

THE MACAL RIVER: A FLORISTIC AND PHYTOSOCIOLOGICAL STUDY OF A THREATENED RIVERINE VEGETATION COMMUNITY IN BELIZE

L. URBAN^{1,3}, S. G. M. BRIDGEWATER² & D. J. HARRIS¹

A species checklist is presented for a stretch of the seasonally flooded Macal River in the Cayo District of Belize, together with preliminary phytosociological data for the primary riverine communities. A total of 229 species were recorded in the seasonally flooded riparian zone, representing 7% of the flora of Belize. Results of quantitative sampling indicate that *Inga vera* subsp. *vera* dominates the river corridor. Other important woody associates include *Cuphea calophylla*, *C. utriculosa*, *Calyptanthes bartlettii*, *C. lindeniana*, *Lindenia rivalis*, *Pleuranthodendron lindenii*, *Calliandra tergemina* and *Nectandra salicifolia*. One of the most significant threats to riparian vegetation in the region is the Chalillo Dam upstream of the study site. The current work provides baseline floristic and ecological data for this threatened riparian habitat and documents the structure and composition of vegetation that exists downstream from the dam before its construction.

Keywords. Belize, Chalillo Dam, floristics, Macal River, Maya Mountains, phytosociology, riparian vegetation, riverine community.

INTRODUCTION

Many different terms are used to refer to vegetation found along the banks of running fresh waters. These include riparian vegetation (Decamps & Tabacchi, 1994), gallery forest, and streamside forests (Brinson, 1990). Although terminology differs, riparian vegetation can be loosely defined as the flora that grows in the transition region between aquatic and terrestrial environments along freshwater rivers and streams. It is the nature of the hydrological regime that distinguishes the riparian zone from its surroundings (Malanson, 1993), with its structure, composition and dynamics shaped by river-related processes such as inundation, the transportation of sediment, and the erosive and abrasive forces of water (Brinson, 1990).

Riparian vegetation zones are often notably species-rich habitats and are responsible for higher rates of biomass production when compared with other adjacent forest communities (Brinson, 1990; Decamps & Tabacchi, 1994). Their high species diversity is due in part to floods. These can create a mosaic of microhabitats within which numerous plant species coexist (Swanson *et al.*, 1988; Gregory *et al.*, 1991).

¹ Royal Botanic Garden Edinburgh, 20A Inverleith Row, Edinburgh EH3 5LR, UK.

² Natural History Museum, Cromwell Road, London SW7 5BD, UK.

³ Current address: Arkansas Herbarium, Biomass Research Center 141, Fayetteville, AR 72701, USA. E-mail: lurban@uark.edu

Riparian landscapes are highly threatened ecosystems as they are inherently rare habitats, occupying a mere one-thousandth of the earth's surface (Hynes, 1970).

The majority of studies on riparian vegetation have been conducted in northern temperate regions, with only a small body of work carried out in tropical ecosystems. Consequently, riparian ecosystems in the Neotropics remain poorly known, with little published work available on their floristic composition and ecological structure. With regard to Belize, the majority of published research on riparian forests has focused on those traversing pine-savanna areas (Meave *et al.*, 1991; Macdougall & Kellman, 1992; Kellman & Tackaberry, 1993; Kellman & Meave, 1997; Kellman *et al.*, 1998; Pither & Kellman, 2002). This has largely focused on understanding the extent to which specific environmental factors influence the structure and composition of these ecosystems. Such studies do not usually involve detailed floristic inventories, although riparian corridors in the pine-savanna of Belize are postulated as areas of high species diversity, and are thought to play prominent roles in maintaining regional biodiversity (Meave *et al.*, 1991; Kellman *et al.*, 1998; Pither & Kellman, 2002).

