
Rufous Piha *Lipaugus unirufus*. Common: 1-7 recorded daily at lower camps; unrecorded from SU.
Lovely Cotinga *Cotinga amabilis*. Rare: 1 male seen in top of leafless tree at UC on 23 Feb.
Thrush-like Schiffornis *Schiffornis turdinus*. Common at lower camps (1-4 daily); uncommon at SU.
Red-capped Manakin *Pipra mentalis*. Common at lower camps (1-15 daily); once at SU.
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 albilinea*. Rare: 1-2 seen over clearing at bend in stream at C1 on 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, but 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 C1 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 SU.

Tropical Gnatcatcher *Polioptila plumbea*. Fairly common at C1, C2, and C3; common at UC; not recorded at SU.

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 SU.

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

Gray Catbird *Dumetella carolinensis*. Rare: 1 was in tangle by stream near C1 on 20-21 Feb.

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

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 SU.

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 J. Lee at C1 on 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 SU.

Chestnut-sided Warbler *Dendroica pensylvanica*. Uncommon: Individuals recorded 3 times at C1 (same bird?) and twice at UC.

Magnolia Warbler *Dendroica magnolia*. Uncommon: 2 at C1 on 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 C1 by J. Lee on 22 Feb.

Northern Waterthrush *Seiurus noveboracensis*. Uncommon: 1 each on 4 dates at C1, C2, and C3.

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

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

Common Yellowthroat *Geothlypis trichas*. Rare: 1 male seen at C1 on 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, C1, and C2.

Wilson's Warbler *Wilsonia pusilla*. Uncommon: 1 at SU on 13 Feb; 1 at C1 on 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 *Tangara 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 C1 on 20 Feb and 3 seen at C1 on 20 Feb.

Red-legged Honeycreeper *Cyanerpes cyaneus*. Uncommon: 1-6 seen on 4 dates at SU, UC, and C1.

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

Elegant Euphonia *Euphonia elegantissima*. Rare: 2 heard and tape-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 UC 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 *Habia rubica*. Common: 2-23 recorded daily.
Red-throated Ant-Tanager *Habia fuscicauda*. Fairly common: 1-8 recorded most days; however, 2 on 11 Feb were the only ones recorded on SU.
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 C1.
Common Bush-Tanager *Chlorospingus ophthalmicus*. Very common at SU (15-40 daily); uncommon elsewhere: 6 near C1 on 16 Feb; group of 12-14 between C1 and UC on 21 Feb.
Buff-throated Saltator *Saltator maximus*. Rare: 1 seen at C1 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 neotropical 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). Historically the study of bats away from roost sites has relied primarily 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 night by the same species assemblage. Standard capture techniques require relatively expensive equipment and constant tending, limiting the number of localities that can be sampled simultaneously.

In the Neotropics, mist netting has been particularly effective for leaf-nosed bats (family Phyllostomidae) and traps more effective for other families (LaVal and Fitch, 1977; Tuttle, 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 the ultrasonic echolocation calls of bats (Fenton, 1988). Echolocation calls of many species of bats are distinctive (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 that 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 geographic 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 distribution 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 al.*, 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 monitoring 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 opportunity 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 at 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 at 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 sonotype, 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, this 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 fragments 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 bat 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 south 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 phyllostomids such as *Mimon* spp. or *Lonchorhina aurita*.

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 al., 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 records 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, but 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 February 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 were 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 (1993)**	**UC Feb. 1997**	**C1 Feb. 1997**	**SU Feb. 1997**	**C33/2 June 1997**
HETEROMYIDAE – POCKET MICE					
Heteromys desmarestianus	Collected				
MURIDAE – RODENTS					
Oryzomys alfaroi	Collected				
Ototylomys hatti	Collected				
Tylomys nudicaudus	Collected				
AGOUTIDAE – PACA					
Agouti paca	Recorded				1 seen, tracks scarce
DASYPROCTIDAE – AGOUTI					
Dasyprocta punctata	Recorded				

