

Rapid Assessment Program

RAP

Working

Papers

3

A Biological Assessment of the Columbia River Forest Reserve, Toledo District, Belize

CONSERVATION INTERNATIONAL

APRIL 1993

Conservation Priorities: The Role of RAP

Our planet faces many serious environmental problems, among them global climate change, pollution, soil erosion, and toxic waste disposal. At Conservation International (CI), we believe that there is one problem that surpasses all others in terms of importance because of its irreversibility, the extinction of biological diversity. Conservation efforts still receive only a tiny fraction of the resources, both human and financial, needed to get the job done. As a result of this, we must use available resources efficiently, applying them to those places with the highest concentrations of diversity which are at most immediate risk of disappearing.

CI uses a strategic, hierarchical approach for setting conservation investment priorities. At a global level, we have targeted the “hotspots,” 15 tropical areas that hold a third or more of all terrestrial diversity and are at great risk. Our global priorities also focus on major tropical wilderness areas and the “megadiversity” country concept, which highlights the importance of the national entities that harbor high biodiversity. We are now undertaking a series of priority-setting exercises for other major categories of ecosystems, among them marine systems, deserts, and dry forests.

The next level of priority setting is the bio-regional workshop, a process where experts assemble their combined knowledge of an area to map regional conservation priorities using CI’s geographic information system (CISIG). We have also taken a taxon-based approach, working with the Species Survival Commission of IUCN to produce action plans for key groups of organisms.

These priority-setting exercises provide the scientific underpinning for urgent conservation decisions in hotspot regions. Although the hotspots we have identified occupy less than 3-4 percent of the land surface of the planet, they still cover several million square kilometers, only small areas of which have been properly inventoried. To fill the gaps in our regional knowledge, CI created the Rapid Assessment Program (RAP) in 1989.

RAP assembles teams of world-renowned experts and host country scientists to generate first-cut assessments of the biological value of poorly known areas. An area’s importance can be characterized by its total biodiversity, its degree of endemism, the uniqueness of an ecosystem, and the degree of risk of extinction. As a conservation tool, RAP precedes long-term scientific inventory.

When satellite images of an area targeted for a RAP assessment are available, the team consults them prior to a trip to determine the extent of forest cover and likely areas for exploration. Once in-country, the scientists make overflights in small planes or helicopters to identify forest types and points for field transects. Ground travel often requires a combination of vehicles, boats, pack animals, and foot travel to get the team to remote sites where few, if any, roads exist. Trips last from two to eight weeks.

On each trip, in-country scientists form a central part of the team. Local experts are especially critical to understanding areas where little exploration has been undertaken. Subsequent research and protection of habitats following a RAP trip depends on the initiatives of local scientists and conservationists.

The RAP concept was born during a field trip by Murray Gell-Mann of the MacArthur Foundation, Spencer Beebe, one of CI’s founders, and Ted Parker, current leader of the RAP team. RAP has been generously funded by the John D. and Catherine T. MacArthur Foundation’s World Resources and Environment Program, headed by Dan Martin.

RAP reports are available to the host governments of the countries being surveyed and to all interested conservationists, scientists, institutions, and organizations. We hope that these reports will catalyze the effective conservation action on behalf of our planet’s biological diversity, the legacy of life that is so critical to us all.

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Table of Contents

Participants	3
Organizational Profiles	4
Acknowledgments	5
Overview	6
Introduction	6
Summary	7
Conservation Opportunities	14
Technical Report	17
Methods	17
Site Descriptions	18
Birds	21
Mammals	23
Reptiles and Amphibians	25
Literature Cited	26
Appendices	28
1. Plant List: Columbia River Forest Reserve	29
2. Plant List by Site	45
3. Birds of the Columbia River Forest Reserve	71
4. Mammals of the Columbia River Forest Reserve	80
5. Reptiles and Amphibians of the Columbia River Forest Reserve	81

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Conservation International (CI) is an international, nonprofit organization based in Washington, DC, whose mission is to conserve biological diversity and the ecological processes that support life on earth. CI employs a strategy of “ecosystem conservation” that seeks to integrate biological conservation with economic development for local populations. CI’s activities focus on developing scientific understanding, practicing ecosystem management, stimulating conservation-based development, and assisting with policy design.

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BELIZE CENTER FOR ENVIRONMENTAL STUDIES

The Belize Center for Environmental Studies (BCES) is a local nonprofit, nongovernmental organization established to promote the integration of environmentally sound planning with economic development in Belize. The Center’s main activities include raising public awareness of the unique features of Belize’s environment; land use planning, including the identification and protection of critical habitats; information

collection, synthesis and dissemination; and environmental assessments. The research center houses both local and international information on all aspects of the environment, and is widely used by local and international students and scientists.

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MISSOURI BOTANICAL GARDEN

The Missouri Botanical Garden, a nonprofit organization founded in 1859, is the oldest continuously operating botanical garden in the United States. Its mission is to discover and share knowledge about plants and their environment, in order to preserve and enrich life. The major projects of the Research Division, with a staff of over 150, center on studies of diversity, classification, conservation, and uses of plants, especially in the tropics. The Garden houses a rapidly expanding herbarium, currently containing more than 4 million collections from around the world, and a library with approximately 115,000 volumes.

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For able assistance and guidance in the field we thank Modesto Bol of the Belize Forestry Department, Martin Meadows, and the following Mopan villagers of San Jose who worked very hard to move heavy equipment and supplies in and out of our camps in remote and rugged parts of the reserve: Alberto Tec, Benigno Cho, Edilberto Cho, Francisco Cho, Abraham Coc, Margarito Cul, Sebastian Ico, Bernardino Tec, Felipe Tec, Sebastian Tec, Tino Tzub, and the mayor of the town, Mr. Bolon. We are also very grateful to the British Forces (esp. Brigadier Christopher Elliott), who transported us to Union Camp via helicopter, thus saving several

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Overview

INTRODUCTION

During the first two weeks of April 1992, members of Conservation International's Rapid Assessment Program team (Louise H. Emmons, Bruce K. Holst, and T.A. Parker) and Modesto Bol, a representative of the Belize Forestry Department, visited the Columbia River Forest Reserve in an attempt to quickly assess the biological importance of this poorly known area at the southeastern edge of the Maya Mountains in southern Belize along the Guatemalan border. This fieldwork was sponsored by the Belize Center for Environmental Studies and the Belize Zoo and Tropical Education Center, whose directors have become increasingly concerned about the destruction of forests along the edges of the reserve, and about human activities well inside its borders (e.g., hunting, illegal timber extraction, and slash-and-burn agriculture). Before the impact of these activities can be accurately measured, and before the natural resources of the reserve can be adequately managed, there is an urgent need for in depth studies of the flora and fauna of the region. Despite years of occasional visits to this area by biologists, the results of such work have only rarely been published. As recently as 1981, the authors of the most comprehensive list of Belizean plants (Dwyer and Spellman 1981) pointed to the need for floral inventories in the less accessible parts of the Maya Mountains. Except for brief descriptions of plant communities provided in the expedition reports of Matola (1989, 1990), knowledge of the flora of the reserve is based primarily on unpublished collections in a number of foreign institutions. Similarly, the fauna of this area was until now known from scattered museum collections of a few groups (e.g., bats; see McCarthy 1988). Recent intensive biological surveys in other parts of the Maya Mountains, such as along the upper Bladen River (Brokaw and Lloyd-Evans 1987) and in the upper Raspaculo River basin (Rogers and Sutton 1991), provide much-needed additional informa-

tion on the flora and fauna of the region. In this report we summarize the results of our own fieldwork in the Maya Mountains of southern Belize.

The Columbia River Forest Reserve encompasses 103,000 acres of rugged limestone hills and low mountains in an elevational range of approximately 300 to 900 m. Most of the reserve falls within two life zones (sensu Holdridge 1967): Subtropical lower montane wet forest (at >600 m) and Subtropical wet forest (at <600 m). These tropical evergreen forest types typically receive more than 2500 mm of rainfall each year, and some areas on the windward, Caribbean-facing slopes in the region may receive up to 4000 mm in some years (Hartshorn et al. 1984). Much of the area consists of strongly karstic, limestone hills with numerous cave systems and large sinkholes (Matola 1990). The calcareous soils of this area are presumably fertile, but are especially susceptible to erosion due to the high rainfall and steepness of the terrain.

The forests of the reserve were first studied by botanists in the 1920's, when numerous logging roads were pushed into what was then an unexplored wilderness. Access to the area was further facilitated by a network of trails cut by chicleros who harvested the sap of chicle trees (*Manilkara zapota*). Exploitation of these resources continued into the 1960's, by which time most of the (accessible) valuable hardwoods such as mahogany (*Swietenia macrophylla*) had already been cut out (Matola 1990). At the present time, the original logging roads and chiclero trails that once criss-crossed the area are now almost entirely overgrown and difficult to follow. Current threats to the reserve include subsistence agriculture by farmers from nearby Guatemala, a number of whom have already cleared at least one large area of tall forest at Gloria Camp, and hunting by people from villages such as San Jose. As the human

population of the Toledo District grows, increasing pressure will be brought to bear on the Columbia River Forest Reserve, and there will be an ever-increasing need for better protection and management of this biologically important protected area.

SUMMARY

Over a period of 12 days, the group surveyed evergreen forests in the limestone hills of the Columbia River Forest Reserve, and on Little Quartz Ridge to the northeast (Fig. 1). From work at several sites (Union Camp, Gloria Camp, Little Quartz Ridge) along the principal trail from San Jose to north of Little Quartz Ridge, and from observations made during an overflight of much of the area on 31 March, we learned that nearly all of the reserve is covered by some type of old-growth forest. Clearings of any kind are small and widely scattered. Variation in the structure and floristic composition of the various forest types observed within the reserve probably reflects the local distribution of rainfall, soil types, and drainage. The epiphyte-laden tall forest on limestone at Gloria Camp presumably receives considerably more rainfall (>3000 mm?) than the drier-looking forests on interior ridges such as those above Union Camp, even though the two areas have similar plant and animal communities. The stunted forest on poor soils along the crest of Little Quartz Ridge is distinct from that of other areas studied, having a number of montane plant elements previously unreported from the country. These forest types are described in detail later in this report.

Dominant trees in the taller forests (25-35 m) throughout the area surveyed include *Dialium guianense* (Leguminosae), *Calophyllum brasiliense* (Clusiaceae), *Erblichia odorata* (Turneraceae), *Euterpe macrospadix* (Arecaceae), *Ficus* spp. (Moraceae),

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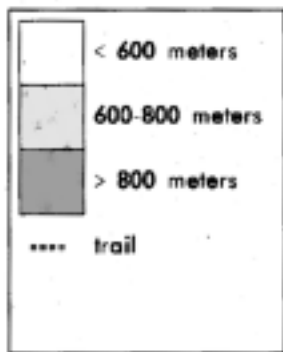
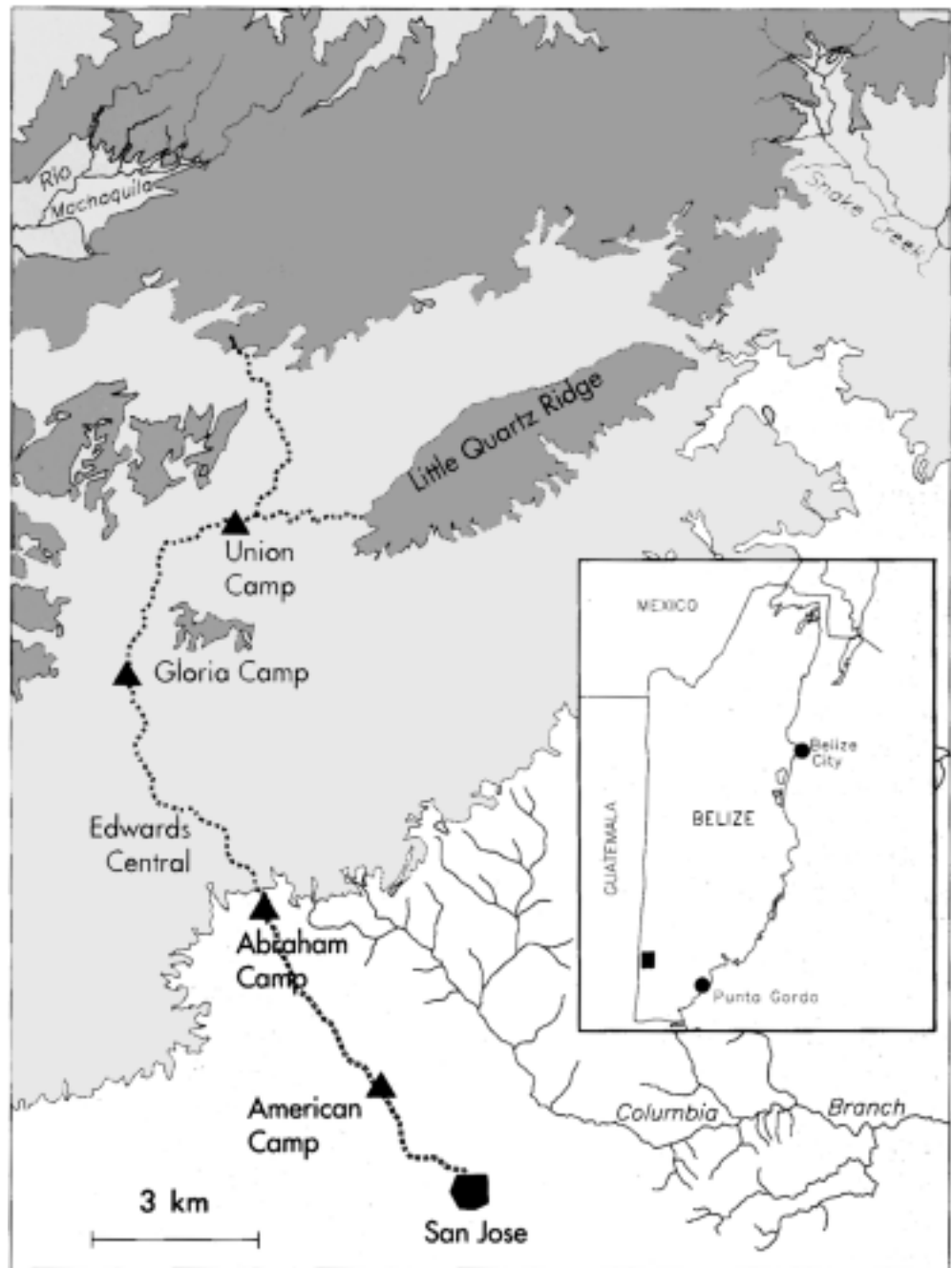


Figure 1.
*Map of the area
 visited in the
 Columbia River
 Forest Reserve.*

Guarea glabra (Meliaceae), *Hirtella triandra* (Chrysobalanaceae), *Pithecellobium arbor-eum* (Mimosaceae), *Sebastiania longicuspis* (Euphorbiaceae), *Symphonia globulifera* (Clusiaceae), and *Terminalia amazonia* (Combretaceae). Chicle trees (*Manilkara zapota*, Sapotaceae) were common but patchily distributed. In some areas (except in the wettest zone) they formed stands of giant individuals up to 40 m tall and 200 cm around. Almost all of these had been tapped by chicleros at some time in the past. Small numbers of medium-sized and small individuals of valuable hardwoods such as mahogany, *Swietenia macrophylla* (Meliaceae), and cedar (*Cedrela mexicana*) were also observed in the reserve, but most large individuals near the major trails were apparently logged out many years ago. One of the largest mahogany trees found was about 23 m tall and 51 cm in dbh (another larger individual was not measured). Many of the largest trees at Union Camp appeared to have been damaged by hurricanes in the distant past, perhaps by Hurricane Hattie in 1961. Numerous large trunks were snapped off about 25 m above the ground. All of these survivors had resprouted large limbs and branches and appeared to be healthy.

Palms are conspicuous and diverse in the reserve. At least 16 species are represented in our collections, including a variety of understory species in the genus *Chamaedorea* (6 spp.), and *Cryosophila argentea*, *Calyptrogyne ghiesbreghtiana*, and *Synechanthus fibrosus*. Common larger species include *Euterpe macrospadix* and *Orbignya cohune*. Lianas were present in all of the forest types, although they were rather sparse in the lower slope forests on Little Quartz Ridge. One of the most common liana species is *Passiflora obovata*, an endemic to forests on limestone substrate in the Maya Moun-

tains and previously considered quite rare. Twelve additional species of vines and lianas in the family Bignoniaceae were also found, including a few that were previously unrecorded (*Arrabidaea viscida*) or thought to be rare (*Anemopaegma chrysantha*) in the country.

Most of the forest types in the reserve had few arboreal epiphytes, although the canopies of tall forests at Gloria Camp and Edwards Central were heavily laden with both vascular (e.g., bromeliads and orchids) and non-vascular (mosses) epiphytes, presumably as a result of higher rainfall. Twenty-seven species of orchids are represented in our collections, including examples (from Union Camp) of the little-known genus and species *Kegeliella kupperi*, until now known from a small number of specimens from wet lower montane forests in eastern Panama (Dressler and Whitten 1992). This and other local plant species (e.g., *Colpothrinax cookii*) found in the wet hill and low mountain forests in the Columbia River Forest Reserve are apparently among the unusual floristic elements of a once widespread lower montane forest type that now survives in widely separated and fast-shrinking patches scattered along the Caribbean slope in Middle America. The extensive subtropical lower montane wet forest (sensu Holdridge 1967) at 600-900 m in the Columbia River Forest Reserve is undoubtedly one of the largest examples of its kind left in the Neotropics.

Plant collections made during this expedition by Bruce Holst and Modesto Bol contain approximately 434 species in 112 families (95 seed plant families and 17 pteridophyte families). This indicates the presence of a diverse local flora that may surpass 1500 species, which would represent a high percentage of all plant species in the country. A surprising number of the plant

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species identified to date had not been reported from the the country (see Table 1), which reflects the botanical neglect of lower montane wet forests at the southern end of the Maya Mountains. For example, of the 68 species of ferns found during our brief survey, 15 species (or 22%) were new to the country (R. Moran, pers. comm.). Most of these species were collected near Union Camp, a locality that also produced at least four plant genera new to the country: *Bombacopsis quinata* (Bombacaceae), *Kegelella kupperi* (Orchidaceae), *Rhamnus* cf. *sphaerosperma* (Rhamnaceae), and *Spherospermum cordifolium* (Ericaceae). The variety of additional new country records include a small palm (*Chamaedorea tenella*), several vines and lianas (*Arrabidaea viscida*, *Passiflora lancetillensis*), an epiphyte (*Hillia panamensis*), and a curious shrub (*Pilea ecbolophylla*) that grows only on limestone outcrops in the forest. A number of rare or little-known species were also collected, including the bignone *Anemopaegma chrysanthum*, and a recently described tree (*Inga davidsei*) known from only two additional specimens, one from Belize and one from Guatemala.

The low forest on top of Little Quartz Ridge at 800-900 m was particularly interesting from a botanical perspective. Among the numerous montane plant taxa found in the ridgecrest forest were representatives of at least three families not previously recorded in Belize: Chloranthaceae (*Hedyosmum mexicanum*), Magnoliaceae (*Magnolia* cf. *yoroconte*), and Styracaceae (*Styrax argenteus*). There is an additional unpublished Belize specimen of *S. argenteus* (collected in 1988) in the Missouri Botanical Garden collection (MBGC) from the nearby Mountain Pine Ridge area. This forest contained a number of additional plant species of

interest including the rare montane palm *Colpothrinax cookii*, which was described only recently from specimens collected in Alta Verapaz, Guatemala (Read 1969), and was first observed in Belize at this locality in 1987 (Matola 1990). Our specimens of *C. cookii* from Little Quartz Ridge were identified through direct comparison with material in the MBGC. Other montane elements of interest include trees such as the oak *Quercus cortesii* (Fagaceae), *Cyrilla racemiflora* (Cyrillaceae), and *Ilex guianensis* (Aquifoliaceae), and the terrestrial ferns *Lindsaea klotzschiana* and *L. lancea* (the former is new to Belize).

Based on the results of our bird survey in the Columbia River Forest Reserve, the avifauna of the wet forests (and second-growth) at about 350-750 m in this portion of the Maya Mountains appears to be unusually rich and includes at least 232 species, representing well over 90% of the species restricted to evergreen forests in the country. We recorded 224 bird species, including 43 transients or wintering species from eastern North America, in the areas studied. Of this total, 144 were forest-based residents, and 30 were transients or winter residents in forest. Eight additional species (2 forest, 6 non-forest) were found in the reserve during an earlier expedition (Matola 1990). Most of the resident species are widespread in Neotropical evergreen forests, but at least 30 species do not range south of Panama, and half of these are restricted to the threatened moist and wet forests along the Caribbean slope from southern Mexico to northern Costa Rica (e.g., Keel-billed Motmot *Electron carinatum*, Northern Nightingale Wren *Microcerculus philomela*, and Black-throated Shrike-Tanager *Lanio aurantius*). The motmot is a species of special conservation concern as a result of massive deforestation within

TABLE 1.