The Macal River Watershed is regarded as one of the most biologically diverse watersheds remaining in Central America (Minty, 2001). Studies have shown that it provides important habitats for rare and endangered species such as the Scarlet Macaw, Baird's Tapir, and the Morelet Crocodile (Meerman & Sabido, 2001). Recently, the construction of a hydroelectric dam on the river at Chalillo has caused widespread concern (Minty, 2001). The dam has resulted in an estimated loss of 18 km of riverine habitat on the Macal and another 15 km on one of its tributaries (the Rascapulo). Although the riverine vegetation is regarded as biologically rich and is currently threatened, no detailed floristic information is available.

The present study provides a floristic checklist for a stretch of riparian corridor along the Macal River. In addition, preliminary phytosociological data for this habitat are presented, together with brief floristic notes on the woody flora of an oak-dominated savanna occurring in the uplands adjacent to the riparian corridor beside the study site.

STUDY AREA

The study focused on a 1.5 km stretch of the Macal River centred upon the Guacamallo Bridge (16°44'00"N, 88°59'17"W). The Macal River runs through the Cayo District of southwestern Belize and is part of the Belize River Watershed which eventually flows eastward to Belize City where it enters the Caribbean Sea (Fig. 1). The area has a subtropical climate typical of the region, with a dry season lasting from February to May during which monthly rainfall averages less than 100 mm (Harcourt & Sayer, 1996). The vast majority of precipitation falls in the wet season from approximately June until January. The onset of the wet season corresponds to seasonal floods that characterize the hydraulic regime of the river.

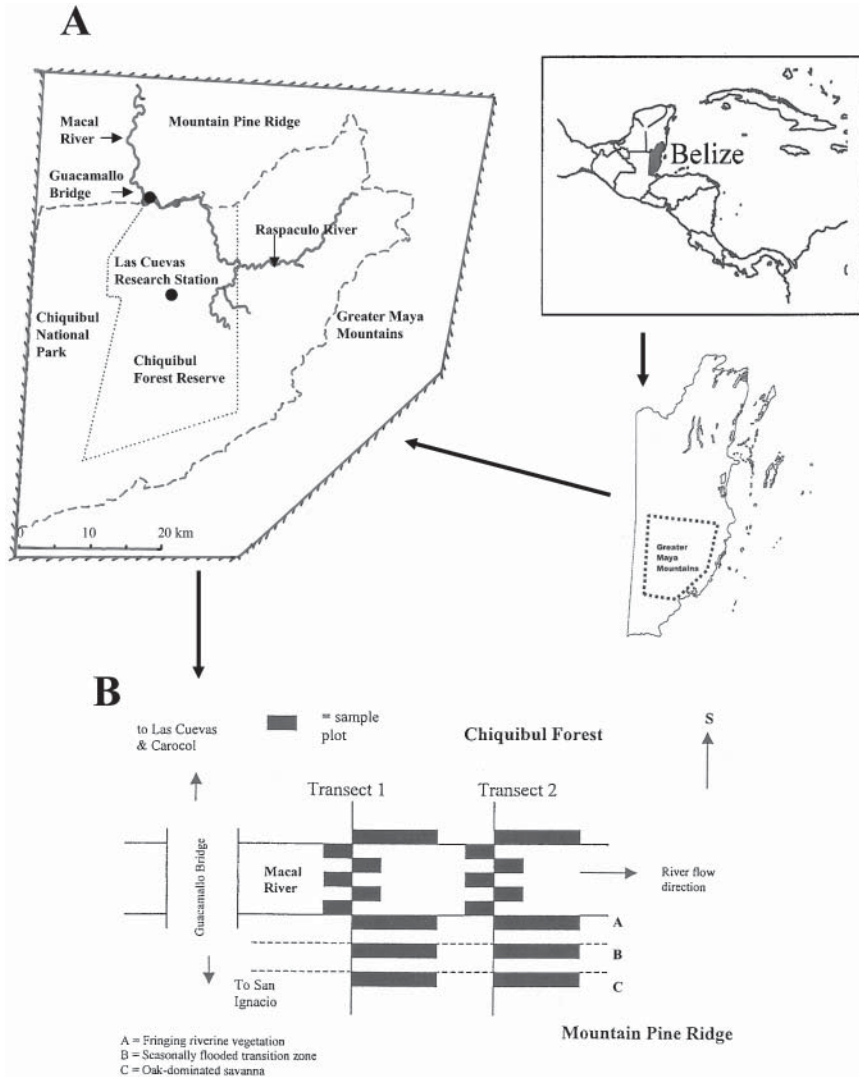


FIG. 1. A, Map of Belize showing its location in Central America, the location of the Greater Maya Mountains within Belize, and the location of the study site within the Greater Maya Mountains. B, Diagram of the study site showing the location of the transects on the Macal River below Guacamallo Bridge, and the position of the quantitative plots.