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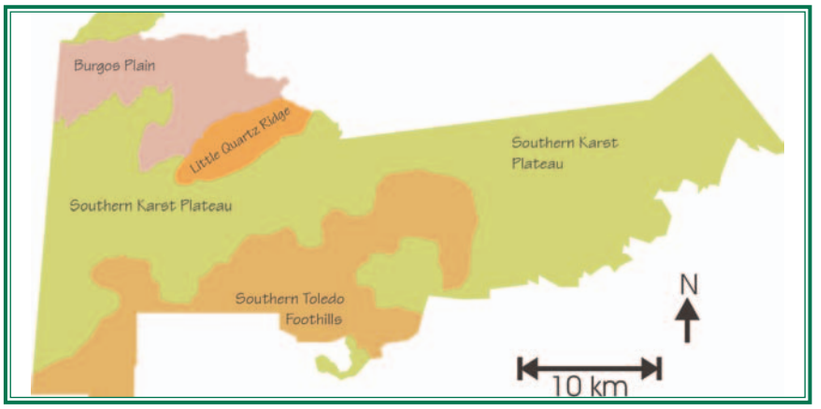
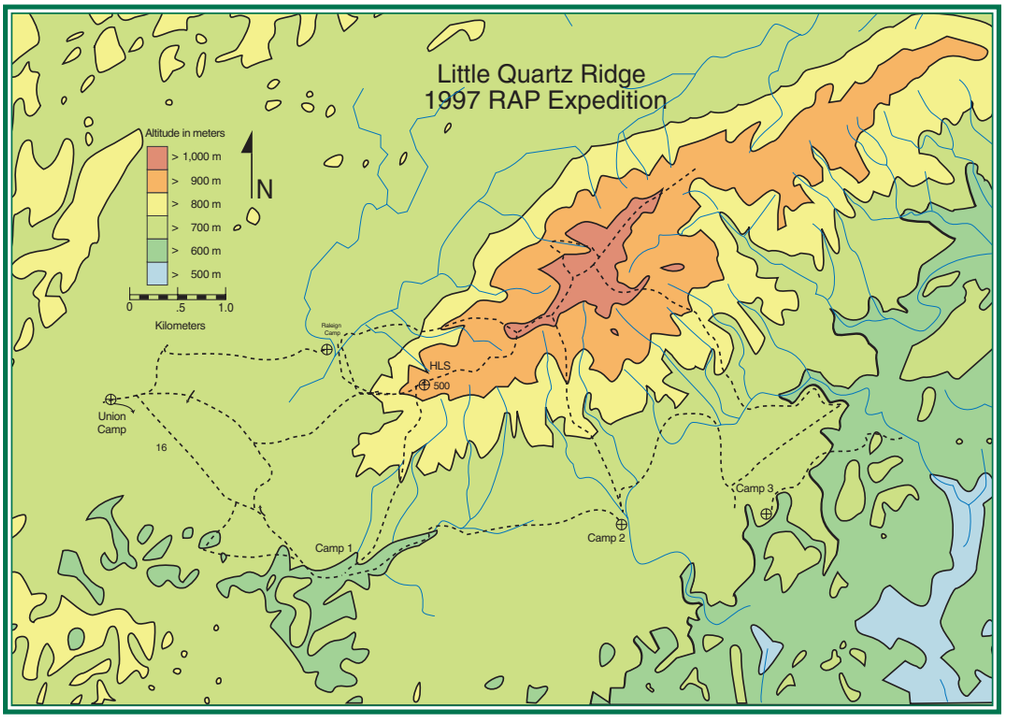
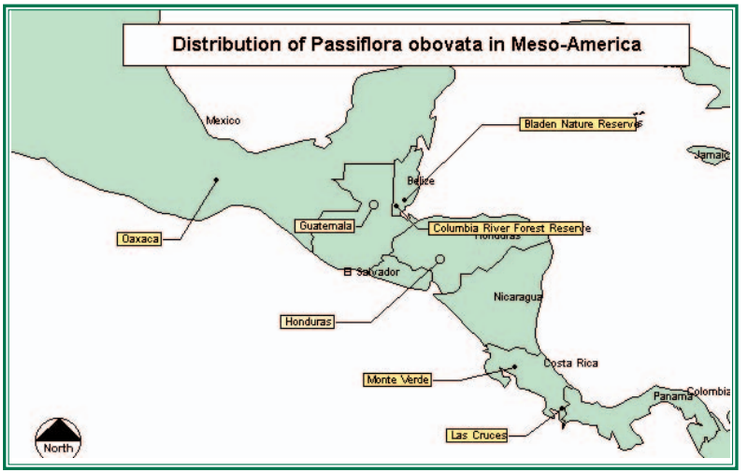
Map 1. Location of the Columbia River Forest Reserve (CRFR) in Belize.



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 1, Columbia River Forest Reserve, 13 Feb. 1997. J.C. Lee.

Picture 3. *Tillandsia multicaulis.* Columbia River Forest Reserve, Feb. 1997. L.D. Munsey.

Picture 4. Stream habitat at Camp1, Columbia River Forest Reserve, 13 Feb. 1997. L.D. Munsey.

Picture 5. B. Allen with moss collection on top of Little Quartz Ridge. Columbia River Forest Reserve, Feb. 1997. S. Matola.

Picture 6. Bromeliads on fallen tree, Columbia River Forest Reserve, 13. Feb. 1997. J.C. Lee.

Picture 7. *Columnea sulfurea.* Columbia River Forest Reserve, Feb. 1997. L.D. Munsey.

Picture 8. J.C. Meerman with *Passiflora obovata* vine. Camp 2, Columbia River Forest Reserve, 14 Feb. 1997. J.C. Lee.

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

Picture 10. *Rothschildia roxana.* Columbia River Forest Reserve, Feb. 1997. L.D. Munsey.

Picture 11. *Eleutherodactylus* sp. Camp 2, Columbia River Forest Reserve, Feb. 1997. L.D. Munsey.

Picture 12. *Bufo campbelli.* The most commonly encountered amphibian. Columbia River Forest Reserve, Feb. 1997. L.D. Munsey.

Picture 13. *Rana juliana.* An endemic frog species with Little Quartz Ridge as its type locality. Camp 2, Columbia River Forest Reserve, 14 Feb. 1997. J.C. Lee.