Plant Families, Genera, and Species not Previously Reported for Belize.***New Plant Families for Belize**Chloranthaceae (*Hedyosmum mexicanum* Cord.)Magnoliaceae (*Magnolia* cf. *yoroconte* Dandy)Styracaceae (*Styrax argenteus* Presl)**New Genera for Belize***Bombacopsis* (*B. quinata* (Jacq.) Dugand) - Bombacaceae*Kegeliella* (*K. kupperi* Mansfeld) - Orchidaceae*Rhamnus* (*R.* cf. *sphaerosperma* Sw.) - Rhamnaceae*Spherospermum* (*S. cordifolium* Benth.) - Ericaceae**New Species for Belize****ARECACEAE***Chamaedorea tenella* H. Wendl.**BIGNONIACEAE***Arrabidaea viscida* (Donn. Sm.) A. Gentry**PASSIFLORACEAE***Passiflora lancetillensis* MacDougal, sp. nov., ined.**PIPERACEAE***Peperomia claytonioides* Kunth.**PTERIDOPHYTES***Adiantum capillus-veneris* L.*Dennstaedtia bipinnata* (Cav.) Maxon*Diplazium riedelianum* (Bong. ex Kuhn) Kuhn ex C. Chr.*Diplazium striatum* (L.) C. Presl*Hymenophyllum pulchellum* Schldl. & Cham.*Lindsaea klotzschiana* Moritz*Nephrolepis multiflora* (Roxb.) F.J. Jarrett ex C.V. Morton*Pecuma divaricata* (E. Fourn.) Mickel & Beitel*Polypodium dissimila* L.*Pteris quadriaurita* Retz.*Sphaeropteris horrida* (Liebm.) R.M. Tryon*Sticherus palmatus* (J.H. Schaffn. ex Underw.) Copel.*Trichomanes crispum* L.*Trichomanes pyxidiferum* L.*Vittaria stipitata* Kunze**RUBIACEAE***Hillia panamensis* Standl.**URTICACEAE***Pilea ecbolophylla* J.D. Sm.**BRYOPHYTES***Callicosta evanescens* C. Müll.*Homalia glabella* (Hedw.) B.S.G.*Lepidopilidium portoricense* (C. Müll.) Crum & Steere*Lepidopilum polytrichoides* (Hedw.) Brid.*Phyllosonium fulgens* (Hedw.) Brid.*Porotrichum korthalsianum* (Dozy & Molke.) Mitt.*Macromitrium contextum* Hampe**Very Rare Species****BIGNONIACEAE***Anemopaegma chrysanthum* Dugand - Second collection for Belize.**MIMOSACEAE***Inga davidsei* Sousa - Second collection for Belize, known also from a single collection in Guatemala.

*As of this writing, it is only a partial list, and there will undoubtedly be at least a few more species to add to it.

Our surveys indicate that the Columbia River Forest Reserve may support globally significant numbers of Neotropical migrants...

its small geographical and ecological range (Collar et al. 1992). The largest remaining population of this species probably occurs in the Maya Mountains. It is also worth noting that 35 additional species found by us in the Columbia River Forest Reserve are considered rare or accidental in the country by Wood et al. (1986). Most of these are represented by large populations in the reserve (i.e., they were recorded daily in small to moderate numbers, and probably number in the thousands).

The forest bird community of the Columbia River Forest is enriched by the presence of a number of wet foothill forest species that are rare or absent from drier forests in the Peten or to the north in Belize (e.g., Violet Sabrewing *Campylopterus hemileucurus*, Slaty Antwren *Myrmotherula schisticolor*, Speckled Mourner *Laniocera rufescens*, and Shining Honeycreeper *Cyanerpes lucidus*), and by a small montane forest component of six species that typically occur in cloudforests above 700 m (e.g., Spotted Woodcreeper *Xiphorhynchus erythropygius*, Slate-colored Solitaire *Myadestes unicolor*, Common Bush-Tanager *Chlorospingus ophthalmicus*). The Slaty Antwren and another inconspicuous species found at Union Camp, the Crested Owl (*Lophotrix cristata*), have not been reported previously from the country.

As in other Middle American forests, migrants from eastern North America apparently comprise a substantial percentage of all species and individuals that occur in the Maya Mountains during more than half the year (September-April). Some indication of the numerical representation of migrants in the Columbia River Forest at this time of year can be derived from one five hour census (06:00-11:00) at Union Camp on 4 April during which Parker recorded 478 individuals of 94 species along approximately 1.5 km x 50 m of

trail through the interior of tall forest south of the camp. Of these totals, 137 individuals (29%) and 22 species (23%) were transient or wintering species. Daily field notes indicate that migrants gradually increased in number and diversity throughout the time of our stay, and imply that more than 30% of all birds in this forest were migrants during the latter days of our visit (8-13 April). Similar estimates were derived from mist-net data obtained in January-February in the upper Raspaculo River basin not far to the north (Mallory 1991). Our surveys indicate that the Columbia River Forest Reserve may support globally significant numbers of Neotropical migrants, especially during certain migratory periods (e.g., March-April).

The most numerous migrant passerine birds in the Columbia River Forest from 3-13 April, with 12-30+ individuals recorded daily in small areas (<1.5 km x 50 m) were: Acadian Flycatcher (*Empidonax virescens*), Swainson's Thrush (*Catharus ustulatus*), Black-and-white Warbler (*Mniotilta varia*), Magnolia Warbler (*Dendroica magnolia*), Cerulean Warbler (*Dendroica cerulea*), Chestnut-sided Warbler (*Dendroica pensylvanica*), Kentucky Warbler (*Oporornis formosus*), American Redstart (*Setophaga ruticilla*), Wilson's Warbler (*Wilsonia pusilla*), and Summer Tanager (*Piranga rubra*). Smaller but significant numbers (<10/day) of the following species were also recorded: Worm-eating Warbler (*Helmitheros vermivorus*), Golden-winged Warbler (*Vermivora chrysoptera*), Blue-winged Warbler (*Vermivora pinus*), Black-throated Green Warbler (*Dendroica virens*), and Ovenbird (*Seiurus aurocapillus*). Several of the above species are especially threatened by the destruction of old-growth forests in Central America (see Morton 1992). Another migrant (or wintering) species of interest was Chuck-wills-widow (*Caprimulgus carolinensis*), at least three individuals

of which were tape-recorded in the forest-edge at Union Camp in early April; this species is not listed in a recent compilation of Belizean birds (Wood et al. 1986), although an unpublished specimen was recently obtained in the country (M. Meadows, pers. comm.). A Warbling Vireo (*Vireo gilvus*) carefully observed in the same place on 4 April apparently represents the first record for Belize.

Our observations of Cerulean Warblers in the canopy of tall hill forests at about 600-750 m in the Columbia River Forest are particularly noteworthy. This species is of special conservation concern because it has suffered a long-term population decline, reportedly as a result of habitat destruction on both its breeding grounds in the eastern United States, and its wintering grounds on the eastern slopes of the Andes in South America (Robbins et al. 1992). The occurrence of large numbers (>80 sightings) of this species in the Maya Mountains in early April strongly suggests that lower montane forests in this region are of great importance to this and other forest-based species (e.g., Swainson's Thrush) that migrate through portions of Central America in the spring, from wintering areas far to the south. Widespread destruction of wet forests at 500-1500 m in southern Mexico, Guatemala, Honduras, and Nicaragua represents a severe threat to long-distance Neotropical migrants such as these. The entire world population of Cerulean Warbler may be concentrated in forests at these elevations in a very small geographic area in northern Middle America during late March and early April. If this is so, then destruction of these forests may well represent the greatest threat to the long-term survival of this species. This revelation underscores the urgent need to determine the migratory routes and staging areas of Neotropical migrant landbirds in Middle America.

Large tracts of relatively undisturbed forest such as the Columbia River Forest Reserve will become increasingly important to numerous Neotropical migrants as the evergreen forests in adjacent countries become reduced to small and widely scattered fragments.

We recorded 29 species of mammals in the Columbia River Forest. Of these, 15 were captured, eight were identified by sight or sound, and six were identified from calls or tracks. Most of the species encountered are typical of lowland evergreen forests of Belize and Mesoamerica in general. Large mammals (e.g., agoutis, brocket deer, coatis, and howler monkeys) were very scarce by Neotropical standards, except for tapirs (*Tapirus bairdi*), which were common. The most numerous non-flying mammals in the areas studied were Deppe's Squirrels (*Sciurus deppei*), kinkajous (*Potos flavus*), and spiny pocket mice (*Heteromys desmarestianus*).

One of the most interesting mammal species observed in the reserve (at Union Camp) was the cacomistle (*Bassariscus sumichrasti*). At least three or four individuals (or pairs?) were heard almost nightly as they moved through the canopy of forests around the clearing. Their apparent patchy distribution in the area (none were recorded at Gloria Camp) suggests that they may be restricted to a certain type of forest, or perhaps to forest areas with limestone outcrops. This species is apparently uncommon and local throughout its range in Middle America and is undoubtedly declining as a result of widespread deforestation.

Several species that should occur in this forest were not found, including spider monkeys (*Ateles geoffroyi*) — said by local guides to have been present up until 15 years ago, but now thought to be extinct. White-lipped peccaries (*Tayassu pecari*) are very rare according to local Mayans who had

*...a fifth
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seen them only a few times over the past five years. Possible reasons for the scarcity of these and other large mammal species are discussed below.

Information on the herpetofauna of the reserve is limited. To date, only 27 species of snakes, lizards, and frogs have been recorded, but numerous additional species probably occur (see Matola 1990 for list). It is noteworthy, however, that among the 10 species of frogs in our collections, three represent new records for Belize, including a rare fringed treefrog (*Hylaminera*), the cloudforest-dwelling *Hyla bromeliacea*, and an undescribed species of *Eleutherodactylus*. Because a fifth of all frog species collected were new to Belize, we believe that further fieldwork will reveal the presence of many more species of interest. The Columbia River Forest Reserve therefore may hold a distinctive herpetofauna that is important for the overall herpetological diversity of Belize.

CONSERVATION OPPORTUNITIES (L.H. Emmons and T.A. Parker III)

Based on the preliminary results of floral and faunal surveys in the Columbia River Forest Reserve, we can say without any hesitation that the evergreen forests of this area (and contiguous areas such as the Upper Bladen River and Upper Raspaculo River basin to the north) are of great national and international importance as a reservoir of biological diversity. Our studies strongly suggest that the most species-rich plant and animal communities in Belize occur in the wet forests at 600-900 m on the windward slopes of the southern Maya Mountains in the Toledo District. Terrestrial and aerial reconnaissance of similar terrain in adjacent countries indicates that this is one of the only large, continuous tracts of relatively undisturbed evergreen forest left in Middle America. In addition to its biological value,

the Columbia River Forest is also a critically important watershed that traps and recycles the heavy rainfall that is so crucial to the productivity of agricultural lands along the base of the mountains to the east. The removal of forest cover in this rain-drenched region, and the rapid soil depletion that would inevitably follow in such steep and porous limestone terrain, will undoubtedly have strong and lasting impacts on the rural economy of southern Belize. For these reasons, we offer the following recommendations.

1 To preserve the integrity of the Columbia River Forest Reserve, a concerted effort should be made to strengthen protection of its borders. At Gloria Camp, 3-4 km east of the Guatemalan border, we found a recent, large clearing and a temporary camp that had been occupied by as many as 20 people who our Mopan guides had identified as Guatemalans. Unless such incursions are controlled, much of the western edge of the forest reserve will be gradually eroded away by the activities of these colonists. Similarly, unless the southern boundary of the reserve is accepted (and its importance understood) by the Mopan Maya living in villages such as San Jose, these people — who have long hunted in this forest and depend on it for a number of essential products — will also continue to clear portions of it for their milpa-type of agriculture. It is hoped that this agriculture will be confined to the moderate slopes and level areas along the base of the mountains (e.g., below about 400 m), because some of the wettest forests in the region, and those in the most erosion-prone terrain, occur on the windward-facing slopes above approximately 400 m. As mentioned earlier, these forests (as at Gloria Camp) are also among the most species-rich and therefore biologically important of the country's ecosystems.

2 Increased protection should extend to the full-range of forest types in the reserve, and beyond to the north toward the main divide of the Maya Mountains. Our preliminary studies indicate that there is a substantial amount of variation in the composition and structure of forests in the region, ranging from the wettest, most diverse types on limestone in the south, to the somewhat drier and less diverse (but different) forests on the interior ridges to the north. Protection of forests in the headwater region of the Rio Machaquila, where groundwater may be more prevalent, is highly recommended. The unexplored montane forests (above 1000 m) to the northeast along the main divide (as in the Doyle's Peak area, see Matola 1989) appear from the air to be similar to those on Little Quartz Ridge, but are taller and presumably more floristically diverse. Biological exploration and protection of these area-restricted forests is also a high conservation priority for the country. The ideal protected area for the region would encompass all of the above areas. Authorities should explore the possibility of establishing a national park in the core of this region, to be surrounded by various types of additional protected areas where non-damaging activities (e.g., limited, carefully monitored timber extraction or subsistence hunting) would be allowed.

3 A few comments on the impact of hunting within the reserve are in order. If the number of hunters from San Jose remains constant, the Columbia River Forest Reserve should continue to provide game for them indefinitely. The far interior of the reserve, toward the higher parts of the Maya Mountains, provides a reservoir too remote to exploit to extinction. However, the encroachments by Guatemalan poachers need to be vigorously controlled, because severe hunting pressure in areas beyond the intensive hunting zone

of San Jose could tip the populations of game species into serious decline. A well defended reserve — and especially a protected core area within the reserve — could have the important function for the people of San Jose of maintaining populations of their game species, to be hunted only in a large buffer zone outside. Education about this function and local cooperation would be essential for successful maintenance of the reserve.

4 To study and monitor the effects of hunting and other exploitative activities (e.g., the long-term impact of heavy logging and chicle extraction) in the Columbia River Forest Reserve and beyond, we recommend the establishment of one or several permanent camps along the western edge of the reserve, as in the vicinity of Union Camp or Gloria Camp. These would serve as guardposts and research stations where more intensive scientific studies could be carried out. Local people could be employed on a temporary or permanent basis to maintain such facilities. These camps could also be used to support small groups of ecotourists that could be easily attracted to the region if some of their basic needs could be met (e.g., trained guides, shelter, orientation, information on the flora and fauna of the area). A hunting ban in all areas within five kilometers of such camps would undoubtedly result in a rapid increase in large animal species, many of which would also become acclimated to the presence of non-threatening humans in the area (this has occurred in as few as 10 years at some localities in Amazonia; pers. obs.).

5 Once such guard stations are established, it would be desirable to reintroduce spider monkeys into the reserve (if they do not reappear by their own means). Because they are strongly frugivorous and travel widely, these large primates are important dispersers of fruit. Their permanent loss from the forest could have long-term impacts on the distribution and abundance of some plant species. Likewise, if a three-to-five-year moratorium on hunting white-lipped peccaries could be implemented, herds could make a strong recovery (if indeed overhunting is the cause of small herd size in this area).

6 Well-organized ecotourism could generate a substantial amount of income for communities such as San Jose. Although some number of tourists (from Punta Gorda) now visit this and other Maya villages to gain a glimpse of the people and their way of life, our experience with the Mopan Maya of San Jose suggests that much needs to be done in the way of education and diplomacy before an equitable system of profit distribution can be worked out in these villages. An even larger problem at this time is the fact that the rain forests that tourists would come to see are inaccessible. The main trail from San Jose to Union Camp is in poor condition, being difficult to follow and treacherous in many places. The first few kilometers of this trail pass through milpas and small patches of second-growth woodland. To reach nice, tall forest (above American Camp) requires an arduous hike of 2-3 hours. A closer route to old-growth rainforest should be located if casual tourists are to ever see this habitat near San Jose. To attract more serious hiking enthusiasts, the trail to Union Camp should be extended north to higher elevations along the Main Divide of the Maya Mountains. This would also facilitate biological exploration of this remote area.

Technical Report

METHODS

Field methods varied according to each specialist. Holst and Bol collected plants and data on numerous woody species (including measurements of many of the larger trees). Specimens are currently housed in the Missouri Botanical Garden collections (St. Louis, Missouri). Plant identifications were made by Holst and specialists at the MBG (see Acknowledgements). Holst also made qualitative descriptions of habitat structure and composition in all areas studied (see Site Descriptions). Emmons trapped small mammals for eight nights with Tomahawk, Sherman, and Victor rat traps, for a total of 578 trap/nights. Bats were captured by setting mist nets on two nights, once in front of a cave mouth near Union Camp. Mammal specimens are currently housed in the Smithsonian Institution (Washington, D.C.). Other mammals were observed while walking trails by day (Emmons 24.51 hours; and Parker) and night (Emmons 18.75 h). This was facilitated by the presence of many well-used trails in the area. Mayan guides and helpers were questioned about mammals they knew of in the area (although their knowledge seemed limited, and most were unaware of a number of species that should occur in the region). Parker surveyed birds (ca. 85 hours) with the aid of binoculars, tape-recorders and unidirectional microphones; the majority of forest-dwelling species were tape-recorded, and copies of all recordings will be deposited in the Library of Natural Sounds (Cornell University), and eventually, in the Belize Center for Environmental Studies (Belize City). Mist-nets were not used, primarily because they capture only a small percentage of the species and individuals at low levels in a tall forest (especially during brief surveys) and they require large amounts of time to maintain. Parker recorded information on habitat and foraging behavior, height, substrate, and prey type for most of the bird species observed. He also censused birds (by sight and sound) along several forest transects (ca. 1.5 km x ca. 100 m) at Union Camp.

SITE DESCRIPTIONS (B.K. HOLST)

Vegetation at Union Camp

Most of the topography in this area consists of undulating, densely forested limestone hills with numerous, prominent outcrops of jagged limestone, especially along the ridgecrests. The taller forest (25-30 m) on the slopes and ridgetops appears somewhat drier than that of the stream bottoms and more level areas at lower elevations. The sparsity of epiphytes and presence of deciduous trees (*Erythrina* spp., *Erblichia odorata*, *Pithecellobium arboreum*) provide evidence that there is a marked dry season. Common canopy trees on these slopes and ridges include *Calophyllum brasiliense* var. *rekoii* (Clusiaceae), *Casearia* spp. (Flacourtiaceae), *Erblichia odorata* (Turneraceae; a conspicuous species with showy, orange flowers), *Sebastiania longicuspis* (Euphorbiaceae), *Zanthoxylum juniperinum* (Rutaceae), an unidentified species of Lauraceae, and the palm *Euterpe macrospadix* (Arecaceae). Chicle trees, *Manilkara zapota* (Sapotaceae), are the largest trees in this area, in places being the dominant species with numerous giant individuals 35-40 m tall. All of these had been tapped by chicleros in the distant past, as evidenced by prominent slashes from near the ground to high up on the massive trunks. The common liana in the canopy trees is *Sinclairia polyantha* (Compositae). The dominant understory tree is *Rinorea guatemalensis* (Violaceae). Other shrubs and small trees include *Ardisia paschalis* (Myrsinaceae), *Trophis mexicana* (Moraceae), and the understory palms *Calypstrogyne ghiesbreghtiana* (in moist pockets), *Chamaedorea* sp., and *Synechanthus fibrosus* (Arecaceae). The understory was virtually free of herbaceous plants except for on the limestone outcrops where *Dorstenia lindeniana* (Mor-

aceae) was common. The aroid *Anthurium bakeri* occurs on many fallen logs, and the saprophytic herb *Voyria parasitica* (Gentianaceae) was frequent in areas with large accumulations of leaf litter. An apparently rare cycad, *Zamia* sp., was seen only two times and these specimens were sterile. Although epiphytes are not abundant, those that occur in this habitat tend to be large and shrub-like, such as *Blakea cuneata* (Melastomataceae), *Clusia* spp. (Clusiaceae), the huge tank-forming bromeliad *Androlepis skinneri* and the smaller, purple-flowered *Aechmea lueddemanniana*. The other group of common epiphytic bromeliads of the genus *Tillandsia* are much smaller plants, but are mostly covered by gray scales to help them pull moisture out of the air. The rare, herbaceous, yellow-flowered gesneriad *Columnea sulfurea* was seen several times on large tree trunks.

The exposed limestone creek that flows by Union Camp had a supply of water that appeared irregularly along its course. The large quantities of rock along the creek provided a unique substrate for many herbaceous and suffrutescent species not found elsewhere in the forest. The most common of these were *Justicia breviflora* (Acanthaceae), *Cuphea hyssopifolia* (Lythraceae), *Peperomia* sp., *Peperomia claytonioides* (Piperaceae), *Spigelia humboldtiana* (Loganiaceae), and *Tectaria heracleifolia* (Aspleniaceae). *Selaginella guatemalensis* and *S. stellata* (Selaginellaceae) occurred on the stream banks, along with several species of shrubs, including *Crossopetalum eucmosum*, *Maytenus schippii* (Celastraceae), *Palicourea padifolia* (Rubiaceae), small tree ferns (*Cyathea multiflora*), and small trees such as *Cleidion castaneifolium* (Euphorbiaceae), *Miconia impetiolaris* (Melastomataceae), *Tovomitopsis nicaraguensis* (Clusiaceae), and *Trophis mexicana* (Moraceae).

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The floodplains and low, moist areas near the stream are dominated by palm species, particularly *Calypstrogyne ghiesbreghtiana*, a beautiful acaulescent species that forms large colonies, *Chamaedorea tenella* (another new species for Belize), and *Astrocaryum mexicanum* (ware cohune), one of the two common spiny palms in the area. These areas are also rich in ferns, and we easily found at least 20 species. Another common moist area plant that forms small colonies is the yellow-flowered *Heliconia aurantiaca* (Heliconiaceae). One of the richest plant communities in this area is found on logs that have fallen across the streams where moisture is more abundant and evenly available. Particularly numerous in this type of habitat are small ferns, orchids, bromeliads, and *Peperomia* species. The first examples (for Belize) of the poorly known orchid *Kegeliella kupperi* were collected here, as were specimens of a new genus of Ericaceae for the country, *Sphrospermum*.