The substrate of the riverbed adjacent to Guacamallo Bridge alternates between limestone and granite rocks of the Mountain Pine Ridge. Smaller amounts of sedimentary and volcanic rock are also found in the channel. Geological heterogeneity of the river channel at the study site results from its position between two geologically distinct regions. The upland bedrock on the right (downstream) bank of the

study sites comprises nutrient-poor granite of the Mountain Pine Ridge, whilst the bedrock of the uplands on the left (downstream) bank is limestone. Thus, the Macal River essentially lies on a boundary between the oak- and pine-dominated savanna of the Mountain Pine Ridge to the north and east, and the semi-deciduous tropical forest of the Chiquibul Reserve to the south. The contrast between these two vegetation types is floristically and structurally striking.

The first vegetation classification of Belize was conducted by the Land Survey Team (Wright *et al.*, 1959), who classified the vegetation along the Macal River as 'Cohune-Banak Forest' nested within a broader vegetation classification defined as 'Broadleaf Forest with Occasional Lime-Loving Species'. Characteristic species cited for this vegetation type include *Attalea cohune* Mart., *Viola koschnyi* Warb., *Schizolobium parahyba* (Vell.) S.F.Blake, *Ceiba pentandra* (L.) Gaertn. and *Ficus ovalis* (Liebm.) Miq. According to a later classification (Iremonger & Brokaw, 1995) the same vegetation was classified as 'Disturbed Scrub'. Meerman & Sabido (2001) identify vegetation along the Macal River as 'Deciduous Broadleaf Lowland Riparian Shrubland in Hills'. This classification is based on standardized UNESCO terminology and is accompanied by a species list of 31 taxa. In another recent vegetation map of the Maya Mountains in Belize (Penn *et al.*, 2004), the same vegetation is classified as 'Riverine Forest (Class 16)' with *Inga vera* Willd. mentioned as being dominant in the most frequently flooded areas.

METHODS

A five-week floristic survey of a stretch of the Macal River was made towards the end of the dry season (April–May 2003) when the channel was almost dry. An inventory was compiled through intensive collecting in an area approximately 1.5 km long and centred upon the Guacamallo Bridge. The species list was subsequently supplemented with 26 extra species records from specimens lodged in the herbaria of the Missouri Botanical Garden (MO), although these specimens have not been seen by the authors. Only specimens known to have been collected from within the riverine corridor at the site were included. Voucher material was not collected for 13 species. These comprised common species well known to the authors. In addition, a checklist of the woody species occurring in the oak-dominated savanna adjacent to the river was compiled. Herbarium specimens were made in sets of five with duplicates deposited at the Royal Botanic Garden Edinburgh (E), the Natural History Museum, London (BM), the Missouri Botanical Garden (MO) and the Forestry Department, Ministry of Natural Resources, Belmopan, Belize (BRH). Specimens were identified using available literature, and by comparison of the collections with specimens at BM, E and BRH. In addition, determinations for a few families were provided by specialists (see Acknowledgements).

Based on marked structural and floristic differences between zones, four distinct vegetation types within the slope of the river valley were recognized. These comprised:

- (i) vegetation in the river channel;
- (ii) fringing riverine vegetation;
- (iii) transition vegetation between riverine and upland communities;
- (iv) oak-dominated savanna.

Within each of these recognized zones stratified sampling was carried out. The purpose of the quantitative sampling was to provide preliminary data on vegetation structure.