The fringe of secondary forest around the Union Camp clearing was comprised of a number of widespread small trees and shrubs, including *Cecropia* sp. (Cecropiaceae), *Clusia minor*, *Vismia camparaguey* (Clusiaceae), *Siparuna andina* (Monimiaceae), *Parathesis aeruginosa* (Myrsinaceae), *Shefflera morototoni* (Araliaceae), *Triplaris* sp. (Polygonaceae), *Costus pulverulentus* (Costaceae), and *Pteris pungens* (Adiantaceae).

Tall, Open Understory Forest East of Union Camp

Several kilometers northeast of Union Camp, along an overgrown logging road, we found a tall, closed-canopy forest (30-35 m tall) on fairly level ground, with emergents to approximately 45 m tall and 190 cm dbh (*Manilkara zapota*, *Terminalia amazonia*). Many of the larger trees had their tops

broken off, probably by a hurricane. The two most common canopy trees are *Dialium guianense* (Leguminosae) and *Calophyllum brasiliense* var. *rekoi* (Clusiaceae). The lower canopy trees (15-25 m tall) include *Dendropanax arboreus* (Araliaceae), *Ficus guajavioides* (Moraceae), *Hirtella triandra* subsp. *triandra* (Chrysobalanaceae), *Hyeronima alchorneoides* (Euphorbiaceae), and *Cymbopetalum mayanum* (Annonaceae). A few medium-sized individuals of *Swietenia macrophylla* (Meliaceae) were also positively identified in this forest. A sample of understory trees included *Annona scleroderma*, *Guatteria amplifolia* (Annonaceae), *Guarea macrophylla* (Meliaceae), and *Symphonia globulifera* (Clusiaceae). Lianas are more abundant in this forest and are represented by more families than are found in the drier limestone hills (Bignoniaceae, Loganiaceae, Menispermaceae, Passifloraceae, Sapindaceae, Vitaceae), with *Vitis tiliifolia* and the endemic *Passiflora obovata* the most common. Because of the dense shade from the closed canopy, the understory was largely open and very easy to walk through. The common shrubby palms in this area are *Calypstrogyne ghiesbreghtiana*, *Cryosophila argentea*, and *Synechanthus fibrosus*; additional shrubs or small trees include *Rinorea guatemalensis*, *Psychotria simiarum*, and *Costus pulverulentus* (Costaceae). Small tree ferns (*Cyathea multiflora*) were also common.

Similarly tall, diverse-looking forest on level land covers a large area along the north side of Little Quartz Ridge (T. Parker, pers. obs.), where large numbers of 35+ m *Manilkara zapota* and *Terminalia amazonia*, along with lesser numbers of *Vochysia hondurensis* (Vochysiaceae) and a few small *Cedrela mexicana* and *Swietenia macrophylla* (Meliaceae) were identified by Modesto Bol.

Little Quartz Ridge

The floristically distinct forest at 800-900 m on the summit of this mountain has a fairly open canopy averaging 15-20 m in height. The undergrowth is sparse, with practically no terrestrial herbs. True epiphytes and vines are also scarce, but many small trees support hemi-epiphytic *Philodendron* species. Two large palms (*Euterpe macrospadix* and *Colpotherinax cookii*) are common and evenly distributed along the ridgetop. The latter species is of particular interest, having been described only recently (1969) from the nearby Alta Verapaz region in Guatemala and from a widely disjunct population in eastern Panama (Read 1969). A number of additional montane plant taxa occur on the top of Little Quartz Ridge, including representatives of three plant families not previously reported from Belize: *Hedyosmum mexicanum* (Chloranthaceae), *Magnolia* cf. *yoroconte* (Magnoliaceae), and *Styrax argenteus* (Styracaceae). Among the common, larger canopy trees in the summit forest were *Quercus cortesii* (Fagaceae) and *Calophyllum brasiliense* (Clusiaceae), and *Pithecellobium arboreum* (Leguminosae). Smaller trees include *Alchornea latifolia* (Euphorbiaceae), *Guatteria amplifolia* (Annonaceae), *Miconia dodecandra* (Melastomataceae), *Myrcia splendens* (Myrtaceae), *Randia matudae* (Rubiaceae), *Simaruba amara* (Simarubaceae), and additional montane elements such as *Cyrilla racemiflora* (Cyrillaceae) and *Ilex guianensis* (Aquifoliaceae). A single individual of the recently described *Inga davidsei* (Mimosaceae) was also found. *Psychotria elata* (Rubiaceae), with showy and abundant red inflorescences, is especially common and conspicuous in the understory. Other common understory shrubs are *Clidemia involucrata* (Melastomataceae),

Critonia sexangulare (Asteraceae), and the palm *Synechanthus fibrosus*. The terrestrial ferns *Danaea elliptica* and the montane species *Lindsaea klotzchiana* and *L. lancea* are also numerous.

The forests on the slopes and base of Little Quartz Ridge were similar to those of the nearby limestone hills with the usual common emergents (*Manilkara zapota*), and smaller species such as *Crossopetalum eucymosum* and *Rinorea guatemalensis*.

Vegetation Around Gloria Camp

The 35 m tall forest on the steep slopes and ravines in the vicinity of this camp was considerably more humid than that observed at other sites. Most of the large tree branches were laden with both vascular and non-vascular (mosses) epiphytes. Prominent canopy trees in this wet forest include the widespread *Calophyllum brasiliense*, *Ceiba pentandra*, *Ficus* spp., *Dialium guianense*, and *Terminalia amazonia*. A few species (e.g., *Manilkara zapota*, *Erblichia odorata*) that were common in drier-looking forest at Union Camp are scarce or absent from this locality. Common understory trees include *Bernardia interrupta* (Euphorbiaceae), *Guarea glabra* (Meliaceae), *Compsoeura sprucei* (Myristicaceae), *Rinorea hummelii* (Violaceae), and a few species not seen elsewhere such as *Beilschmiedea hondurensis* (Lauraceae), *Hamelia calycosa* (Rubiaceae) and *Orthion malpighiifolium* (Violaceae). Among the common forest shrubs are Rubiaceae such as *Psychotria simiarum* and *Faramea occidentalis*, and a conspicuous green-flowered Acanthaceae, *Louteridium donnell-smithii*. *Crysophila argentea* is the dominant understory palm at Gloria, and *Chamaedorea tepejilote* is also frequent. Scattered individuals of *Orbignya cohune* were observed in this forest, but were much more conspicuous

in more disturbed forest at lower elevations and closer to San Jose, where they are obviously left when the forest is cleared. Numerous seedlings and small trees of the widespread *Acalypha diversifolia* (Euphorbiaceae) were noted in small regenerating clearings throughout the area, especially at Edwards Central.

BIRDS (T.A. Parker III)

During 10 days (ca. 85 hours) of intensive fieldwork in the forested hills of the Columbia River Forest Reserve, we identified 224 species of birds (Appendix 3), 43 of which are migrants or wintering species that breed in North America. Most of this effort was concentrated in the interior of tall evergreen forest in the vicinity of Union Camp and Gloria Camp (see Fig. 1) in an elevational range of approximately 650 to 750 m. A few hours were also spent in shrubby second-growth around small clearings at the primary study sites, and also along the lower edge of continuous forest near American Camp, not far from the village of San Jose (at ca. 300 m). Eight additional species (2 forest, 6 non-forest) were recorded in the reserve by participants of an earlier expedition (Matola 1990; see end of Appendix 3).

We were fortunate to be able to study the avifauna of such a remote and relatively undisturbed forest. Few similarly large, uninhabited areas exist anywhere in Middle America. The closest large clearings (>2 ha) to Union Camp were about 20 km to the south. The avifauna in the tall forests near Union Camp is comprised of at least 177 species, including 147 resident species and 30 migrants from North America. An additional 47 species (residents and migrants) were found only in second-growth around small clearings. The presence of fair numbers of the heavily hunted Great Curassow (*Crax rubra*), Great

Tinamou (*Tinamus major*), and Spotted Wood-Quail (*Odontophorus guttatus*) in forests north of Gloria Camp indicates that hunting pressure is not severe in the more remote sections of the forest reserve. Although a few species are inexplicably scarce (e.g., Crested Guan *Penelope purpurascens*) or apparently absent (Scarlet Macaw *Ara macao*) from the reserve, a reduction in hunting pressure on the larger birds and mammals would no doubt result in the full recovery of populations of most species. Our sightings of three species of hawk-eagles is further evidence that the larger fauna of the reserve is relatively intact.

The forest avifauna of this portion of the Maya Mountains is apparently richer than that of any other locality in Belize, and is presumably similar to that of the wet foothills of the Caribbean slope in adjacent Guatemala. At least 35 species found by us in the reserve are considered rare or accidental in the country by Wood et al. (1986). Most of these are represented by small to moderately large populations that probably number in the thousands of individuals (see Appendix 3). The Columbia Forest avifauna includes a number of foothill species that are rare or absent in drier forests in the Peten or to the north in Belize, including Violet Sabrewing (*Campylopterus hemileucurus*), Stripe-tailed Hummingbird (*Eupherusa eximia*), Keel-billed Motmot (*Electron carinatum*), Speckled Mourner (*Laniocera rufescens*), and Shining Honeycreeper (*Cyanerpes lucidus*). There is also a small but distinct montane component in this avifauna, including at least six species (see Summary) that occur primarily in cloudforests above 700 m. A potentially interesting resident and endemic subspecies of Solitary Vireo (*Vireo solitarius notius*) was found in evergreen forest at Union Camp, and isolated forms of this and other montane species (e.g., the Slate-colored Solitaire)

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should be studied to determine the degree to which the Maya Mountain populations have differentiated from others in the Middle American highlands. The recent discovery of the Montane Foliage-gleaner *Anabacerthia variegaticiceps* at nearby Doyle's Peak (Matola 1989) indicates that additional cloudforest species may eventually be found in unexplored, higher parts of the Maya Mountains in Belize.

The rest of the Columbia Forest avifauna is fairly widespread at lower elevations on the Caribbean slope in Middle America, although about 30 species (20%) do not range south of Panama, and half of these are restricted to the threatened forests of southern Mexico to northern Costa Rica (e.g., Stub-tailed Spadebill *Platyrrinchus cancröminus*, Northern Nightingale-Wren *Microcerculus philomela*, and Black-throated Shrike-Tanager *Lanio aurantius*). The bird species that best mirrors the destruction of foothill forests of northern Middle America is the Keel-billed Motmot (*Electron carinatum*), generally considered to be among the rarest of Neotropical birds (Collar et al. 1992). This inconspicuous species was surprisingly numerous in the canopy of tall forests near both Gloria and Union Camps. At least 20 individuals were located in these areas, which indicates that a fairly large population survives in this region. Additional populations have recently been discovered in Belize to the north (Miller 1991, Collar et al. 1992). At least two inconspicuous inhabitants of humid foothill forest (Crested Owl *Lophotrix cristata* and Slaty Antwren *Myrmotherula schisticolor*), both found at Union Camp, have apparently not been reported previously from the country.

As in other Middle American forests, migrants from North America apparently comprise a substantial percentage of all species and individuals that occur in the Maya

Mountains during more than half the year (September-April). Of the 215 bird species that we recorded in all habitats in the Columbia River Forest Reserve during the first two weeks of April, 43 (20%) breed in eastern North America. Furthermore, of 177 forest-based species found by us in the reserve, 30 (20%) were migrants or wintering species from the north. Some indication of the numerical representation of migrants in the Columbia Forest avifauna at this time of year can be derived from one five hour census at Union Camp on 4 April (see Summary).

The most common and conspicuous migrant bird species inside the Columbia forest from 3-13 April were wood warblers (Parulidae), represented by 16 species, followed by flycatchers (5 spp.), vireos (4 spp.), thrushes (2 spp.), hawks (1 sp.), cuckoos (1 sp.), and tanagers (1 sp.). Additional species of warblers, vireos, and flycatchers were recorded in edge habitats nearby (see Appendix 3). The most numerous migrant warbler species, with 12-30+ individuals recorded daily in small areas (<1.5 km x 100 m) of forest are listed in the Summary. A number of migrants that are especially threatened by the destruction of old-growth evergreen forests in Middle America (see Morton 1991) were recorded in the reserve. Many of the Kentucky Warblers exhibited territorial behavior (i.e., strong response to playbacks of call notes, and repeated sightings of individuals within the same small areas of forest), which suggests that there is a large wintering population here. Significant numbers of Worm-eating Warblers may also winter in this forest; this species and transient Golden-winged Warblers were frequently observed foraging (searching curled dead leaves) in the viny middlestory and lower canopy of mature forest around Union Camp. Other species that may winter in large numbers here include Wood Thrush (*Hylocichla mustelina*) and

Hooded Warbler (*Wilsonia citrina*), most of which may have already departed (before 3 April) for their breeding grounds.

We recorded several species that occur in the Columbia forest as spring (and fall?) transients, including Eastern Wood Pewee (*Contopus virens*), Acadian Flycatcher (*Empidonax virescens*), Golden-winged Warbler, Swainson's Thrush (*Catharus ustulatus*), and Cerulean Warbler. The latter three were especially numerous during our visit. Swainson's Thrushes were very common (>20/day) at Gloria Camp from 10-13 April, and many individuals were in full song. As in the case of Cerulean Warbler (see Summary), these thrushes were probably staging in this area, for the subspecies reported from Belize (*C. u. swainsoni*; Russell 1964) winters primarily in lower Andean forests of Ecuador, Peru and Bolivia. Many individuals were observed feeding on the fruits of *Bursera simaruba*, a common middlestory tree. An observation of a Black-billed Cuckoo (*Coccyzus erythrophthalmus*) in a canopy vine tangle at the edge of a treefall up in tall forest south of Union Camp on 8 April is also noteworthy, as the species is listed as hypothetical in Belize by Russell (1964). This and other expected transients (e.g., Bay-breasted Warbler *Dendroica castanea*) may pass through this area during the last two weeks of April and in early May, and an effort should be made to survey these forests for migrants at that time of year and in the fall. It is becoming increasingly clear that the migratory routes of some Neotropical migrants are very narrow in Middle America, and the protection of their habitats during migration may be as important to some species as the preservation of their breeding and wintering habitats.

As discussed earlier, our observation of large numbers of Cerulean Warblers is of particular interest. Little is known of the migratory routes of this species, and there

are only a handful of published spring records for it in northern Middle America. We were quite surprised to find such large numbers (>80 sightings) of Cerulean Warblers in the canopy and upper middlestory of tall hill forests (at ca. 600-750m) in the Columbia River Forest Reserve during our stay. Indeed, this was one of the most numerous of migrant passerines in the canopy of this forest during early April, being outnumbered by only three species (Black-and-white Warbler, Wilson's Warbler, and Magnolia Warbler). All of the Cerulean Warblers observed in the area were in the interior of mature forest far from edges; most individuals were in the shady lower canopy from about 14 to 20m above the ground. A detailed account of the habitat and foraging behavior of this species in the Columbia Forest will be published elsewhere.

MAMMALS (L.H. Emmons)

In the 10 days we spent within the Columbia River Forest Reserve, we recorded 29 species of mammals (Appendix 4). Of these, 15 were captured, 8 were identified by sight or sound, and 6 were identified from calls or tracks. All were species that from their known distributions would be expected to occur in the region. Mammals were observed while walking trails by day (Emmons 24.51 hours; and Parker) and night (Emmons 18.75 h). This was facilitated by the presence of many well-used trails in the area, but hampered by rain on four nights.

The mammal species encountered at Union Camp and Gloria Camp are typical of lowland humid or evergreen broadleaf forests of Belize and Mesoamerica in general. Of the large mammals, only tapirs (*Tapirus bairdi*) were abundant. Although none were seen, fresh tracks were present on all trails surveyed and at all points of water. Other large

**Perhaps
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centration
of...
cacomistles
(*Bassariscus
sumichrasti*)**

mammals were very scarce by Neotropical standards. Only three agoutis (*Dasyprocta punctata*), and one each of brocket deer (*Mazama americana*), coati (*Nasua narica*), tayra (*Eira barbara*), howler monkey (*Alouatta pigra*), and one group of collared peccaries (*Tayassu tajacu*), was seen during the entire expedition.

The most abundant non-flying mammals were Deppe's squirrels (*Sciurus deppei*), with about two dozen sightings, largely due to mating groups, kinkajous (*Potos flavus*) with six sightings, and spiny pocket mice (*Heteromys desmarestianus*) with four captures. Despite a good effort to trap small mammals (578 trap/nights; see Methods), trapping success was low (2%). The rate may have been reduced by rain and bright moonlight on three nights each, but similar rates are often recorded from tropical forests.

Bats were captured by setting mist nets on two nights, once in front of a cave mouth. Because a number of bat collections already exist for Columbia River Forest (McCarthy 1988), we gave bat netting low priority.

We heard monkeys (*Alouatta*) howling daily; at dawn we could usually hear several groups. These were dispersed at large intervals of apparently at least 500 m to 1 km. There was no evidence of spider monkeys (*Ateles geoffroyi*). Local Indians stated that *Ateles* had been present in the forest until 15 years ago, but were now extinct. Tracks identified as a small group of white-lipped peccaries (*Tayassu pecari*) were found by Bol and Holst near Quartz Ridge. Most of the Mopan guides concurred that they had not seen this species for about five years, but one hunter said that he sometimes found small groups of 10-20.

Perhaps the most interesting record of mammals was of a concentration of at least three or four individuals/pairs of cacomistles (*Bassariscus sumichrasti*) in forest canopy

around the helipad at Union Camp, and others to the NE of the camp. Their vocalizations were tape-recorded, but they fled at our approach, and we saw only the eyeshine. The cacomistles called and counter-called for several hours off and on throughout each night. None were heard at Gloria, or on the trail for a couple of km east of Union Camp, so the population may be patchy or localized. Cacomistles have a small geographic range in a threatened habitat and appear to be everywhere rare. They are said to be extinct in parts of their range, do not occur in some parks within their theoretical range (e.g., La Selva; they are listed as CITES Appendix III in Costa Rica), and probably are much more severely threatened than are most mammals globally listed by CITES, such as many primate species, tapirs, and otters. The Columbia Forest could contain an important population.

There may be multiple causes of the low densities of large mammals in the Columbia River Forest Reserve. Monkeys may have been decimated by both yellow fever and hunting during the chicleo period. Persistent hunting or disease may have prevented repopulation by these slowly reproducing species. Our observations, particularly of many large tinamous and a good number of curassows along the main trails, suggest that hunting pressure near and NE of Union Camp was not sufficient to account for the low numbers of agoutis, peccaries and deer. This was not the case in forest along the trail from Gloria Camp towards San Jose, where evidence of game animals was increasingly scarce. We think it likely that some constraint in resources, such as low numbers of large-seeded palm nuts or seasonal fruit or water shortages, limits densities of deer, agoutis and peccaries. These species are prolific breeders that elsewhere exist at higher densities under heavier hunting pressure. Tapirs, being

browsers, may not be subject to the same constraints. However, tapirs may also be virtually free from hunting (the Mayans said that they did not hunt tapirs because the meat was too rich and caused a rash, a statement we have also heard elsewhere).

The extent of hunting pressure is difficult to judge. There were recent (within a few days) signs of people using the trails, but none of camping at Union Camp itself. All the evidence (e.g., cigarette packages) was of Guatemalan origin. Without particularly looking for them, I found one shotgun shell at Union Camp, none between Union Camp and Gloria, two (excluding several at the campsite) between Gloria and Edwards Central, and five between Edwards Central and Abraham Camp. Signs of hunting thus increased towards the inhabited periphery of the reserve. Most of our guides said they never came as far as Union Camp to hunt, but one said he did so about twice a year, seeking curassows and white-lipped peccaries. A young man said his father shot about 10-15 curassows per year, hunting from San Jose.

REPTILES AND AMPHIBIANS (L.H. Emmons and J.R. Meyer)

Information about the herpetofauna of the Columbia River Forest was collected by John R. Meyer on an expedition in 1990 (Matola 1990), and was supplemented by specimens collected by Louise Emmons in April 1992. We surveyed different localities on each expedition, but almost all camps were along the same, main trail from San Jose to Union Camp.

The total list is short and largely incomplete. In December 1990 poor weather conditions (extreme cold) resulted in low specimen numbers, and in April 1992 specimens were only opportunistically collected during work on mammals. Many additional species are to be expected (see Matola 1990).

As noted in the earlier report (Matola 1990), the herpetofauna recorded thus far shows an affinity with lower montane herpetofaunas found on the northern slopes of the mountains in Chiapas, Mexico, Alta Verapaz, Guatemala, and the Caribbean slopes of northern Honduras.

It is noteworthy that in the small list of only 10 frog species, three are new records for Belize, including a rare fringed treefrog (*Hyla minera*), the cloudforest-dwelling *Hyla bromeliacea*, and a new species of *Eleutherodactylus* (collected on both expeditions and currently being described). Because a fifth of all frog species collected were new to Belize, we believe that further collections are likely to make new additions to the Belizean fauna.

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Appendices

Appendix 1	Plant List: Columbia River Forest Reserve	(Holst)
Appendix 2	Plant List by Site	(Holst)
Appendix 3	Birds of the Columbia River Forest Reserve	(Parker)
Appendix 4	Mammals of the Columbia River Forest Reserve	(Emmons)
Appendix 5	Reptiles and Amphibians of the Columbia River Forest Reserve	(Meyer, Emmons)

Plant List: Columbia River Forest Reserve

Bruce K. Holst

Plant species collected in the Columbia River Forest Reserve, Maya Mountains, Belize. April 3-14, 1992. The collections contain approximately 434 species in 112 families (95 seed plant families and 17 pteridophyte families). Each species in the list is followed by a habit designation and field collection numbers.

Belize. Toledo District: Southeastern Maya Mountains, Columbia River Forest Reserve (main collecting localities in vic. Union Camp, Little Quartz Ridge, Gloria Camp, and Edwards Central). 700-900 meters elevation; 16½18-25°N, 89½06-09°W

APPENDIX 1

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

ACANTHACEAE		
<i>Aphelandra aurantiaca</i> (Scheidw.) Lindl.	H	4051
<i>Justicia breviflora</i> (Nees) Rusby	S	4025, 4243, 4245
<i>Louteridium donnell-smithii</i> S. Wats.	S	4045
<i>Odontonema callistachyum</i> (Schltdl. & Cham.) Kuntze	H	3871
? sp.	H	3873
ANNONACEAE		
<i>Annona scleroderma</i> Safford	S	4007, 4230
<i>Cymbopetalum mayanum</i> Lundell	T	4177, 4195
<i>Guatteria amplifolia</i> Tr. & Pl.	S	4198, 4207, 4280
<i>Malmea depressa</i> (Baill.) R.E. Fries	S	4115
AMARANTHACEAE		
<i>Cyathula achyranthoides</i> (H.B.K.) Moq.	H	4454
APOCYNACEAE		
<i>Aspidosperma cruentum</i> Woodson	T	4134
<i>Stemmadenia donnell-smithii</i> (Rose) Woodson	T	4114
<i>Tabernaemontana amygdalifolia</i> Jacq.	S	4200
AQUIFOLIACEAE		
<i>Ilex guianensis</i> (Aublet) O. Kuntze	T	4288
ARACEAE		
<i>Anthurium bakeri</i> Hook.f.	H	3888
<i>Anthurium flexile</i> Schott subsp. <i>flexile</i>	E	4470
<i>Anthurium interruptum</i> Sodiro	E	4024
<i>Anthurium lucens</i> Standl. ex Yuncker	T	4241
<i>Anthurium pentaphyllum</i> var. <i>bombacifolium</i> (Schott) Madison	E	4116
<i>Anthurium scandens</i> (Aublet) Engler subsp. <i>scandens</i>	E	4396
<i>Anthurium schlechtendalii</i> Kunth. subsp. <i>schlechtendalii</i>	E	4069
<i>Monstera acuminata</i> K. Koch	E	4121, 4382

APPENDIX 1

<i>Philodendron aurantifolium</i> Schott	E	4437
<i>Philodendron radiatum</i> Schott	E	4303
<i>Philodendron sagittifolium</i> Liebm.	E	4499
<i>Philodendron scandens</i> K. Koch & Sodiro	E	4422
<i>Philodendron tripartitum</i> (Jacq.) Schott	E	4388
<i>Rhodospatha wendlandii</i> Schott	E	4401, 4446
<i>Spathiphyllum blandum</i> Schott	H	4366
<i>Syngonium macrophyllum</i> Engler	E	4201
<i>Syngonium podophyllum</i> Schott	E	4057
<i>Xanthosoma</i> cf. <i>mexicanum</i> Liebm.	H	4497
ARALIACEAE		
<i>Dendropanax arboreus</i> (L.) Decne. & Planch.	T	4149, 4216
<i>Oreopanax obtusifolius</i> L. Wms.	E	4087, 4491
<i>Schefflera morototoni</i> (Aublet) Maguire, Steyerm. & Frodin	T	observed
ARECACEAE		
<i>Astrocaryum mexicanum</i> Liebm.	S	4044
<i>Bactris</i> sp.	S	4501
<i>Calyptrogyne ghiesbreghtiana</i> (Linden & H. Wendl.) H. Wendl.	S	4002
<i>Chamaedorea ernesto-augustii</i> H. Wendl.	S	4005
<i>Chamaedorea graminifolius</i> H. Wendl.	S	4330
<i>Chamaedorea neurochlamys</i> Burret	S	4344
<i>Chamaedorea tenella</i> H. Wendl.	S	3879, 3898, 4326
<i>Chamaedorea tepejilote</i> Liebm.	S	4387, 4409
<i>Chamaedorea</i> sp.	S	3885, 4104
<i>Colpothrinax cookii</i> Read	T	4333
<i>Cryosophila argentea</i> Barlett	S	4210
<i>Desmoncus</i> sp.	L	4098
<i>Euterpe macrospadix</i> Oersted	T	4003
<i>Orbignya cohune</i> (Mart.) Dahlg. ex Standl.	T	observed
<i>Reinhardtia gracilis</i> (Wendl.) Burret	S	4500
<i>Synechanthus fibrosus</i> (H. Wendl.) H. Wendl.	S	3893
ASTERACEAE		
<i>Bidens</i> sp. ?	H	4363
<i>Critonia sexangulare</i> (Klatt) King & Robinson	S	4269
<i>Sinclairia polyantha</i> (Klatt.) Rydb., vel sp. aff.	L	4126

BEGONIACEAE		
<i>Begonia glabra</i> Aublet	H	4508
<i>Begonia heracleifolia</i> Schltld. & Cham.	H	3901
<i>Begonia nelumbiifolia</i> Schltld. & Cham.	H	4373
<i>Begonia sericoneura</i> Liebm.	H	4035
BIGNONIACEAE		
<i>Anemopaegma chrysanthum</i> Dugand	V	4356
<i>Arrabidaea inaequalis</i> (DC. ex Splitg.) K. Sch.	V	4225, 4434
<i>Arrabidaea podopogon</i> (DC.) A. Gentry	L	4262
<i>Arrabidaea verrucosa</i> (Standl.) A. Gentry	L	4165, 4490
<i>Arrabidaea viscida</i> (Donn. Sm.) A. Gentry	L	4420
<i>Martinella obovata</i> (H.B.K.) Bur. & K. Sch.	V	4118
<i>Mussatia hyacinthina</i> (Standl.) Sandw.	V	4315
<i>Paragonia pyramidata</i> (L. Rich.) Bur.	V	4371, 4406
<i>Pithecoctenium crucigerum</i> (L.) A. Gentry	L	4484
<i>Stizophyllum riparium</i> (H.B.K.) Sandw.	V	4319
<i>Tynanthus guatemalensis</i> Donn. Sm.	L	4468
BOMBACACEAE		
<i>Bombacopsis quinata</i> (Jacq.) Dugand	T	4242
<i>Pachira aquatica</i> Aublet	T	4151
<i>Quararibea yunckeri</i> Standl. subsp. <i>yunckeri</i>	T	4062
BROMELIACEAE		
<i>Aechmea lueddemanniana</i> (K. Koch) Mez	E	4004, 4028
<i>Androlepis skinneri</i> Brongn. ex Houlet	E	4085
<i>Pitcairnia</i> sp.	H	4162
<i>Tillandsia anceps</i> Loddiges	E	4046
<i>Tillandsia bulbosa</i> Hooker	E	4054
<i>Tillandsia</i> cf. <i>butzii</i> Mez	E	3874
<i>Tillandsia festucoides</i> Brongn. ex Mez	E	3872, 3887, 4031, 4071
<i>Tillandsia filifolia</i> Schltld. & Cham.	E	4076
<i>Tillandsia leiboldiana</i> Schltld.	E	4053-A
<i>Tillandsia monadelpha</i> (E. Morren) Baker	E	4140, 4430
<i>Tillandsia pruinosa</i> Sw.	E	4072

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

APPENDIX 1

<i>Tillandsia</i> sp.	E	4252
<i>Vriesea</i> sp.	E	4279
BURSERACEAE		
<i>Bursera simaruba</i> (L.) Sarg.	T	observed
<i>Protium</i> cf. <i>glabrum</i> (Rose) Engler	S	4152, 4391
<i>Protium schippii</i> Lundell	T	4079
CACTACEAE		
<i>Epiphyllum crenatum</i> (Lindl.) G. Don	E	4483
<i>Epiphyllum oxypetalum</i> (DC.) Haw.	E	4039
<i>Rhipsalis baccifera</i> (J. Miller) Stearn	E	4427
CAESALPINIACEAE		
<i>Bauhinia guianensis</i> Aublet	V	4352
<i>Dialium guianense</i> (Aublet) Sandw.	T	4168, 4170
CARICACEAE		
<i>Jacaratia mexicana</i> DC.	S	4467
CECROPIACEAE		
<i>Cecropia</i> sp.	T	observed
<i>Coussapoa</i> sp.	T	observed
<i>Pourouma</i> sp.	T	observed
CELASTRACEAE		
<i>Crossopetalum eucyosum</i> (Loes. & Pitt.) Lundell	S	4032, 4033, 4314, 4365
<i>Maytenus schippii</i> Lundell	S	4053
<i>Maytenus</i> sp.	T	4090
<i>Wimmeria bartlettii</i> Lundell	S	4251
CHLORANTHACEAE		
<i>Hedyosmum mexicanum</i> Cord.	T	4273
CHRYSOBALANACEAE		
<i>Hirtella americana</i> L.	T	4237
<i>Hirtella triandra</i> Sw. subsp. <i>triandra</i>	T	4167
CLUSIACEAE		
<i>Calophyllum brasiliense</i> var. <i>rekoi</i> Standl.	S	4094, 4186
<i>Clusia</i> cf. <i>lundellii</i> Standl.	S	4378
<i>Clusia minor</i> L.f., s.l.	S	3865
<i>Clusia</i> sp. (<i>C. salvinii</i> group)	E	4184, 4408
<i>Garcinia</i> cf. <i>intermedia</i> (Pittier) Hammel	S	4175

APPENDIX 1

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

<i>Symphonia globulifera</i> L.f.	T	4185
<i>Tovomitopsis nicaraguensis</i> Pl. & tr.	S,T	4013, 4189, 4407
<i>Vismia camparaguey</i> Sprague & Riley	S	4097
? sp.	E	4180
COMBRETACEAE		
<i>Terminalia amazonia</i> (J.F. Gmel.) Exell	T	4202, 4220, 4357, 4465
COMMELINACEAE		
<i>Tradescantia zanoniana</i> (L.) Sw.	H	4458
<i>Tripogandra grandiflora</i> (Donn. Sm.) Woodson	H	4137
CONVOLVULACEAE		
<i>Ipomoea setosa</i> Ker.	V	4374
<i>Maripa nicaraguensis</i> Hemsl.	L	4203, 4487
? sp.	V	4321
COSTACEAE		
<i>Costus pulverulentus</i> C.B. Presl	H	4332
CUCURBITACEAE		
<i>Gurania makoyana</i> (Lem.) Cogn.	L	4232, 4263, 4392
<i>Sicydium</i> sp.	V	4136, 4462
<i>Sicyos</i> sp.	V	4064
CYCLANTHACEAE		
<i>Asplundia labela</i> (Schult.) Harl.	E	4178, 4212
CYPERACEAE		
<i>Scleria latifolia</i> Sw.	H	4060, 4278
<i>Scleria secans</i> (L.) Urban	H	4300
CYRILLACEAE		
<i>Cyrilla racemiflora</i> L.	T	4299
DILLENIACEAE		
<i>Doliocarpus dentatus</i> (Aublet) Standl. subsp. <i>dentatus</i>	L	4206, 4297
DIOSCOREACEAE		
<i>Dioscorea bartlettii</i> Lundell	V	4012
ELAEOCARPACEAE		
<i>Sloanea tuerckheimii</i> Donn. Sm.	S	4293
ERICACEAE		
<i>Satyria warszewiczii</i> Klotzsch	E	4042, 4182, 4282
<i>Sphyrospermum cordifolium</i> Benth.	E	3868

APPENDIX 1

EUPHORBIACEAE		
<i>Acalypha diversifolia</i> Jacq.	T	4418, 4509
<i>Alchornea latifolia</i> Sw.	T	4093, 4267
<i>Bernardia interrupta</i> (Schltr.) Muell. Arg.	T	4112, 4421
<i>Cleidion castaneifolium</i> Muell. Arg.	T	4009, 4099, 4174, 4223
<i>Hyeronima alchorneioides</i> Allemão	T	4204
<i>Sebastiania longicuspis</i> Standl.	T	4056
FABACEAE		
<i>Dalbergia tucurensis</i> Donn. Sm.	T	4148
<i>Desmodium</i> sp.	H	4398
<i>Erythrina folkersii</i> Krukoff & Moldenke	S	4080, 4450
<i>Erythrina</i> sp.	T	observed
<i>Machaerium</i> cf. <i>riparium</i> Brandeg.	L	4250
<i>Mucuna</i> sp.	V	4471
? sp.	S	4451
FAGACEAE		
<i>Quercus cortesii</i> Liebm.	T	4307
FLACOURTIACEAE		
<i>Casearia bartlettii</i> Lundell	S	4117, 4256
<i>Casearia tremula</i> (Griseb.) Wright	T	4092, 4214, 4218
<i>Laetia thamnia</i> L.	S	4111, 4259
<i>Pleuranthodendron lindenii</i> (Turcz.) Sleumer	T	4466
<i>Xylosma characanthum</i> Standl.	S	4353
GENTIANACEAE		
<i>Voyria parasitica</i> (Schltdl. & Cham.) Ruyters & Maas	H	4010
GESNERIACEAE		
<i>Columnnea sulfurea</i> Donn. Sm.	E	4068
HELICONIACEAE		
<i>Heliconia aurantiaca</i> Griseb.	H	3884
<i>Heliconia wagnerianum</i> Peters.	H	4505
HIPPOCRATEACEAE		
<i>Hippocratea volubilis</i> L.	L	4089
? sp.	L	4199
ICACINACEAE		
<i>Calatola laevigata</i> Standl.	T	4494

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

IRIDACEAE		
<i>Neomarica variegata</i> (Martens & Galeotti) Henrich & Goldb.	H	4209
LACISTEMATACEAE		
<i>Lacistema aggregatum</i> (Bergius) Rusby	S	4020
LAMIACEAE		
<i>Salvia miniata</i> Fernald	H	4022
<i>Scutellaria longifolia</i> Benth.	S	4301
<i>Scutellaria orichalcea</i> Donn. Sm.	H	4016
LAURACEAE		
<i>Beilschmiedea hondurensis</i> Kosterm.	T	4435
<i>Licaria peckii</i> (Johnston) Kosterm.	T	4128
? sp.	S	4298
? sp.	S	4329
LOGANIACEAE		
<i>Spigelia humboldtiana</i> Cham. & Schtdl.	H	4043, 4342
<i>Strychnos brachistantha</i> Standl.	L	4211, 4328
<i>Strychnos panamensis</i> Seeman	S	4272
LORANTHACEAE		
<i>Phoradendron crassifolium</i> (DC.) Eichler	S	4205
LYTHRACEAE		
<i>Cuphea hyssopifolia</i> H.B.K.	H	3877
MAGNOLIACEAE		
<i>Magnolia</i> cf. <i>yoroconte</i> Dandy	T	4266
MALPIGHIACEAE		
<i>Tetrapterys</i> sp.	L	4493
? sp.	L	observed
MARANTACEAE		
<i>Calathea crotalifera</i> S. Watson	H	4472
<i>Calathea micans</i> Körn.	H	4372
? sp.	H	observed
MARCGRAVIACEAE		
<i>Marcgravia schippii</i> Standl.	E	4067
<i>Souroubea</i> sp.	V	4309
MELASTOMATACEAE		
<i>Blakea cuneata</i> Standl.	S	3878, 4183

APPENDIX 1

<i>Clidemia involucrata</i> DC.	S	4271
<i>Miconia dodecandra</i> (Desr.) Cogn.	T	4268
<i>Miconia impetiolaris</i> (Sw.) D. Don	T	4001, 4414
<i>Miconia mirabilis</i> (Aublet) L. Wms.	T	4061
<i>Mouriri exilis</i> Gleason	S	4290
<i>Ossaea micrantha</i> (Sw.) Macfad.	S	4447
MELIACEAE		
<i>Guarea glabra</i> Vahl	T	4425
<i>Guarea</i> cf. <i>macrophylla</i> Vahl	S	4229, 4233
<i>Guarea</i> sp.	T	4169
<i>Swietenia macrophylla</i> King	T	4192
<i>Trichilia erythrocarpa</i> Lundell	T	4052, 4248
<i>Trichilia pallida</i> Sw.	S	4432
MENISPERMACEAE		
<i>Abuta panamensis</i> (Standl.) Krukoff & Barneby	L	4286
<i>Cissampelos</i> sp.	V	4355
<i>Disciphania calocarpa</i> Standl.	L	4150, 4164
MIMOSACEAE		
<i>Inga davidsei</i> Sousa	T	4304
<i>Inga</i> sp.	T	4215
<i>Inga</i> sp.	T	4383
<i>Pithecellobium arboreum</i> (L.) Urban	T	4055
<i>Pithecellobium donnell-smithii</i> (Britt. & Rose) Standl.	T	4131
? sp.	S	4231
MONIMIACEAE		
<i>Siparuna andina</i> (Tul.) A.DC.	S	3866, 4078
MORACEAE		
<i>Dorstenia contrajerva</i> L.	H	4481
<i>Dorstenia lindeniana</i> Bur.	H	3891
<i>Ficus crassiuscula</i> Standl.	E	4063
<i>Ficus guajavioides</i> Lundell	T	4173
<i>Ficus</i> sp.	T	4190
<i>Ficus</i> sp.	T	4498
<i>Pseudolmedia spuria</i> (Sw.) Griseb	T	4260
<i>Trophis mexicana</i> (Liebm.) Bur.	S	3886, 4124

MYRISTICACEAE		
<i>Compsonera sprucei</i> (A. DC.) Warb.	T	4424
MYRSINACEAE		
<i>Ardisia compressa</i> H.B.K.	S	4084
<i>Ardisia guianensis</i> (Aublet) Mez, s.l.	S	4015
<i>Ardisia paschalis</i> Donn. Sm.	S	4107
<i>Ardisia pellucida</i> Oerst., vel aff.	S	4393
<i>Ardisia</i> sp.	S	4240
<i>Parathesis aeruginosa</i> Standl.	S	4096, 4358
MYRTACEAE		
<i>Calyptranthes</i> cf. <i>chytraculia</i> (L.) Sw.	S	4160, 4348
<i>Calyptranthes megistophylla</i> Standl.	S	4157, 4227
<i>Calyptranthes</i> sp.	T	4236
<i>Eugenia</i> cf. <i>oerstediana</i> O. Berg	S	4506
<i>Eugenia</i> sp.	S	4161
<i>Eugenia</i> sp.	S	4410
<i>Eugenia</i> sp.	S	3895, 4247
<i>Pimenta dioica</i> (L.) Merrill	T	4113
<i>Myrcia splendens</i> (Sw.) DC.	T	4291
NYCTAGINACEAE		
<i>Pisonia aculeata</i> L.	L	4122
? sp.	S	4349
OLACACEAE		
<i>Heisteria media</i> Blake	T	4486
OLEACEAE		
<i>Linociera domingensis</i> (Lam.) Knobl.	S	4253
<i>Linociera oblanceolata</i> Robins.	S	4120, 4411
ORCHIDACEAE		
<i>Beloglottis</i> sp.	H	4369
<i>Dichaea</i> sp.	E	4219
<i>Elleanthus graminifolius</i> (Barbr. Rodr.) Løjnant	E	3896
<i>Encyclia</i> cf. <i>abbreviata</i> (Schltr.) Dressler	E	4163
<i>Encyclia polybulbon</i> (Sw.) Dressler & Pollard	E	4101
<i>Epidendrum</i> sp.	E	4235
<i>Epidendrum</i> sp.	E	4431

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

APPENDIX 1

<i>Kegeliella kupperi</i> Mansfeld	E	4019
cf. <i>Lacaena</i> sp.	E	4274
<i>Maxillaria aciantha</i> Rchb.f.	E	4103
<i>Maxillaria</i> cf. <i>elatio</i> r Reichb.f.	E	4130
<i>Maxillaria uncat</i> a Lindley	E	4197
<i>Maxillaria variabilis</i> Batem ex Lindl., vel sp. aff.	E	4380
<i>Ornithocephalus inflexus</i> Lindl.	E	4086
<i>Pelexia</i> sp.	H	4017, 4476
<i>Pleurothallis</i> sp.	E	4453
<i>Polystachya foliosa</i> (Hook.) Reichb.f., vel sp. aff.	E	4254
<i>Ponera striata</i> Lindl.	E	4238
<i>Scaphyglottis prolifrea</i> Cogn.	E	4139
<i>Scaphyglottis</i> sp.	E	4179
<i>Scaphyglottis</i> sp.	T	4026
<i>Sobralia</i> ?	E	4400
<i>Trichosalpinx blaisdelli</i> (S. Wats.) Luer, vel sp. aff.	E	4166
<i>Trigonidium egertonianum</i> Batem. ex Lindl.	E	4181
<i>Vanilla planifolia</i> Andr., vel sp. aff.	E	4234
<i>Xylobium</i> sp.	E	4129
? sp.	E	4102
PASSIFLORACEAE		
<i>Passiflora guatemalensis</i> S. Wats.	V	4138
<i>Passiflora lancetillensis</i> McDougal, sp. nov., ined.	V	4144
<i>Passiflora obovata</i> Killip	L	4194, 4455
<i>Passiflora oerstedii</i> var. <i>choconiana</i> S. Watson	V	4345
<i>Passiflora</i> sp.	L	4457
PHYTOLACCACEAE		
<i>Phytolacca rivinoides</i> Kunth & Bouché	H	4469
PIPERACEAE		
<i>Peperomia claytonioides</i> Kunth.	H	3882
<i>Peperomia</i> sp.	H	3899, 4426
<i>Peperomia</i> sp.	E	4036, 4073, 4100
<i>Peperomia</i> sp.	E	4037
<i>Peperomia</i> sp.	E	4066
<i>Peperomia</i> sp.	E	4075