For sampling, two transect lines selected as representative of the general vegetation were placed across the river at right angles to its course. The locations of both transect lines were recorded using GPS at the deepest points of the river bed (16°52'07"N, 89°02'62"W for Transect 1; 16°44'00"N, 89°59'17"W for Transect 2). Plots adjacent to the transect lines were placed subjectively within each of the clearly recognized vegetation associations (Fig. 1). Within the river channel five 50 × 50 m quadrats were established adjacent to each of the two transect lines across the river, with the long side parallel to the channel. The total of 10 plots gave a survey area of 0.5 ha. In each plot, the numbers of all woody and herbaceous species were recorded and their frequencies calculated.

In the fringing riverine vegetation association three plots measuring 25 × 5 m were established on either side of the riverbank adjacent to both transect lines with their long sides parallel to the river (Fig. 1). Thus, a total of 0.15 ha was surveyed. The diameter and height of all woody species ≥ 10 cm in diameter at 30 cm above ground level were recorded. The decision to record diameter at 30 cm instead of the more conventional breast height (1.3 m above ground level) was made because tree and shrub species in this zone tend to be multi-branched at low levels. In the seasonally flooded transitional zone between the fringing riverine vegetation association and the upland oak-dominated savanna on the downstream right bank side of the river, three plots measuring 25 × 10 m were established adjacent to the transect lines, giving a total area of 0.15 ha. Diameter at breast height (dbh) and height were recorded for all individuals ≥ 10 cm dbh. In the oak-dominated savanna a total of six plots (50 × 10 m) were established (representing a total area of 0.3 ha), with three plots situated adjacent to each transect. The height and dbh of all individuals ≥ 10 cm dbh were recorded within these plots. Voucher material was collected of all species recorded. Phytosociological data were analysed using the software program FITOPAC (Shepherd, 1995).

RESULTS

A species list for riverine vegetation and the oak-dominated savanna occurring within the study area is provided in the Appendix. Those species collected during the current survey and those derived from pre-existing herbaria records are clearly identified by the cited specimens. All specimens from this study were collected by Lillis Urban. The Appendix lists species authors, and so these are not repeated again in the text henceforth. Frequency data for species occurring on rocks within the river

channel are presented in Table 1. Phytosociological data are given for the fringing riverine vegetation in Table 2, for the transitional riverine association in Table 3 and for the oak-dominated savanna in Table 4.

Species list

A total of 345 specimens were collected in the riverine habitat, representing 229 species. Of these, 205 taxa (89.5%) were identified to species level, 22 (9.5%) only to genus level and 2 (1%) only to family level. This list was supplemented by a further 26 records (to species level) from specimen data collated from the herbaria of Missouri (MO), the Natural History Museum (BM) and the Royal Botanic Garden Edinburgh (E). In the oak-dominated savanna eight woody species were recorded. Two of the species collected are endemic to Belize. The first, *Calypttranthes bartlettii*, grows on islands in the river channel and in the fringing riverine vegetation. *Dalechampia shippii* was collected in the oak woodland, although detailed collections were not made of the herbaceous flora of this vegetation type.

Quantitative sampling

Vegetation in the river channel is sparse and the majority of recorded taxa are herbaceous ruderals or small shrubs confined to sandy inlets in the channel and crevices in boulders. Only eight of the 27 species found in the river channel are woody; all are less than 1.5 m in height. The primary woody species comprise: *Cuphea calophylla*, *C. utriculosa*, *Inga vera* subsp. *vera*, *Calypttranthes bartlettii*, *Lindenia rivalis*, *Calliandra tergemina*, *Mimosa pellita* and *Serjania hundertii*. Characteristic non-woody taxa are *Spermacoce verticillata*, *Arundinella berteroniana*, *Symphytichum expansum* and *Polygala paniculata*. In addition, *Najas wrightiana* and *Marathrum* sp. were commonly observed growing on inundated rocks within the river itself.