APPENDIX 1

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

<i>Peperomia</i> sp.	H	4325
<i>Peperomia</i> sp.	H	4375
<i>Peperomia</i> sp.	E	4415
<i>Peperomia</i> sp.	H	4459, 4482
<i>Piper</i> sp.	S	4095, 4327
<i>Piper</i> sp.	S	4154, 4361, 4331, 4376
<i>Piper</i> sp.	S	4159, 4244
<i>Piper</i> sp.	S	4294
<i>Piper</i> sp.	S	4350
<i>Piper</i> sp.	S	4367
<i>Piper</i> sp.	S	4449
POACEAE		
<i>Olyra latifolia</i> L.	H	4155
<i>Olyra glaberrima</i> Raddi	H	3892
<i>Oplismenus burmannii</i> (Retz.) P. Beauv.	H	4351
POLYGONACEAE		
<i>Coccoloba acapulcensis</i> Standl.	T	4239
<i>Coccoloba belizensis</i> Standl.	T	4156
<i>Coccoloba tuerckheimii</i> Donn. Sm.	T	4228
<i>Triplaris</i> sp.	T	observed
PROTEACEAE		
<i>Roupala montana</i> Aublet	S	4050
PTERIDOPHYTES (Ferns and fern allies, 69 species, 17 families)		
<i>Adiantum capillus-venerus</i> L.	H	4014
<i>Adiantum macrophyllum</i> Sw.	H	4226, 4377
<i>Adiantum pulverulentum</i> L.	H	4504
<i>Adiantum tenerum</i> Sw.	H	4142
<i>Adiantum tetraphyllum</i> Willd.	H	4360
<i>Antrophyum ensiforme</i> Hook.	E	4143
<i>Asplenium crassifolium</i> (L.) Lellinger	H	3889
<i>Asplenium cristatum</i> Lam.	H	4397, 4480
<i>Asplenium juglandifolium</i> Lam.	E	4027, 4289
<i>Asplenium monodon</i> Liebm.	E	4038, 4224
<i>Blechnum gracile</i> Kaulf.	H	4316
<i>Bolbitis pergamentacea</i> (Maxon) Ching	H	4464

APPENDIX 1

<i>Campyloneurum costatum</i> (Kunze) C. Presl	E	4359
<i>Campyloneurum repens</i> (Aublet) C. Presl	H	4385
<i>Ctenitis interjecta</i> (C. Chr.) Ching	H	4502
<i>Ctenitis melanosticta</i> (Kunze) Copel	H	4368
<i>Ctenitis salvinii</i> (Baker) Stolze	H	3890
<i>Cyathea multiflora</i> Sm.	S	3883, 4217
<i>Cyathea myosuroides</i> (Liebm.) Domin	S	4285
<i>Danaea elliptica</i> Sm.	H	4305
<i>Dennstaedtia bipinnata</i> (Cav.) Maxon	H	4474
<i>Didymochlaena truncatula</i> (Sw.) J. Sm.	H	4394
<i>Diplazium riedelianum</i> (Bong. ex Kuhn) Kuhn ex C. Chr.	H	4317
<i>Diplazium striatastrum</i> (L.) C. Presl	H	4473
<i>Diplazium werckleanum</i> H. Christ	H	4317-A, 4323
<i>Elaphoglossum apodum</i> var. <i>latum</i> Mickel	E	3875
<i>Elaphoglossum glaucum</i> (Fée) T. Moore	E	3869
<i>Elaphoglossum herminieri</i> (Bory & Fée ex Fée) T. Moore	E	3870, 4402
<i>Elaphoglossum peltatum</i> (Sw.) Urb.	H	3894
<i>Huperzia pithyoides</i> (Schltdl. & Cham.) Holub	E	4381
<i>Hymenophyllum pulchellum</i> Schltdl. & Cham.	E	4041
<i>Lindsaea klotzschiana</i> Moritz in Ettingsh.	H	4265
<i>Lindsaea lancea</i> (L.) Bedd.	H	4283
<i>Lomariopsis recurvata</i> Fée	E	4417
<i>Lomariopsis vestita</i> E. Fourn.	H	4171
<i>Lygodium heterodoxum</i> Kunze	V	4153
<i>Lygodium venustum</i> Sw.	H	4511
<i>Microgramma percussa</i> (Cav.) Sota	E	4000, 4141, 4403
<i>Nephrolepis multiflora</i> (Roxb.) F.M. Jarrett ex C.V. Morton	E	4507
<i>Niphidium crassifolium</i> (L.) Lellinger	E	4354
<i>Pecluma divaricata</i> (E. Fourn.) Mickel & Beitel	H	4460
<i>Polybotrya osmundacea</i> Willd.	H	4048, 4049
<i>Polybotrya polybotrioides</i> (Baker) H. Christ	H	4047
<i>Polypodium dissimile</i> L.	E	4034
<i>Pteridium caudatum</i> (L.) Maxon	H	4510
<i>Pteris altissima</i> Poiret	H	4395
<i>Pteris pungens</i> Willd.	H	3864

APPENDIX 1

<i>Pteris quadriaurita</i> Retz, s.l.	H	3900
<i>Salpichlaena volubilis</i> (Sw.) J. Sm.	H	4287
<i>Selaginella guatemalensis</i> Baker	H	4030, 4311
<i>Selaginella pallescens</i> (C. Presl) Spring	H	3881
<i>Selaginella sertata</i> Spring	H	4341
<i>Selaginella stellata</i> Spring	H	4029
<i>Sphaeropteris horrida</i> (Liebm.) R.M. Tryon	T	4213
<i>Sticherus palmatus</i> (J.H. Schaffn. ex Underw.) Copel.	H	4270
<i>Tectaria heracleifolia</i> (Willd.) Underw.	S,H	3880, 4318
<i>Tectaria incisa</i> Cav.	H	4478
<i>Tectaria mexicana</i> (Fée) C.V. Morton	H	4475
<i>Terpsichore mollissima</i> (Fée) A.R. Sm.	E	4040
<i>Thelypteris blanda</i> (Fée) C.F. Reed	S	4312
<i>Thelypteris ghiesbreghtii</i> (Hook.) C.V. Morton	T	4320
<i>Thelypteris nicaraguensis</i> (E. Fourn.) C.V. Morton	H	4324
<i>Thelypteris paucipinnata</i> (J.D. Sm.) C.F. Reed	H	4343
<i>Thelypteris toganetra</i> A.R. Sm.	H	4132
<i>Trichomanes collariatum</i> Bosch	E	4196, 4313
<i>Trichomanes crispum</i> L.	E	4023
<i>Trichomanes punctatum</i> subsp. <i>sphenoides</i> (Kunze) Wess. Boer	E	4496
<i>Trichomanes pyxidiferum</i> L.	H	4310
<i>Vittaria graminifolia</i> Kaulf.	E	3876
<i>Vittaria stipitata</i> Kunze	E	4070
? sp.	E	4188
RHAMNACEAE		
<i>Rhamnus</i> cf. <i>sphaerosperma</i> Sw.	T	4221
RHIZOPHORACEAE		
<i>Cassipourea guianensis</i> Aublet	S	4308
ROSACEAE		
<i>Photinia microcarpa</i> Standl.	T	4258
RUBIACEAE		
<i>Chiococca alba</i> (L.) A.S. Hitchc.	L	4249
<i>Faramea occidentalis</i> (L.) A. Rich.	S	4419
<i>Hamelia calycosa</i> J.D. Smith	T	4413
<i>Hillia panamensis</i> Standl.	E	4292

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

APPENDIX 1

<i>Hoffmannia bullata</i> L.W. Wms.	H	4448, 4399
<i>Hoffmannia ghiesbreghtii</i> (Lem.) Hemsl.	H	4322, 4461
<i>Palicourea padifolia</i> (R. & S.) Taylor & Lorrence	S	4031, 4346
<i>Psychotria costivenia</i> Griseb.	S	3867, 4261
<i>Psychotria deflexa</i> DC.	S	4074
<i>Psychotria elata</i> (Sw.) Hammel	S	4295, 4296
<i>Psychotria panamensis</i> Standl.	S	4302
<i>Psychotria pleuropoda</i> J.D. Smith	S	4404
<i>Psychotria poeppigiana</i> Muell. Arg.	S	4011, 4284
<i>Psychotria simiarum</i> Standl.	S	4021, 4176, 4405
<i>Psychotria tenuifolia</i> Sw.	S	4081, 4452
<i>Psychotria</i> sp.	S	4433
<i>Randia</i> cf. <i>gentlei</i> Lundell	S	4133
<i>Randia matudae</i> Lorence & Dwyer	T	4281
<i>Rudgea cornifolia</i> (H. & B.) Standl.	S	4479
RUTACEAE		
<i>Zanthoxylum juniperinum</i> P. & E.	T	4123
<i>Zanthoxylum</i> sp.	S	4276
SAPINDACEAE		
<i>Allophyllus</i> cf. <i>psilospermus</i> Radlk.	T	4119
<i>Cupania</i> sp.	L	4193
<i>Matayba apetala</i> (Macfad.) Radlk.	T	4257
<i>Matayba</i> sp.	T	4488
<i>Serjania</i> or <i>Paullinia</i> spp. (2 or 3 species here)	L	4109, 4135, 4158, 4347, 4370
? sp.	S	4208
SAPOTACEAE		
<i>Chrysophyllum</i> sp.	S	4390
<i>Manilkara zapota</i> (L.) van Royen	T	4082
<i>Pouteria reticulata</i> (Engler) Eyma subsp. <i>reticulata</i>	T	4246
? sp.	T	4059
? sp.	S	4008
? sp.	T	4088
SIMARUBACEAE		
<i>Simaruba amara</i> Aublet	T	4147

APPENDIX 1

SMILACACEAE		
<i>Smilax luculenta</i> Kilip & Morton	V	4127
<i>Smilax</i> sp.	L	4083
SOLANACEAE		
<i>Cestrum</i> sp.	V	4222
<i>Cestrum</i> sp.	V	4436
<i>Lycianthes nitida</i> Bitter	S	4386
<i>Lycianthes purpusii</i> (Brandeg.) Bitt.	S	4389
? sp.	S	4485
STERCULIACEAE		
<i>Guazuma ulmifolia</i> Lam.	T	4492
STYRACACEAE		
<i>Styrax argenteus</i> Presl	S	4277
SYMPLOCACEAE		
<i>Symplocos</i> sp.	T	4058
THEACEAE		
<i>Ternstroemia tepezapote</i> Schltld. & Cham.	T	4306
TILIACEAE		
<i>Heliocarpus</i> sp.	T	observed
TURNERACEAE		
<i>Erblichia odorata</i> Seeman	T	4145
URTICACEAE		
<i>Boehmeria ramiflora</i> Jacq.	S	4018
<i>Myriocarpa longipes</i> Liebm.	S	4463
<i>Myriocarpa obovata</i> J.D. Sm.	S	4108, 4238-A
<i>Pilea ecbolophylla</i> J.D. Sm.	S	4106
VERBENACEAE		
<i>Stachytarpheta cayennensis</i> (Rich.) Vahl	H	4364
VIOLACEAE		
<i>Lycianthes hypoleuca</i> Standl.	V	4125
<i>Orthion malpighiifolium</i> (Standl.) Standl. & Steyerm.	T	4423
<i>Rinorea guatemalensis</i> (S. Wats.) H.H. Bartlett	S	4006, 4065
<i>Rinorea hummelii</i> Sprague	S	4412
VITACEAE		
<i>Cissus</i> sp.	L	4456

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

APPENDIX 1

<i>Vitis biformifolia</i> Standley	L	4110
<i>Vitis tiliifolia</i> H. & B.	L	4191
ZAMIACEAE		
<i>Zamia</i> sp.	S	3897, 4105
UNIDENTIFIED ANGIOSPERMS		
? sp.	T	4091
? sp.	T	4172
? sp.	T	4187
? sp.	S	4255
? sp.	S	4362
? sp.	T	4489
BRYOPHYTES		
<i>Bryopteris trinitensis</i> (Lehm. & Lindb.) Lehm. & Lindb.		4441, 4513
<i>Callicosta evanescens</i> C. Müll.		4512B
<i>Holomitrium arboreum</i> Mitt.		4438, 4444
<i>Homalia glabella</i> (Hedw.) B.S.G.		4338B, 4339
<i>Lepidopilidium portoricense</i> (C. Müll.) Crum & Steere		4335
<i>Lepidopilum polytrichoides</i> (Hedw.) Brid.		4495
<i>Macromitrium contextum</i> Hampe		4340
<i>Neckeropsis undulata</i> (Hedw.) Reich.		4440, 4514
<i>Phyllogonium fulgens</i> (Hedw.) Brid.		4336
<i>Pilotrichella pentasticha</i> (Brid.) Wijk & Marg.		4515
<i>Pirella angustifolia</i> (C. Müll.) Arzeni		4337
<i>Plagiochila disticha</i> Lindenb.		4512
<i>Plagiochila</i> sp.		4334
<i>Porotrichum korthalsianum</i> (Dozy & Molk.) Mitt.		4338
<i>Racopilum tomentosum</i> (Hedw.) Brid.		4445
<i>Stictolejeunea squamata</i> (Willd. ex Web.) Schiffn.		4442
<i>Taxilejeunea</i> sp.		4439, 4443

Plant List by Site

Bruce K. Holst

Plant species collected in the Columbia River Forest Reserve arranged by camp or area visited.
April 3-14, 1992.

Union Camp. 700-750 m, 16½°23'N, 89½°08'W

1. Along creek north of Union Camp and adjacent low, moist areas (April 4, 5, 6)

ACANTHACEAE		
<i>Aphelandra aurantiaca</i> (Scheidw.) Lindl.	H	4051
<i>Justicia breviflora</i> (Nees) Rusby	S	4025
<i>Louteridium donnell-smithii</i> S. Wats.	S	4045
<i>Odontonema callistachyum</i> (Schltdl. & Cham.) Kuntze	H	3871
? sp.	H	3873
ANNONACEAE		
<i>Annona scleroderma</i> Safford	S	4007
ARACEAE		
<i>Anthurium interruptum</i> Sodiro	E	4024
ARECACEAE		
<i>Astrocaryum mexicanum</i> Liebm.	S	4044
<i>Calypstrogyne ghiesbreghtiana</i> (Linden & H. Wendl.) H. Wendl.	S	4002
<i>Chamaedorea ernesto-augustii</i> H. Wendl.	S	4005
<i>Chamaedorea tenella</i> H. Wendl.	S	3879, 3898
<i>Chamaedorea</i> sp.	S	3885
<i>Euterpe macrospadix</i> Oersted	T	4003
BEGONIACEAE		
<i>Begonia sericoneura</i> Liebm.	H	4035
BROMELIACEAE		
<i>Aechmea lueddemanniana</i> (K. Koch) Mez	E	4004, 4028
<i>Tillandsia anceps</i> Loddiges	E	4046
<i>Tillandsia</i> cf. <i>butzii</i> Mez	E	3874
<i>Tillandsia festucoides</i> Brongn. ex Mez	E	4031-A
<i>Tillandsia lieboldiana</i> Schltdl.	E	4053-A
<i>Tillandsia</i> sp.	E	3872
CACTACEAE		
<i>Epiphyllum oxypetalum</i> (DC.) Haw.	E	4039
CELASTRACEAE		
<i>Crossopetalum eucymosum</i> (Loes. & Pitt.) Lundell	S	4032, 4033
<i>Maytenus schippii</i> Lundell	S	4053

APPENDIX 2

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

APPENDIX 2

CLUSIACEAE		
<i>Tovomitopsis nicaraguensis</i> Pl. & Tr.	S	4013
DIOSCOREACEAE		
<i>Dioscorea bartlettii</i> Lundell	V	4012
ERICACEAE		
<i>Satyria warszewiczii</i> Klotzsch	E	4042
<i>Sphrospermum cordifolium</i> Benth.	E	3868
EUPHORBIACEAE		
<i>Cleidion castaneifolium</i> Muell. Arg.	S	4009
HELICONIACEAE		
<i>Heliconia aurantiaca</i> Griseb.	H	3884
LACISTEMATACEAE		
<i>Lacistema aggregatum</i> (Bergius) Rusby	S	4020
LAMIACEAE		
<i>Salvia miniata</i> Fernald	H	4022
<i>Scutellaria orichalcea</i> Donn. Sm.	H	4016
LOGANIACEAE		
<i>Spigelia humboldtiana</i> C. & S.	H	4043
LYTHRACEAE		
<i>Cuphea hyssopifolia</i> H.B.K.	H	3877
MELASTOMATACEAE		
<i>Blakea cuneata</i> Standl.	S	3878
<i>Miconia impetiolearis</i> (Sw.) D. Don	T	4001
MELIACEAE		
<i>Trichilia erythrocarpa</i> Lundell	T	4052
MORACEAE		
<i>Trophis mexicana</i> (Liebm.) Bur.	S	observed
MYRSINACEAE		
<i>Ardisia guianensis</i> (Aublet) Mez, s.l.	S	4015
ORCHIDACEAE		
<i>Kegeliella kupperi</i> Mansfeld	E	4019
<i>Pelexia</i> sp.	H	4017
<i>Scaphyglottis</i> sp.	T	4026
PIPERACEAE		
<i>Peperomia claytonioides</i> Kunth.	H	3882

APPENDIX 2

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

<i>Peperomia</i> sp.	H	3899
<i>Peperomia</i> sp.	E	4036
<i>Peperomia</i> sp.	E	4037
<i>Piper</i> sp.	S	4154
POACEAE		
<i>Olyra latifolia</i> L.	H	4155
POLYGONACEAE		
<i>Coccoloba belizensis</i> Standl.	T	4156
PROTEACEAE		
<i>Roupala montana</i> Aublet	S	4050
PTERIDOPHYTES		
<i>Adiantum capillus-venerus</i> L.	H	4014
<i>Asplenium juglandifolium</i> Lam.	E	4027
<i>Asplenium monodon</i> Liebm.	E	4038
<i>Cyathea multiflora</i> Sm.	S	3883
<i>Elaphoglossum apodum</i> var. <i>latum</i> Mickel	E	3875
<i>Elaphoglossum glaucum</i> (Fée) T. Moore	E	3869
<i>Elaphoglossum herminieri</i> (Bory & Fée ex Fée) T. Moore	E	3870
<i>Hymenophyllum pulchellum</i> Schldl. & Cham.	E	4041
<i>Lygodium heterodoxum</i> Kunze	V	4153
<i>Microgramma percussa</i> (Cav.) Sota	E	4000
<i>Polybotrya osmundacea</i> Willd.	H	4048, 4049
<i>Polybotrya polybotrioides</i> (Baker) H. Christ	H	4047
<i>Polypodium dissimile</i> L.	E	4034
<i>Selaginella guatemalensis</i> Baker	H	4030
<i>Selaginella pallescens</i> (C. Presl) Spring	H	3881
<i>Selaginella stellata</i> Spring	H	4029
<i>Tectaria heracleifolia</i> (Willd.) Underw.	H	3880
<i>Terpsichore mollissima</i> (Fée) A.R. Sm.	E	4040
<i>Trichomanes crispum</i> L.	E	4023
<i>Vittaria graminifolia</i> Kaulf.	E	3876
RUBIACEAE		
<i>Palicourea padifolia</i> (R. & S.) Taylor & Lorrence	S	4031
<i>Psychotria costivenia</i> Griseb.	S	3867

APPENDIX 2

<i>Psychotria poeppigiana</i> Muell. Arg.	S	4011
<i>Psychotria simiarum</i> Standl. [light gap]	S	4021
SAPOTACEAE		
? sp.	S	4008
URTICACEAE		
<i>Boehmeria ramiflora</i> Jacq. [light gap]	S	4018
BRYOPHYTES		
<i>Bryopteris trinitensis</i> (Lehm. & Lindenb.) Lehm. & Lindenb.		4513
<i>Callicosta evanescens</i> C. Muhl.		4512-B
<i>Neckeropsis undulata</i> (Hedw.) Reich.		4514
<i>Pilotrichella pentasticha</i> (Brid.) Wijk & Marg.		4515
<i>Plagiochila disticha</i> Lindenb.		4512
2. Drier hills east and north of Union Camp (April 4, 6)		
ANNONACEAE		
<i>Malmea depressa</i> (Baill.) R.E. Fries	S	4115
APOCYNACEAE		
<i>Aspidosperma cruentum</i> Woodson	T	4134
<i>Stemmadenia donnell-smithii</i> (Rose) Woodson	T	4114
ARACEAE		
<i>Anthurium bakeri</i> Hook.f.	H	3888
<i>Anthurium pentaphyllum</i> var. <i>bombacifolium</i> (Schott) Madison	E	4116
<i>Anthurium schlechtendalii</i> Kunth. ssp. <i>schlechtendalii</i>	E	4069
<i>Monstera acuminata</i> K. Koch	E	4121
<i>Syngonium podophyllum</i> Schott	E	4057
ARALIACEAE		
<i>Dendropanax arboreus</i> (L.) Decne. & Planch.	T	4149
<i>Oreopanax obtusifolius</i> L. Wms.	E	4087
ARECACEAE		
<i>Astrocaryum mexicanum</i> Liebm.	S	observed
<i>Chamaedorea</i> sp.	S	4104
<i>Cryosophila argentea</i> Barlett	S	4210
<i>Desmoncus</i> sp.	L	4098
<i>Orbignya cohune</i> (Mart.) Dahlg. ex Standl.	T	observed
<i>Synechanthus fibrosus</i> (H. Wendl.) H. Wendl.	S	3893

APPENDIX 2

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

ASTERACEAE		
<i>Sinclairia polyantha</i> (Klatt.) Rydb., vel sp. aff.	L	4126
BIGNONIACEAE		
<i>Martinella obovata</i> (H.B.K.) Bur. & K. Sch.	V	4118
BOMBACACEAE		
<i>Pachira aquatica</i> Aublet	T	4151
<i>Quararibea yunckeri</i> Standl. subsp. <i>yunckeri</i>	T	4062
BROMELIACEAE		
<i>Androlepis skinneri</i> Brongn. ex Houlet	E	4085
<i>Pitcairnia</i> sp.	H	4162
<i>Tillandsia bulbosa</i> Hooker	E	4054
<i>Tillandsia festucoides</i> Brongn. ex Mez	E	3887, 4071
<i>Tillandsia filifolia</i> S. & C.	E	4076
<i>Tillandsia monadelpha</i> (E. Morren) Baker	E	4140
<i>Tillandsia pruinosa</i> Sw.	E	4072
BURSERACEAE		
<i>Protium</i> cf. <i>glabrum</i> (Rose) Engler	S	4152
<i>Protium schippii</i> Lundell	T	4079
CELASTRACEAE		
<i>Maytenus</i> sp.	T	4090
CLUSIACEAE		
<i>Calophyllum brasiliense</i> var. <i>rekoii</i> Standl.	S	4094
COMMELINACEAE		
<i>Tripogandra grandiflora</i> (Donn. Sm.) Woodson	H	4137
CUCURBITACEAE		
<i>Sicydium</i> sp.	V	4136
<i>Sicyos</i> sp.	V	4064
CYPERACEAE		
<i>Scleria latifolia</i> Sw.	H	4060
EUPHORBIACEAE		
<i>Alchornea latifolia</i> Sw.	T	4093
<i>Bernardia interrupta</i> (Schltr.) Muell. Arg.	T	4112
<i>Cleidion castaneifolium</i> Muell. Arg.	S	4099
<i>Sebastiania longicuspis</i> Standl.	T	4056

APPENDIX 2

FABACEAE		
<i>Dalbergia tucurensis</i> Donn. Sm.	T	4148
<i>Erythrina folkersii</i> Krukoff & Moldenke	S	4080
<i>Erythrina</i> sp.	T	observed
FLACOURTIACEAE		
<i>Casearia bartlettii</i> Lundell	S	4117
<i>Casearia tremula</i> (Griseb.) Wright	T	4092
<i>Laetia thamnia</i> L.	S	4111
GENTIANACEAE		
<i>Voyria parasitica</i> (Schltdl. & Cham.) Ruyters & Maas	H	4010
GESNERIACEAE		
<i>Columnnea sulfurea</i> Donn. Sm.	E	4068
HIPPOCRATEACEAE		
<i>Hippocratea volubilis</i> L.	L	4089
LAURACEAE		
<i>Licaria peckii</i> (Johnston) Kosterm.	T	4128
MARCGRAVIACEAE		
<i>Marcgravia schippii</i> Standl.	E	4067
MELASTOMATACEAE		
<i>Miconia mirabilis</i> (Aublet) L. Wms.	T	4061
MENISPERMACEAE		
<i>Disciphania calocarpa</i> Standl.	L	4150
MIMOSACEAE		
<i>Pithecellobium arboreum</i> (L.) Urban	T	4055
<i>Pithecellobium donnell-smithii</i> (Britt. & Rose) Standl.	T	4131
MONIMIACEAE		
<i>Siparuna andina</i> (Tul.) A. DC.	S	4078
MORACEAE		
<i>Dorstenia lindeniana</i> Bur.	H	3891
<i>Ficus crassiuscula</i> Standl.	E	4063
<i>Trophis mexicana</i> (Liebm.) Bur.	S	3886, 4124
MYRSINACEAE		
<i>Ardisia compressa</i> H.B.K.	S	4084
<i>Ardisia paschalis</i> Donn. Sm.	S	4107

APPENDIX 2

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

MYRTACEAE		
<i>Calyptanthes cf. chytraculia</i> (L.) Sw.	S	4160
<i>Calyptanthes megistophylla</i> Standl.	S	4157
<i>Eugenia</i> sp.	S	4161
<i>Eugenia</i> sp.	S	3895
<i>Pimenta dioica</i> (L.) Merrill	T	4113
NYCTAGINACEAE		
<i>Pisonia aculeata</i> L.	L	4122
OLEACEAE		
<i>Linociera oblanceolata</i> Robins.	S	4120
ORCHIDACEAE		
<i>Elleanthus graminifolius</i> (Barbr. Rodr.) Løjnant	E	3896
<i>Encyclia polybulbon</i> (Sw.) Dressler & Pollard	E	4101
<i>Maxillaria aciantha</i> Rchb.f.	E	4103
<i>Maxillaria cf. elatior</i> Reichb.f.	E	4130
<i>Ornithocephalus inflexus</i> Lindl.	E	4086
<i>Scaphyglottis prolifera</i> Cogn.	E	4139
<i>Xylobium</i> sp.	E	4129
? sp.	E	4102
PASSIFLORACEAE		
<i>Passiflora guatemalensis</i> S. Wats.	V	4138
<i>Passiflora lancetillensis</i> McDougal, sp. nov., ined.	V	4144
PIPERACEAE		
<i>Peperomia</i> sp.	E	4066
<i>Peperomia</i> sp.	E	4073, 4100
<i>Peperomia</i> sp.	E	4075
<i>Piper</i> sp.	S	4095
<i>Piper</i> sp.	S	4159
POACEAE		
<i>Olyra glaberrima</i> Raddi	H	3892
PTERIDOPHYTES		
<i>Adiantum tenerum</i> Sw.	H	4142
<i>Antrophyum ensiforme</i> Hook.	E	4143
<i>Asplenium crassifolium</i> (L.) Lellinger	H	3889
<i>Ctenitis salvinii</i> (Baker) Stolze	H	3890

APPENDIX 2

<i>Elaphoglossum peltatum</i> (Sw.) Urb.	H	3894
<i>Microgramma percussa</i> (Cav.) Sota	E	4141
<i>Thelypteris toganetra</i> A.R. Sm.	H	4132
<i>Vittaria stipitata</i> Kunze	E	4070
RUBIACEAE		
<i>Psychotria deflexa</i> DC.	S	4074
<i>Psychotria tenuifolia</i> Sw.	S	4081
<i>Randia</i> cf. <i>gentlei</i> Lundell	S	4133
RUTACEAE		
<i>Zanthoxylum juniperinum</i> P. & E.	T	4123
SAPINDACEAE		
<i>Allophyllus</i> cf. <i>psilospermus</i> Radlk.	T	4119
<i>Paullinia</i> sp.	L	4109
<i>Paullinia</i> sp.	V	4135
<i>Paullinia</i> sp.	L	4158
SAPOTACEAE		
? sp.	T	4059
? sp.	T	4088
<i>Manilkara zapota</i> (L.) van Royen	T	4082
SIMARUBACEAE		
<i>Simaruba amara</i> Aublet	T	4147
SMILACACEAE		
<i>Smilax</i> sp.	L	4083
<i>Smilax luculenta</i> Kilip & Morton	V	4127
SOLANACEAE		
<i>Lycianthes hypoleuca</i> Standl.	V	4125
SYMPLOCACEAE		
<i>Symplocos</i> sp.	T	4058
TURNERACEAE		
<i>Erblichia odorata</i> Seeman	T	4145
URTICACEAE		
<i>Myriocarpus obovata</i> J.D. Sm.	S	4108
<i>Pilea ecbolophylla</i> J.D. Sm.	S	4106
VIOLACEAE		
<i>Rinorea guatemalensis</i> (S. Wats.) H.H. Bartlett	S	4006, 4065

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

ZAMIACEAE		
<i>Zamia</i> sp.	S	3897, 4105
FAMILY INDET.		
? sp.	T	4091
3. Secondary forest around Union Camp (April 4)		
ARALIACEAE		
<i>Schefflera morototoni</i> (Aublet) Maguire, Steyerm. & Frodin	T	observed
CLUSIACEAE		
<i>Clusia minor</i> L.f., s.l.	S	3865
<i>Vismia camparaguey</i> Sprague & Riley	S	4097
COSTACEAE		
<i>Costus pulverulentus</i> C.B. Presl	H	4332
MONIMIACEAE		
<i>Siparuna andina</i> (Tul.) A.DC.	S	3866
MYRSINACEAE		
<i>Parathesis aeruginosa</i> Standl.	S	4096
POLYGONACEAE		
<i>Triplaris</i> sp.	T	observed
PTERIDOPHYTES		
<i>Pteris pungens</i> Willd.	H	3864
4. Tall, open-understory forest east of Union Camp (April 7, 8)		
ANNONACEAE		
<i>Annona</i> cf. <i>scleroderma</i> Safford	S	4230
<i>Cymbopetalum mayanum</i> Lundell	T	4177, 4195
<i>Guatteria amplifolia</i> Tr. & Pl.	S	4198, 4207
APOCYNACEAE		
<i>Tabernaemontana amygdalifolia</i> Jacq.	S	4200
ARACEAE		
<i>Syngonium macrophyllum</i> Engler	E	4201
ARALIACEAE		
<i>Dendropanax arboreus</i> (L.) Decne. & Planch.	T	4216
BIGNONIACEAE		
<i>Arrabidaea inaequalis</i> (DC. ex Splitg.) K. Sch.	V	4225
<i>Arrabidaea verrucosa</i> (Standl.) A. Gentry	L	4165

APPENDIX 2

CAESALPINIACEAE		
<i>Dialium guianense</i> (Aublet) Sandw.	T	4168, 4170
CECROPIACEAE		
<i>Cecropia</i> sp.	T	observed
CHRYSOBALANACEAE		
<i>Hirtella triandra</i> Sw. subsp. <i>triandra</i>	T	4167
CLUSIACEAE		
<i>Calophyllum brasiliense</i> var. <i>rekoi</i> Standl.	T	4186
<i>Clusia</i> sp. (<i>C. salvinii</i> group)	E	4184
<i>Garcinia</i> cf. <i>intermedia</i> (Pittier) Hammel	S	4175
<i>Symphonia globulifera</i> L.f.	T	4185
<i>Tovomitopsis nicaraguensis</i> Pl. & Tr.	T	4189
? sp.	E	4180
COMBRETACEAE		
<i>Terminalia amazonia</i> (J.F. Gmel.) Exell	T	4202, 4220
CONVOLVULACEAE		
<i>Maripa nicaraguensis</i> Hemsl.	L	4203
COSTACEAE		
<i>Costus</i> sp.	H	observed
CUCURBITACEAE		
<i>Gurania makoyana</i> (Lem.) Cogn.	L	4232, 4263
CYCLANTHACEAE		
<i>Asplundia labela</i> (Schult.) Harl.	E	4178, 4212
DILLENIACEAE		
<i>Dolioscarpus dentatus</i> (Aublet) Standl. subsp. <i>dentatus</i>	L	4206
ERICACEAE		
<i>Satyria warszewiczii</i> Klotzsch	E	4182
EUPHORBIACEAE		
<i>Cleidion castaneifolium</i> Muell. Arg.	S,T	4174, 4223
<i>Hyeronima alchorneioides</i> Allemão	T	4204
FLACOURTIACEAE		
<i>Casearia tremula</i> (Griseb.) Wright	T	4214, 4218
HIPPOCRATEACEAE		
? sp.	L	4199

APPENDIX 2

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

IRIDACEAE		
<i>Neomarica variegata</i> (Martens & Galeotti) Henrich & Goldb.	H	4209
LOGANIACEAE		
<i>Strychnos brachistantha</i> Standl.	L	4211
LORANTHACEAE		
<i>Phoradendron crassifolium</i> (DC.) Eichler	S	4205
MALPIGHIACEAE		
? sp.	L	observed
MARANTACEAE		
? sp.	H	observed
MARCGRAVIACEAE		
<i>Marcgravia schippii</i> Standl.	E	observed
MELASTOMATACEAE		
<i>Blakea cuneata</i> Standl.	E	4183
<i>Miconia mirabilis</i> (Aublet) L. Wms.	S	observed
MELIACEAE		
<i>Guarea</i> cf. <i>macrophylla</i> Vahl	S	4229, 4233
<i>Guarea</i> sp.	T	4169
<i>Swietenia macrophylla</i> King	T	4192
MENISPERMACEAE		
<i>Disciphania calocarpa</i> Standl.	L	4164
MIMOSACEAE		
<i>Inga</i> sp.	T	4215
? sp.	S	4231
MORACEAE		
<i>Ficus guajavioides</i> Lundell	T	4173
<i>Ficus</i> sp.	T	4190
MYRTACEAE		
<i>Calyptranthes megistophylla</i> Standl.	S	4227
ORCHIDACEAE		
<i>Dichaea</i> sp.	E	4219
<i>Encyclia</i> cf. <i>abbreviata</i> (Schltr.) Dressler	E	4163
<i>Maxillaria uncata</i> Lindley	E	4197
<i>Scaphyglottis</i> sp.	E	4179

APPENDIX 2

<i>Trichosalpinx blaisdelli</i> (S. Wats.) Luer, vel sp. aff.	E	4166
<i>Trigonidium egertonianum</i> Batem. ex Lindl.	E	4181
PASSIFLORACEAE		
<i>Passiflora obovata</i> Killip	L	4194
POLYGONACEAE		
<i>Coccoloba tuerckheimii</i> Donn. Sm.	T	4228
PTERIDOPHYTES		
<i>Adiantum macrophyllum</i> Sw.	H	4226
<i>Asplenium monodon</i> Liebm.	E	4224
<i>Cyathea multiflora</i> Sm.	S	4217
<i>Lomariopsis vestita</i> E. Fourn.	H	4171
<i>Sphaeropteris horrida</i> (Liebm.) R.M. Tryon	T	4213
<i>Trichomanes collariatum</i> Bosch	E	4196
? sp.	E	4188
RHAMNACEAE		
<i>Rhamnus</i> cf. <i>sphaerosperma</i> Sw.	T	4221
RUBIACEAE		
<i>Psychotria simiarum</i> Standl.	S	4176
SAPINDACEAE		
<i>Cupania</i> sp.	L	4193
? sp.	S	4208
SOLANACEAE		
<i>Cestrum</i> sp.	V	4222
VITACEAE		
<i>Vitis tiliifolia</i> H. & B.	L	4191
FAMILY INDET		
? sp.	T	4172
? sp.	T	4187
5. Exposed limestone hilltop several km east of Union Camp, towards Little Quartz Ridge, 700-750 m, (April 9)		
ACANTHACEAE		
<i>Justicia breviflora</i> (Nees) Rusby	H	4243, 4245
APOCYNACEAE		
<i>Aspidosperma</i> sp.	T	observed

APPENDIX 2

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

ARACEAE		
<i>Anthurium lucens</i> Standl. ex Yuncker	T	4241
BIGNONIACEAE		
<i>Arrabidaea podopogon</i> (DC.) A. Gentry	L	4262
BOMBACACEAE		
<i>Bombacopsis quinata</i> (Jacq.) Dugand	T	4242
BROMELIACEAE		
<i>Tillandsia</i> sp.	E	4252
BURSERACEAE		
<i>Bursera simaruba</i> (L.) Sarg.	T	observed
CECROPIACEAE		
<i>Pourouma</i> sp.	T	observed
CELASTRACEAE		
<i>Wimmeria bartlettii</i> Lundell	S	4251
CHRYSOBALANACEAE		
<i>Hirtella americana</i> L.	T	4237
FABACEAE		
<i>Machaerium</i> cf. <i>riparium</i> Brandeg.	L	4250
FLACOURTIACEAE		
<i>Casearia bartlettii</i> Lundell	S	4256
<i>Laetia thamnia</i> L.	S	4259
MELIACEAE		
<i>Trichilia erythrocarpa</i> Lundell	S	4248
MIMOSACEAE		
<i>Pithecellobium arboreum</i> (L.) Urban	T	observed
MORACEAE		
<i>Pseudolmedia spuria</i> (Sw.) Griseb	T	4260
MYRSINACEAE		
<i>Ardisia paschalis</i> Donn. Sm.	S	observed
<i>Ardisia</i> sp.	S	4240
MYRTACEAE		
<i>Calyptranthes</i> sp.	T	4236
<i>Eugenia</i> sp.	S	4247
OLEACEAE		
<i>Linociera domingensis</i> (Lam.) Knobl.	S	4253

APPENDIX 2

ORCHIDACEAE		
<i>Epidendrum</i> sp.	E	4235
<i>Polystachya foliosa</i> (Hook.) Reichb.f., vel sp. aff.	E	4254
<i>Ponera striata</i> Lindl.	E	4238
<i>Vanilla planifolia</i> Andr., vel sp. aff.	E	4234
PIPERACEAE		
<i>Piper</i> sp.	S	4244
POLYGONACEAE		
<i>Coccoloba acapulcensis</i> Standl.	T	4239
ROSACEAE		
<i>Photinia microcarpa</i> Standl.	T	4258
RUBIACEAE		
<i>Chiococca alba</i> (L.) A.S. Hitchc.	L	4249
<i>Psychotria costivenia</i> Griseb.	S	4261
SAPINDACEAE		
<i>Matayba apetala</i> (Macfad.) Radlk.	T	4257
SAPOTACEAE		
<i>Pouteria reticulata</i> (Engler) Eyma subsp. <i>reticulata</i>	T	4246
<i>Manilkara zapota</i> (L.) van Royen	T	observed
TILIACEAE		
<i>Heliocarpus</i> sp.	T	observed
URTICACEAE		
<i>Myriocarpa obovata</i> J.D. Sm.	S	4238-A
FAMILY INDETS		
? sp.	S	4255
6. Little Quartz Ridge, summit, 800-900 m (1000 m on map), 16½24-25°N, 89½07-06°W (April 10, 11)		
ANNONACEAE		
<i>Guatteria amplifolia</i> Tr. & Pl.	S	4280
AQUIFOLIACEAE		
<i>Ilex guianensis</i> (Aublet) O. Kuntze	T	4288
ARACEAE		
<i>Philodendron radiatum</i> Schott	E	4303

APPENDIX 2

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

ARECACEAE		
<i>Colpothrinax cookii</i> Read	T	4333
<i>Euterpe macrospadix</i> Oersted	T	observed
ASTERACEAE		
<i>Critonia sexangulare</i> (Klatt) King & Robinson	S	4269
BROMELIACEAE		
<i>Pitcairnia</i> sp.	H	observed
<i>Vriesea</i> sp.	E	4279
CHLORANTHACEAE		
<i>Hedyosmum mexicanum</i> Cord.	T	4273
CLUSIACEAE		
<i>Calophyllum brasiliense</i> var. <i>rekoii</i> Standl.	T	observed
CYCLANTHACEAE		
<i>Asplundia labela</i> (Schult.) Harl.	E	observed
CYPERACEAE		
<i>Scleria latifolia</i> Sw.	H	4278
<i>Scleria secans</i> (L.) Urban	H	4300
CYRILLACEAE		
<i>Cyrilla racemiflora</i> L.	T	4299
DILLENIACEAE		
<i>Doliocarpus dentatus</i> (Aublet) Standl. subsp. <i>dentatus</i>	L	4297
ELAEOCARPACEAE		
<i>Sloanea tuerckheimii</i> Donn. Sm.	S	4293
ERICACEAE		
<i>Satyria warszewiczii</i> Klotzsch	E	4282
EUPHORBIACEAE		
<i>Alchornea latifolia</i> Sw.	T	4267
FAGACEAE		
<i>Quercus cortesii</i> Liebm.	T	4307
LAMIACEAE		
<i>Scutellaria longifolia</i> Benth.	S	4301
LAURACEAE		
? sp.	S	4298
LOGANIACEAE		
<i>Strychnos panamensis</i> Seeman	S	4272

APPENDIX 2

MAGNOLIACEAE		
<i>Magnolia</i> cf. <i>yoroconte</i> Dandy	T	4266
MARCGRAVIACEAE		
<i>Souroubea</i> sp.	V	4309
MELASTOMATACEAE		
<i>Blakea cuneata</i> Standl.	E	observed
<i>Clidemia involucrata</i> DC.	S	4271
<i>Miconia dodecandra</i> (Desr.) Cogn.	T	4268
<i>Mouriri exilis</i> Gleason	S	4290
MENISPERMACEAE		
<i>Abuta panamensis</i> (Standl.) Krukoff & Barneby	L	4286
MIMOSACEAE		
<i>Inga davidsei</i> Sousa	T	4304
<i>Pithecellobium arboreum</i> (L.) Urban	T	observed
MYRTACEAE		
<i>Myrcia splendens</i> (Sw.) DC.	T	4291
ORCHIDACEAE		
cf. <i>Lacaena</i> sp.	E	4274
PIPERACEAE		
<i>Piper</i> sp.	S	4294
PTERIDOPHYTES		
<i>Asplenium juglandifolium</i> Lam.	E	4289
<i>Cyathea myosuroides</i> (Liebm.) Domin	S	4285
<i>Danaea elliptica</i> Sm.	H	4305
<i>Lindsaea klotzschiana</i> Moritz in Ettingsh.	H	4265
<i>Lindsaea lancea</i> (L.) Bedd.	H	4283
<i>Salpichlaena volubilis</i> (Sw.) J. Sm.	H	4287
<i>Sticherus palmatus</i> (J.H. Schaffn. ex Underw.) Copel.	H	4270
RHIZOPHORACEAE		
<i>Cassipourea guianensis</i> Aublet	S	4308
RUBIACEAE		
<i>Hillia panamensis</i> Standl.	E	4292
<i>Psychotria elata</i> (Sw.) Hammel	S	4295, 4296
<i>Psychotria panamensis</i> Standl.	S	4302

APPENDIX 2

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

<i>Psychotria poeppigiana</i> Muell. Arg.	S	4284
<i>Randia matudae</i> Lorence & Dwyer	T	4281
RUTACEAE		
<i>Zanthoxylum</i> sp.	S	4276
SAPOTACEAE		
<i>Manilkara zapote</i> (L.) van Royen	T	observed
SIMARUBACEAE		
<i>Simaruba amara</i> Aublet	T	observed
STYRACACEAE		
<i>Styrax argenteus</i> Presl	S	4277
THEACEAE		
<i>Ternstroemia tepezapote</i> Schlttdl. & Cham.	T	4306
BRYOPHYTES		
<i>Lepidopilidium portoricense</i> (C. Muhl.) Crum & Steere		4335
<i>Phyllogonium fulgens</i> (Hedw.) Brid.		4336
<i>Pireela angustifolia</i> (C. Mull.) Arzeni		4337
<i>Plagiochila</i> sp.		4334
7. Little Quartz Ridge, base and slopes, 700-800 m, 16½24-25'N, 89½07-06'W (April 10, 11)		
ARECACEAE		
<i>Chamaedorea graminifolius</i> H. Wendl.	S	4330
<i>Chamaedorea tenella</i> H. Wendl.	S	4326
BIGNONIACEAE		
<i>Mussatia hyacinthina</i> (Standl.) Sandw.	V	4315
<i>Stizophyllum riparium</i> (H.B.K.) Sandw.	V	4319
CELASTRACEAE		
<i>Crossopetalum eucyosum</i> (Loes. & Pitt.) Lundell	S	4314
CONVOLVULACEAE		
? sp.	V	4321
LAURACEAE		
? sp.	S	4329
LOGANIACEAE		
<i>Strychnos brachistantha</i> Standley	S	4328
MELASTOMATACEAE		
<i>Miconia dodecandra</i> (Desr.) Cogn.	T	observed

APPENDIX 2

PIPERACEAE		
<i>Peperomia</i> sp.	H	4325
<i>Piper</i> sp.	S	4327
<i>Piper</i> sp.	S	4331
PTERIDOPHYTES		
<i>Blechnum gracile</i> Kaulf.	H	4316
<i>Diplazium riedelianum</i> (Bong. ex Kuhn) Kuhn ex C. Chr.	H	4317
<i>Diplazium werckleanum</i> H. Christ	H	4317-A, 4323
<i>Selaginella guatemalensis</i> Baker	H	4311
<i>Tectaria heracleifolia</i> (Willd.) Underw.	S	4318
<i>Thelypteris blanda</i> (Fée) C.F. Reed	S	4312
<i>Thelypteris ghiesbreghtii</i> (Hook.) C.V. Morton	T	4320
<i>Thelypteris nicaraguensis</i> (E. Fourn.) C.V. Morton	H	4324
<i>Trichomanes collariatum</i> Bosch	E	4313
<i>Trichomanes pyxidiferum</i> L.	H	4310
RUBIACEAE		
<i>Hoffmannia ghiesbreghtii</i> (Lem.) Hemsl.	H	4322
BRYOPHYTES		
<i>Homalia glabella</i> (Hedw.) BSG		4338-B, 4339
<i>Macromitrium contextum</i> Hampe		4340
<i>Porotrichium korthalsianum</i> (Dozy & Molk.) Mitt.		4338
8. Trail between Union and Gloria Camps (April 13)		
ARACEAE		
<i>Anthurium scandens</i> (Aublet) Engler subsp. <i>scandens</i>	E	4396
<i>Monstera acuminata</i> K. Koch	E	4382
<i>Philodendron tripartitum</i> (Jacq.) Schott	E	4388
<i>Spathiphyllum blandum</i> Schott	H	4366
ARECACEAE		
<i>Chamaedorea neurochlamys</i> Burret	S	4344
<i>Chamaedorea tepejilote</i> Liebm.	S	4387
<i>Orbignya cohune</i> (Mart.) Dahlg. ex Standl.	T	observed
ASTERACEAE		
<i>Bidens</i> sp. ?	H	4363
BEGONIACEAE		
<i>Begonia nelumbiifolia</i> S. & C.	H	4373

APPENDIX 2

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

BIGNONIACEAE

<i>Anemopaegma chrysanthum</i> Dugand	V	4356
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<i>Paragonia pyramidata</i> (L. Rich.) Bur.	V	4371
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BROMELIACEAE

<i>Tillandsia festucoides</i> Brongn. ex Mez	E	4379
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BURSERACEAE

<i>Protium</i> cf. <i>glabrum</i> (Rose) Engler	S	4391
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CAESALPINIACEAE

<i>Bauhinia guianensis</i> Aublet	V	4352
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CELASTRACEAE

<i>Crossopetalum eucyosum</i> (Loes. & Pitt.) Lundell	S	4365
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CLUSIACEAE

<i>Clusia</i> cf. <i>lundellii</i> Standl.	S	4378
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COMBRETACEAE

<i>Terminalia amazonia</i> (J.F. Gmel.) Exell	T	4357
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CONVOLVULACEAE

<i>Ipomoea setosa</i> Ker.	V	4374
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CUCURBITACEAE

<i>Gurania makoyana</i> (Lem.) Cogn.	V	4392
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FABACEAE

<i>Desmodium</i> sp.	H	4398
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FLACOURTIACEAE

<i>Xylosma characanthum</i> Standl.	S	4353
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LOGANIACEAE

<i>Spigelia humboldtiana</i> Cham. & Schltld.	H	4342
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MARANTACEAE

<i>Calathea micans</i> Körn.	H	4372
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MENISPERMACEAE

<i>Cissampelos</i> sp.	V	4355
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MIMOSACEAE

<i>Inga</i> sp.	T	4383
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MYRSINACEAE

<i>Ardisia pellucida</i> Oerst., vel aff.	S	4393
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<i>Parathesis aeruginosa</i> Standl.	S	4358
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APPENDIX 2

MYRTACEAE		
<i>Calyptanthes cf. chytraculia</i> (L.) Sw.	S	4348
NYCTAGINACEAE		
? sp.	S	4349
ORCHIDACEAE		
<i>Beloglottis</i> sp.	H	4369
<i>Maxillaria variabilis</i> Batem ex Lindl., vel sp. aff.	E	4380
PASSIFLORACEAE		
<i>Passiflora oerstedii</i> var. <i>choconiana</i> S. Watson	V	4345
PIPERACEAE		
<i>Peperomia</i> sp.	H	4375
<i>Piper</i> sp.	S	4350
<i>Piper</i> sp.	S	4361, 4376
<i>Piper</i> sp.	S	4367
POACEAE		
<i>Oplismenus burmannii</i> (Retz.) P. Beauv.	H	4351
PTERIDOPHYTES		
<i>Adiantum macrophyllum</i> Sw.	H	4377
<i>Adiantum tetraphyllum</i> Willd.	H	4360
<i>Asplenium cristatum</i> Lam.	H	4397
<i>Campyloneurum costatum</i> (Kunze) C. Presl	E	4359
<i>Campyloneurum repens</i> (Aublet) C. Presl	H	4385
<i>Ctenitis melanosticta</i> (Kunze) Copel	H	4368
<i>Didymochlaena truncatula</i> (Sw.) J. Sm.	H	4394
<i>Huperzia pithyoides</i> (S. & C.) Holub	E	4381
<i>Niphidium crassifolium</i> (L.) Lellinger	E	4354
<i>Pteris altissima</i> Poiret	H	4395
<i>Selaginella sertata</i> Spring	H	4341
<i>Thelypteris paucipinnata</i> (J.D. Sm.) C.F. Reed	H	4343
RUBIACEAE		
<i>Hoffmannia bullata</i> L.W. Wms.	H	4399
<i>Palicourea padifolia</i> (R. & S.) Taylor & Lorence	S	4346
SAPINDACEAE		
<i>Paullinia</i> sp.	V	4347
<i>Paullinia</i> sp.	V	4370

APPENDIX 2

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

SAPOTACEAE		
<i>Chrysophyllum</i> sp.	S	4390
SOLANACEAE		
<i>Lycianthes nitida</i> Bitter	S	4386
<i>Lycianthes purpusii</i> (Brandeg.) Bitt.	S	4389
VERBENACEAE		
<i>Stachytarpheta cayennensis</i> (Rich.) Vahl	H	4364
FAMILY INDETS		
? sp.	S	4362
8. Gloria Camp, 750 m, 16½22'N, 89½10'W, (April 13, 14)		
ACANTHACEAE		
<i>Louteridium donnell-smithii</i> S. Wats.	S	observed
ARACEAE		
<i>Philodendron aurantifolium</i> Schott	E	4437
<i>Philodendron scandens</i> K. Koch & Sodiro	E	4422
<i>Rhodospatha wendlandii</i> Schott	E	4401
ARECACEAE		
<i>Astrocaryum mexicanum</i> Liebm.	S	observed
<i>Chamaedorea tepejilote</i> Liebm.	S	4409
<i>Cryosophila argentea</i> Barlett	S	observed
<i>Orbignya cohune</i> (Mart.) Dahlg. ex Standl.	T	observed
BIGNONIACEAE		
<i>Arrabidaea inaequalis</i> (DC. ex Splitg.) K. Sch.	L	4434
<i>Arrabidaea viscida</i> (Donn. Sm.) A. Gentry	L	4420
<i>Paragonia pyramidata</i> (Rich.) Bur.	L	4406
BROMELIACEAE		
<i>Tillandsia monadelpha</i> (E. Morren) Baker	E	4430
CACTACEAE		
<i>Rhipsalis baccifera</i> (J. Miller) Stearn	E	4427
CAESALPINIACEAE		
<i>Dialium guianense</i> (Aublet) Sandw.	T	observed
CECROPIACEAE		
<i>Coussapoa</i> sp.	T	observed

APPENDIX 2

CLUSIACEAE		
<i>Calophyllum brasiliense</i> var. <i>rekoii</i> Standl.	T	observed
<i>Clusia</i> sp. (<i>C. salvinii</i> group)	E	4408
<i>Tovomitopsis nicaraguensis</i> Pl. & Tr.	S	4407
EUPHORBIACEAE		
<i>Acalypha diversifolia</i> Jacq.	T	4418
<i>Bernardia interrupta</i> (Schltr.) Muell. Arg.	T	4421
LAURACEAE		
<i>Beilschmiedea hondurensis</i> Kosterm.	T	4435
MELASTOMATACEAE		
<i>Miconia impetiolearis</i> (Sw.) D. Don	T	4414
MELIACEAE		
<i>Guarea glabra</i> Vahl	T	4425
<i>Trichilia pallida</i> Sw.	S	4432
MORACEAE		
<i>Ficus</i> sp.	T	observed
MYRISTICACEAE		
<i>Compsonaura sprucei</i> (A. DC.) Warb.	T	4424
MYRTACEAE		
<i>Eugenia</i> sp.	S	4410
OLEACEAE		
<i>Linociera oblanceolata</i> Robins.	S	4411
ORCHIDACEAE		
<i>Epidendrum</i> sp.	E	4431
PIPERACEAE		
<i>Peperomia</i> sp.	E	4415
<i>Peperomia</i> sp.	E	4426
PTERIDOPHYTES		
<i>Elaphoglossum herminieri</i> (Bory & Fée ex Fée) T. Moore	E	4402
<i>Lomariopsis recurvata</i> Fée	E	4417
<i>Microgramma percussa</i> (Cav.) Sota	E	4403
RUBIACEAE		
<i>Faramea occidentalis</i> (L.) A. Rich.	S	4419
<i>Hamelia calycosa</i> J.D. Smith	T	4413

APPENDIX 2

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

<i>Psychotria pleuropoda</i> J.D. Smith	S	4404
<i>Psychotria simiarum</i> Standl.	S	4405
<i>Psychotria</i> sp.	S	4433
SOLANACEAE		
<i>Cestrum</i> sp.	V	4436
TURNERACEAE		
<i>Erblichia odorata</i> Seeman	T	observed
VIOLACEAE		
<i>Orthion malpighiifolium</i> (Standl.) Standl. & Steyererm.	T	4423
<i>Rinorea hummelii</i> Sprague	S	4412
BRYOPHYTES		
<i>Bryopteris trinitensis</i> (Lehm. & Lindenb.) Lehm. & Lindenb.		4441
<i>Holomitrium arboreum</i> Mitt.		4438, 4444
<i>Neckeropsis undulata</i> (Hedw.) Reich.		4440
<i>Racopilum tomentosum</i> (Hedw.) Brid.		4445
<i>Stictolejeunea squamata</i> (Willd. ex Web.) Schiffn.		4442
<i>Taxilejeunea</i> sp.		4439, 4443
9. Trail between Gloria Camp and San José (April 15)		
AMARANTHACEAE		
<i>Cyathula achyranthoides</i> (H.B.K.) Moq.	H	4454
ARACEAE		
<i>Anthurium flexile</i> Schott subsp. <i>flexile</i>	E	4470
<i>Philodendron sagittifolium</i> Liebm.	E	4499
<i>Rhodospatha wendlandii</i> Schott	H	4446
<i>Xanthosoma</i> cf. <i>mexicanum</i> Liebm.	H	4497
ARALIACEAE		
<i>Oreopanax obtusifolius</i> L. Wms.	T	4491
ARECACEAE		
<i>Bactris</i> sp.	S	4501
<i>Orbignya cohune</i> (Mart.) Dahlg. ex Standl.	T	observed
<i>Reinhardtia gracilis</i> (Wendl.) Burret	S	4500
BEGONIACEAE		
<i>Begonia heracleifolia</i> S. & C.	H	3901

APPENDIX 2

BIGNONIACEAE		
<i>Arrabidaea verrucosa</i> (Standl.) A. Gentry	L	4490
<i>Pithecoctenium crucigerum</i> (L.) A. Gentry	L	4484
<i>Tynanthus guatemalensis</i> Donn. Sm.	L	4468
CACTACEAE		
<i>Epiphyllum crenatum</i> (Lindl.) G. Don	E	4483
CARICACEAE		
<i>Jacaratia mexicana</i> DC.	S	4467
COMBRETACEAE		
<i>Terminalia amazonia</i> (J.F. Gmel.) Exell	T	4465
COMMELINACEAE		
<i>Tradescantia zanonii</i> (L.) Sw.	H	4458
CONVOLVULACEAE		
<i>Maripa nicaraguensis</i> Hemsl.	L	4487
CUCURBITACEAE		
<i>Sicydium</i> sp.	V	4462
FABACEAE		
<i>Erythrina folkersii</i> Krukoff & Moldenke	S	4450
<i>Mucuna</i> sp.	V	4471
? sp.	S	4451
FLACOURTIACEAE		
<i>Pleuranthodendron lindenii</i> (Turcz.) Sleumer	T	4466
ICACINACEAE		
<i>Calatola laevigata</i> Standl.	?	4494
MALPIGHIACEAE		
<i>Tetrapteryx</i> sp.	L	4493
MARANTACEAE		
<i>Calathea crotalifera</i> S. Watson	H	4472
MELASTOMATACEAE		
<i>Ossaea micrantha</i> (Sw.) Macfad.	S	4447
MORACEAE		
<i>Dorstenia contrajerva</i> L.	H	4481
<i>Ficus</i> sp.	T	4498
OLACACEAE		
<i>Heisteria media</i> Blake	T	4486

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

ORCHIDACEAE

<i>Pelexia</i> sp.	H	4476
<i>Pleurothallis</i> sp.	E	4453
<i>Sobralia</i> ?	E	4400

PASSIFLORACEAE

<i>Passiflora obovata</i> Killip	L	4455
<i>Passiflora</i> sp.	L	4457

PHYTOLACCACEAE

<i>Phytolacca rivinoides</i> Kunth & Bouché	H	4469
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PIPERACEAE

<i>Peperomia</i> sp.	H	4459, 4482
<i>Piper</i> sp.	S	4449

PTERIDOPHYTES

<i>Adiantum pulverulentum</i> L.	H	4504
<i>Asplenium cristatum</i> Lam.	H	4480
<i>Bolbitis pergamentacea</i> (Maxon) Ching	H	4464
<i>Ctenitis interjecta</i> (C. Chr.) Ching	H	4502
<i>Dennstaedtia bipinnata</i> (Cav.) Maxon	H	4474
<i>Diplazium striatastrum</i> (L.) C. Presl	H	4473
<i>Pecluma divaricata</i> (E. Fourn.) Mickel & Beitel	H	4460
<i>Pteris quadriaurita</i> Retz, s.l.	H	3900
<i>Tectaria incisa</i> Cav.	H	4478
<i>Tectaria mexicana</i> (Fée) C.V. Morton	H	4475
<i>Trichomanes punctatum</i> subsp. <i>sphenoides</i> (Kunze) Wess. Boer	H	4496

SAPINDACEAE

<i>Matayba</i> sp.	T	4488
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RUBIACEAE

<i>Hoffmannia bullata</i> L.W. Wms.	H	4448
<i>Hoffmania ghiesbreghtii</i> (Lem.) Hemsl.	H	4461
<i>Psychotria tenuifolia</i> Sw.	S	4452
<i>Rudgea cornifolia</i> (H. & B.) Standl.	S	4479

SOLANACEAE

? sp.	S	4485
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STERCULIACEAE

<i>Guazuma ulmifolia</i> Lam.	T	4492
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APPENDIX 2

H	herb
E	epiphyte
S	shrub
V	vine
L	liana
T	tree (> 10 cm dbh)

URTICACEAE		
<i>Myriocarpa longipes</i> Liebm.	S	4463
VITACEAE		
<i>Cissus</i> sp.	L	4456
FAMILY INDETS		
? sp.	T	4489
BRYOPHYTES		
<i>Lepidopilum polytrichoides</i> (Hedw.) Brid.		4495
10. Secondary forest near San José (April 15)		
ARECACEAE		
<i>Orbignya cohune</i> (Mart.) Dahlg. ex Standl.	T	observed
BEGONIACEAE		
<i>Begonia glabra</i> Aublet	H	4508
EUPHORBIACEAE		
<i>Acalypha diversifolia</i> Jacq.	S	4509
HELICONIACEAE		
<i>Heliconia wagnerianum</i> Peters.	H	4505
MYRTACEAE		
<i>Eugenia</i> cf. <i>oerstediana</i> O. Berg	S	4506
PTERIDOPHYTES		
<i>Lygodium venustum</i> Sw.	H	4511
<i>Nephrolepis multiflora</i> (Roxb.) F.M. Jarrett ex C.V. Morton	E	4507
<i>Pteridium caudatum</i> (L.) Maxon	H	4510

Birds of the Columbia River Forest Reserve

T.A. Parker, III

Nomenclature and order follow the A.O.U. Checklist of North American Birds (1983).

	UC	GC	AC	Habitats
TINAMIDAE (3)				
<i>Tinamus major</i>	C	C	-	Fh
<i>Crypturellus boucardi</i>	F	F	-	Fh
<i>Crypturellus soui</i>	R	-	-	Fh,Fs
CATHARTIDAE (2)				
<i>Coragyps atratus</i>	-	-	X	Fs,Sg
<i>Sarcoramphus papa</i>	R	-	-	Fh,Fs
ACCIPITRIDAE (10)				
<i>Leptodon cayanensis</i>	-	X	-	Fh
<i>Chondrohierax uncinatus</i> +	-	-	X	Fs
<i>Harpagus bidentatus</i> +	X	-	-	Fh
<i>Leucopternis albicollis</i>	-	-	X	Fh
<i>Buteogallus urubitinga</i>	U	-	-	Fh,Sm
<i>Buteo brachyurus</i>	-	R	-	Fh
<i>Buteo platypterus</i> +*	U	-	-	Fh
<i>Spizastur melanoleucus</i> +	-	R	-	Fh
<i>Spizaetus tyrannus</i>	F	X	-	Fh
<i>Spizaetus ornatus</i> +	U	U	-	Fh
FALCONIDAE (2)				
<i>Micrastur ruficollis</i>	U	F	-	Fh
<i>Micrastur semitorquatus</i>	U	-	-	Fh
CRACIDAE (3)				
<i>Ortalis vetula</i>	U	-	-	Fh,Fs
<i>Penelope purpurascens</i>	U	U	-	Fh
<i>Crax rubra</i>	F	U	-	Fh
PHASIANIDAE (1)				
<i>Odontophorus guttatus</i>	F	F	-	Fh
COLUMBIDAE (6)				
<i>Columba speciosa</i>	U	-	-	Fe
<i>Columba nigrirostris</i>	C	C	X	Fh
<i>Columbina talpacoti</i>	-	-	F	Sg,Fe

APPENDIX 3

Localities	
UC	Union Camp
GC	Gloria Camp
AC	American Camp
Abundance	
C	Common
F	Fairly common
U	Uncommon
R	Rare
X	Recorded
Habitats	
Fh	Mature evergreen forest
Fe	Tall forest edges
Fs	Second-growth forest
Sg	Low second-growth
Sm	Forest stream margins
*	Migrant or wintering species from eastern North America
+	Considered rare or accidental by Wood et al. (1986)

APPENDIX 3

	UC	GC	AC	Habitats
<i>Claravis pretiosa</i>	R	R	X	Fs,Sg
<i>Leptotila cassinii</i>	U	-	X	Fe,Fs
<i>Geotrygon montana</i>	F	C	-	Fh
PSITTACIDAE (3)				
<i>Aratinga nana</i>	-	-	X	Fe,Sg
<i>Pionus senilis</i>	U	U	X	Fh
<i>Amazona farinosa</i>	F	C	-	Fh
CUCULIDAE (4)				
<i>Coccyzus erythrophthalmus</i> +*	R	-	-	Fh
<i>Piaya cayana</i>	F	F	X	Fh,Fs
<i>Dromococcyx phasianellus</i> +	R	-	-	Fh
<i>Crotophaga sulcirostris</i>	-	-	X	Sg
STRIGIDAE (6)				
<i>Otus guatemalae</i>	C	F	X	Fh
<i>Lophotrix cristata</i>	U	-	-	Fh
<i>Pulsatrix perspicillata</i>	U	-	-	Fe
<i>Glaucidium (minutissimum)</i>	F	U	-	Fh
<i>Glaucidium brasilianum</i>	U	-	X	Fe,Fs
<i>Ciccaba virgata</i>	F	X	-	Fh
CAPRIMULGIDAE (4)				
<i>Chordeiles minor</i> *	R	-	-	Sg
<i>Nyctidromus albicollis</i>	-	R	X	Fe,Fs
<i>Caprimulgus carolinensis</i> *	R	-	-	Fe,Fh
<i>Nyctibius griseus</i>	-	-	X	Fe,Sg
APODIDAE (2)				
<i>Streptoprocne zonaris</i>	R	-	-	Fh
<i>Chaetura vauxi</i>	C	F	-	Fh
TROCHILIDAE (11)				
<i>Phaethornis superciliosus</i>	F	C	X	Fh
<i>Phaethornis longuemareus</i>	-	-	X	Fh
<i>Campylopterus curvipennis</i>	U	-	X	Fh,Fe
<i>Campylopterus hemileucurus</i>	F	C	X	Fh
<i>Florisuga mellivora</i>	U	U	X	Fh,Fe
<i>Lophornis helenae</i> +	R	-	-	Fh

APPENDIX 3

	UC	GC	AC	Habitats
<i>Chlorostilbon canivetii</i>	-	-	X	Sg,Fe
<i>Thalurania colombica</i> +	U	F	X	Fh
<i>Amazilia candida</i>	C	F	-	Fh,Sg
<i>Amazilia tzacatl</i>	U	-	-	Fe,Sg
<i>Eupherusa eximia</i> +	C	F	-	Fh,Fe
TROGONIDAE (4)				
<i>Trogon citreolus</i>	-	-	X	Fe,Fs
<i>Trogon violaceus</i>	C	C	X	Fh
<i>Trogon collaris</i>	C	C	X	Fh
<i>Trogon massena</i>	U	F	X	Fh
MOMOTIDAE (3)				
<i>Hylomanes momotula</i> +	F	F	-	Fh
<i>Momotus momota</i>	C	F	X	Fh,Fs
<i>Electron carinatum</i> +	F	F	-	Fh
ALCEDINIDAE (1)				
<i>Chloroceryle americana</i>	U	-	X	Sm
BUCCONIDAE (2)				
<i>Notharchus macrorhynchus</i>	U	U	-	Fh
<i>Malacoptila panamensis</i>	U	X	-	Fh
RAMPHASTIDAE (3)				
<i>Aulacorhynchus prasinus</i>	U	U	-	Fh
<i>Pteroglossus torquatus</i>	U	F	X	Fh,Fs
<i>Ramphastos sulfuratus</i>	C	C	X	Fh
PICIDAE (6)				
<i>Melanerpes pucherani</i>	U	F	X	Fe,Fs
<i>Veniliornis fumigatus</i>	F	F	X	Fh
<i>Piculus rubiginosus</i>	F	F	X	Fh
<i>Celeus castaneus</i>	-	U	-	Fh
<i>Dryocopus lineatus</i>	R	-	X	Fe,Fs
<i>Campephilus guatemalensis</i>	U	F	-	Fh
FURNARIIDAE (3)				
<i>Automolus ochrolaemus</i>	F	F	-	Fh
<i>Xenops minutus</i>	F	F	X	Fh
<i>Sclerurus guatemalensis</i>	F	F	-	Fh

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DENDROCOLAPTIDAE (9)				
<i>Dendrocincla anabatina</i>	F	F	X	Fh
<i>Dendrocincla homochroa</i>	F	F	X	Fh
<i>Sittasomus griseicapillus</i>	C	U	-	Fh
<i>Glyphorhynchus spirurus</i>	-	U	-	Fh
<i>Xiphocolaptes promeropirhynchus</i>	U	-	-	Fh
<i>Dendrocolaptes certhia</i>	U	F	-	Fh
<i>Xiphorhynchus flavigaster</i>	C	C	X	Fh,Fs
<i>Xiphorhynchus erythropygius</i> +	F	U	-	Fh
<i>Lepidocolaptes souleyetii</i>	R	X	X	Fh,Fs
FORMICARIIDAE (7)				
<i>Thamnophilus doliatus</i>	R	-	X	Sg,Fe
<i>Thamnistes anabatinus</i> +	F	F	-	Fh
<i>Dysithamnus mentalis</i> +	C	F	-	Fh
<i>Myrmotherula schisticolor</i>	F	U	-	Fh
<i>Microrhophias quixensis</i>	C	C	X	Fh
<i>Cercomacra tyrannina</i>	U	-	X	Fe,Fs
<i>Formicarius analis</i>	F	F	X	Fh
TYRANNIDAE (35)				
<i>Zimmerius vilissimus</i> +	R	R	-	Fh
<i>Ornithion semiflavum</i> +	?	U	-	Fh,Fe
<i>Myiopagis viridicata</i>	R	-	-	Fh
<i>Elaenia flavogaster</i>	R	-	X	Sg,Fe
<i>Mionectes oleagineus</i>	F	F	-	Fh
<i>Leptopogon amaurocephalus</i>	F	F	X	Fh
<i>Oncostoma cinereigulare</i>	C	F	X	Fh,Fs
<i>Todirostrum sylvia</i> +	-	-	X	Sg,Fe
<i>Todirostrum cinereum</i>	-	-	X	Fe
<i>Rhynchocyclus brevirostris</i>	-	F	-	Fh
<i>Tolmomyias sulphurescens</i>	-	-	X	Fh
<i>Platyrinchus cancriminus</i>	F	U	-	Fh
<i>Onychorhynchus coronatus</i>	-	-	X	Fh
<i>Terenotriccus erythrus</i>	-	-	X	Fh
<i>Myiobius sulphureipygius</i>	F	F	X	Fh

APPENDIX 3

	UC	GC	AC	Habitats
<i>Contopus virens</i> *	U	C	X	Fh,Fe
<i>Contopus cinereus</i>	-	-	-	Fe
<i>Empidonax flaviventris</i> *	U	-	-	Fh
<i>Empidonax virescens</i> +*	C	C	-	Fh
<i>Empidonax minimus</i> *	-	-	X	Fe,Sg
<i>Attila spadiceus</i>	F	F	X	Fh
<i>Laniocera rufescens</i> +	U	U	-	Fh
<i>Rhytipterna holerythra</i>	-	F	-	Fh
<i>Myiarchus tuberculifer</i>	F	F	-	Fh,Fe
<i>Myiarchus crinitus</i> +*	U	-	-	Fh
<i>Pitangus sulphuratus</i>	-	-	X	Sg,Fe
<i>Megarynchus pitangua</i>	R	-	X	Fe,Fs
<i>Miozetetes similis</i>	R	-	X	Fe,Sg
<i>Myiodynastes maculatus</i>	-	U	X	Fh
<i>Myiodynastes luteiventris</i>	U	F	-	Fh,Fe
<i>Tyrannus melancholicus</i>	-	-	X	Fe,Sg
<i>Pachyramphus cinnamomeus</i>	U	U	X	Fh,Fe
<i>Pachyramphus polychopterus</i> +	R	-	-	Fh,Fe
<i>Pachyramphus aglaiae</i>	U	F	X	Fh
<i>Tityra semifasciata</i>	U	U	X	Fh,Fe
COTINGIDAE (2)				
<i>Lipaugus unirufus</i> +	F	F	-	Fh
<i>Cotinga amabilis</i> +	R	-	-	Fh
PIPRIDAE (3)				
<i>Schiffornis turdinus</i>	F	F	-	Fh
<i>Manacus candei</i>	R	-	X	Fe
<i>Pipra mentalis</i>	C	F	X	Fh
HIRUNDINIDAE (3)				
<i>Progne chalybea</i>	-	-	X	Fe
<i>Stelgidopteryx serripennis</i>	-	U	X	Sg,Fe
<i>Hirundo rustica</i> *	-	-	X	Sg
CORVIDAE (2)				
<i>Cyanocorax yncas</i>	U	U	-	Fh
<i>Cyanocorax morio</i>	-	-	X	Fs,Sg

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APPENDIX 3

	UC	GC	AC	Habitats
TROGLODYTIDAE (5)				
<i>Campylorhynchus zonatus</i>	-	R	X	Fe,Sg
<i>Thryothorus maculipectus</i>	C	C	X	Fh,Fs
<i>Troglodytes aedon</i>	-	-	X	Sg
<i>Henicorhina leucosticta</i>	C	C	-	Fh
<i>Microcerculus philomela</i> +	F	F	-	Fh
SYLVIIDAE (2)				
<i>Ramphocaenus melanurus</i>	C	C	-	Fh
<i>Polioptila plumbea</i>	F	F	X	Fh,Fs
TURDIDAE (5)				
<i>Myadestes unicolor</i> +	C	C	-	Fh
<i>Catharus ustulatus</i> *	C	C	X	Fh
<i>Hylocichla mustelina</i> *	U	F	-	Fh,Fs
<i>Turdus grayi</i>	-	-	X	Fe,Sg
<i>Turdus assimilis</i>	F	C	-	Fh
MIMIDAE (1)				
<i>Dumatella carolinensis</i>	F	-	X	Fe,Sg
VIREONIDAE (10)				
<i>Vireolanius pulchellus</i>	C	C	C	Fh
<i>Vireo griseus</i> *	R	-	-	Fe,Sg
<i>Vireo solitarius</i>	U	-	-	Fh
<i>Vireo flavifrons</i> *	U	R	-	Fh
<i>Vireo gilvus</i> *	R	-	-	Fe
<i>Vireo philadelphicus</i> *	U	-	-	Fh
<i>Vireo olivaceus</i> *	U	F	-	Fh,Fe
<i>Vireo flavoviridis</i>	-	-	X	Fe,Sg
<i>Hylophilus ochraceiceps</i>	C	C	X	Fh
<i>Hylophilus decurtatus</i>	C	C	X	Fh,Fs
EMBERIZIDAE				
PARULINAE (23)				
<i>Vermivora pinus</i> *	F	-	-	Fh
<i>Vermivora chrysoptera</i> +*	F	U	-	Fh,Fe
<i>Vermivora "brewsteri"</i> *	R	-	-	Fh
<i>Vermivora peregrina</i> *	F	F	-	Fe,Fh
<i>Parula pitiayumi</i> +	U	U	-	Fh

APPENDIX 3

	UC	GC	AC	Habitats
<i>Dendroica petechia</i> *	-	-	X	Sg,Fe
<i>Dendroica pensylvanica</i> *	C	F	X	Fh,Fe
<i>Dendroica magnolia</i> *	C	F	-	Fh,Fe
<i>Dendroica virens</i> *	F	F	-	Fh
<i>Dendroica cerulea</i> +*	C	C	-	Fh
<i>Mniotilta varia</i> *	C	F	-	Fh,Fe
<i>Setophaga ruticilla</i> *	F	F	X	Fh,Fe
<i>Protonotaria citrea</i> *	R	-	-	Fe
<i>Helmitheros vermivorus</i> *	F	U	-	Fh
<i>Seiurus aurocapillus</i> *	F	U	-	Fh
<i>Seiurus noveboracensis</i> *	R	-	-	Sm
<i>Seiurus motacilla</i> *	U	U	-	Sm
<i>Oporornis formosus</i> *	C	F	X	Fh
<i>Geothlypis trichas</i> *	-	-	X	Sg
<i>Wilsonia citrina</i> *	U	U	-	Fh,Fe
<i>Wilsonia pusilla</i> *	C	F	-	Fh,Sg
<i>Basileuterus culicivorus</i>	C	C	X	Fh
<i>Granatellus sallei</i> +	U	-	-	Sg
COEREBINAE (1)				
<i>Coereba flaveola</i>	F	F	X	Fh,Sg
THRAUPINAE (16)				
<i>Tangara larvata</i>	U	F	-	Fh
<i>Chlorophanes spiza</i> +	F	F	-	Fh
<i>Cyanerpes lucidus</i> +	R	-	-	Fh
<i>Cyanerpes cyaneus</i>	F	F	X	Fh,Fe
<i>Euphonia hirundinacea</i>	U	F	-	Fe,Fs
<i>Euphonia elegantissima</i> +	U	U	-	Fh,Fe
<i>Euphonia gouldi</i>	F	C	X	Fh
<i>Thraupis episcopus</i>	-	-	X	Fe,Sg
<i>Thraupis abbas</i>	R	U	X	Fe
<i>Chlorospingus ophthalmicus</i> +	R	-	-	Fh
<i>Lanio aurantius</i> +	U	F	X	Fh
<i>Habia rubica</i>	C	C	-	Fh
<i>Habia fuscicauda</i>	C	C	X	Fh
<i>Piranga rubra</i> *	F	C	X	Fh,Fe

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APPENDIX 3

	UC	GC	AC	Habitats
<i>Piranga leucoptera</i>	F	F	-	Fh
<i>Ramphocelus sanguinolentus</i>	U	-	-	Fe
CARDINALINAE (8)				
<i>Saltator coerulescens</i>	-	-	X	Sg,Fe
<i>Saltator maximus</i>	U	X	X	Fe,Fs
<i>Saltator atriceps</i>	-	-	X	Sg,Fe
<i>Caryothraustes poliogaster</i>	C	C	-	Fh
<i>Pheucticus ludovicianus</i> *	F	F	-	Fh
<i>Cyanocompsa cyanoides</i>	F	U	-	Fh,Fs
<i>Guiraca caerulea</i> *	-	-	-	Sg
<i>Passerina cyanea</i> *	U	F	X	Sg,Fe
EMBERIZINAE (4)				
<i>Arremon aurantirostris</i>	U	U	-	Fh
<i>Arremonops chloronotus</i>	-	-	X	Sg,Fs
<i>Volatinia jacarina</i>	-	-	X	Sg,Fe
<i>Sporophila torqueola</i>	-	-	X	Sg
ICTERINAE (10)				
<i>Dives dives</i>	-	-	X	Sg,Fe
<i>Quiscalus mexicanus</i>	-	-	X	Sg
<i>Icterus spurius</i> *	-	-	X	Sg,Fs
<i>Icterus chrysater</i>	U	-	-	Fe
<i>Icterus mesomelas</i>	-	-	X	Fe
<i>Icterus galbula</i> *	U	F	-	Fh,Fe
<i>Scaphidura oryzivora</i>	-	-	X	Fe,Sg
<i>Amylycercus holosericeus</i>	-	-	X	Sg
<i>Psarocolius wagleri</i> +	R	-	X	Fh
<i>Psarocolius montezuma</i>	-	-	X	Sg,Fe

Additional bird species found in the reserve during the December 1990 expedition (Matola 1990).

Falco sparverius
Columbina minuta
Pionopsitta haematotis
Amazona albifrons
Hirundo rustica *
Icteria virens *
Ramphocelus passerinii
Tiaris olivacea

Total: 224 species

Resident Forest Species: 144 species

Montane Component: ca. 8 species

Resident Second-Growth Species: 47 species

Migrants: 43 species (indicated by * in main list)

Migrants in Primary Forest: 30

Endemic to Middle American Forests: ca. 30 species (20% of resident forest avifauna)

Localities

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X Recorded

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Sg Low second-growth

Sm Forest stream margins

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Abundance Codes

C Common; more than 10 individuals recorded (by sight or sound) daily within small areas surveyed (generally < 2 km of trail)

F Fairly common; less than 10 individuals recorded daily

U Uncommon; small numbers recorded, not daily

R Rare; very scarce, fewer than 5 individuals recorded during survey

X Species recorded, status uncertain

Mammals of the Columbia River Forest Reserve

Louise H. Emmons

*Voucher specimen(s)

in the United States

National Museum

Didelphidae (opossums)*Micoureus alstoni* **Philander opossum**Didelphis marsupialis***Phyllostomidae (leaf-nosed bats)***Artibeus jamaicensis* **Artibeus toltecus* **Artibeus watsoni* **Carollia perspicillata* **Carollia brevicauda* **Centurio senex* **Glossophaga soricina* **Trachops cirrhosus* ***Cebidae (monkeys)***Alouatta pigra***Procyonidae (raccoon family)***Bassariscus sumichrasti**Nasua narica**Potos flavus***Mustelidae (weasel family)***Eira barbara***Felidae (cats)***Felis* sp. (small cat tracks)*Panthera onca***Tapiridae (tapir)***Tapirus bairdii***Tayassuidae (pecaries)***Tayassu tajacu**Tayassu pecari***Cervidae (deer)***Mazama americana***Sciuridae (squirrels)***Sciurus deppei***Geomyidae (pocket gopher)***Orthogeomys* c.f. *hispidus* (burrows seen)**Heteromyidae (pocket mice)***Heteromys desmarestianus* ***Muridae (rodents)***Oryzomys alfaroi* **Ototylomys hatti* **Tylomys nudicaudus* ***Agoutidae (paca)***Agouti paca***Dasyproctidae (agouti)***Dasyprocta punctata*

Reptiles and Amphibians of the Columbia River Forest Reserve

John R. Meyer and Louise H. Emmons

Identified by John R. Meyer, Jonathan Campbell, Roy McDiarmid, and Robert Reynolds. Specimens at the first two localities collected by Emmons in April 1992, remaining localities collected by Meyer in December 1990. All species except those marked (+) are represented by voucher specimens (USNM).

APPENDIX 5

UC	Union Camp
GC	Gloria Camp
AC	American Camp
EC	Edwards Central
BC	Black Creek Camp
AB	Abraham Camp

	UC	GC	AC	EC	BC	AB	other
Snakes							
<i>Boa constrictor</i> +				X			
<i>Bothrops nummifer</i> +						X	
<i>Coniophanes imperialis</i>	X						
<i>Drymobius margaritiferus</i> +							X
<i>Imantodes cenchoa</i>	X		X				
<i>Leptophis ahaetulla</i> +	X						
<i>Sibon nebulata</i>	X						
<i>Tantilla schistosa</i>			X				
<i>Urotheca elapoides</i>	X						
Lizards							
<i>Ameiva festiva</i> +	X	X	X				
<i>Basiliscus vittatus</i> +			X				
<i>Sphaerodactylus glaucus</i> +							X
<i>Thecadactylus rapicauda</i>		X					
<i>Norops uniformis</i>		X	X				
<i>Norops lemurinus</i> +			X				
<i>Norops limifrons</i>			X				
<i>Norops capito</i>		X					
Frogs							
<i>Eleutherodactylus rugulosus</i>	X	X	X				
<i>E. laticeps</i>		X	X				
<i>E. chac</i>		X	X				
<i>E. sp. nov.</i>		X			X		
<i>Bufo valiceps</i>		X	X				
<i>Rana vaillanti</i>	X		X				
<i>Agalychnis moreleti</i>		X					
<i>Smilisca cyanosticta</i>	X	X					
<i>Hyla bromeliacea</i>		X					
<i>Hyla minera</i>		X					



CONSERVATION INTERNATIONAL

Conservation International (CI) is a private, nonprofit organization dedicated to the conservation of tropical and temperate ecosystems and the species that rely on these habitats for their survival.

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Participants	3
Organizational Profiles	4
Acknowledgments	5
Overview	6
Introduction	6
Summary	7
Conservation Opportunities	14
Technical Report	17
Methods	17
Site Descriptions	18
Birds	21
Mammals	23
Reptiles and Amphibians	25
Literature Cited	26
Appendices	28
1. Plant List: Columbia River Forest Reserve	29
2. Plant List by Site	45
3. Birds of the Columbia River Forest Reserve	71
4. Mammals of the Columbia River Forest Reserve	80
5. Reptiles and Amphibians of the Columbia River Forest Reserve	81