The fringing riverine vegetation community comprised a species-rich dense thicket to 3 m, dominated by *Inga vera* subsp. *vera* which has by far the greatest importance value index (IVI=95.17). *Calypttranthes lindeniana* has the second highest IVI of species sampled (IVI=23.23). Other relatively common and abundant woody species in the association include *Pleuranthodendron lindenii*, *Lonchocarpus* sp. 1 (Urban 255), *Nectandra salicifolia*, *Ficus insipida* and *Casearia corymbosa*. Twelve of the 35 species recorded in the quantitative plots are represented by one individual only.

In the forest scrub transition association, a total of 81 individuals representing 23 species were recorded, with the palm *Astrocaryum mexicanum* showing the highest IVI of all species (IVI=40.87). Other characteristic species of the association include *Spondias mombin*, *Ateleia gummifera*, *Cochlospermum vitifolium*, *Zuelania guidonia*, *Andira inermis* subsp. *inermis*, *Bursera simaruba* and *Vitex gaumeri*. One third of all species sampled are represented by a single individual.

TABLE 1. Species recorded on the rocks and sandy inlets in the river channel

| Species | Family | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 | AFreq. (%) |
|--|--------------------------------|----|----|----|----|----|----|----|----|----|-----|------------|
| <i>Cuphea calophylla</i> | Lythraceae | X | X | X | X | X | X | X | X | | | 80 |
| <i>Cuphea urticulosa</i> | Lythraceae | X | X | X | X | X | X | | X | | | 70 |
| <i>Inga vera</i> subsp. <i>vera</i> | Fabaceae – Mimosoideae | X | X | X | X | X | X | X | | | | 70 |
| <i>Eleocharis retroflexa</i> | Cyperaceae | | X | X | X | X | X | | X | | | 60 |
| <i>Spermacoce verticillata</i> | Rubiaceae | X | X | X | X | X | X | | | | | 50 |
| <i>Arundinella berteroniana</i> | Poaceae | X | X | X | | X | X | X | | | | 50 |
| <i>Calyptranthes bartlettii</i> | Myrtaceae | X | X | X | X | X | X | X | | | | 50 |
| <i>Symphoricarpon expansum</i> | Asteraceae | X | X | X | X | X | X | X | | | | 50 |
| <i>Lindenia rivalis</i> | Rubiaceae | X | X | X | | X | | X | | | | 40 |
| <i>Polygala paniculata</i> | Polygalaceae | X | X | X | | X | | X | | | | 30 |
| <i>Hymenachne amplexicaulis</i> | Poaceae | X | | | | X | X | | X | | | 30 |
| <i>Bauhinia</i> sp. (Urban 30) | Fabaceae – Caesalpinioideae | | | | | | X | X | X | | | 30 |
| <i>Fimbristylis dichotoma</i> | Cyperaceae | | | | X | | | X | X | | | 30 |
| <i>Phyllanthus</i> cf. <i>compressus</i> (Urban 366) | Phyllanthaceae | | | | X | | | X | X | | | 30 |
| <i>Panicum laxum</i> | Poaceae | | | | X | | | X | X | | | 30 |
| <i>Ludwigia octovalis</i> | Onagraceae | | | | X | | | X | X | | | 20 |
| <i>Euphorbiaceae</i> sp. (Urban 91) | Euphorbiaceae | | | | X | | | X | X | | | 20 |
| <i>Mecardonia procumbens</i> | Plantaginaceae | X | | | X | | | | X | | | 10 |
| <i>Lobelia cardinalis</i> | Campanulaceae | | | | | | | | | | | 10 |
| <i>Pilea microphylla</i> | Urticaceae | | | | | | | | | | | 10 |
| <i>Serjania lundellii</i> | Sapindaceae | | | | X | | | | | | | 10 |
| <i>Eragrostis</i> sp. (Urban 363) | Poaceae | | | | X | | | | | | | 10 |
| <i>Selaginella pallenscens</i> | Selaginellaceae | | | | X | | | | | | | 10 |
| <i>Ipomoea</i> cf. <i>umbraticola</i> | Convolvulaceae | | | | | X | | | | | | 10 |
| <i>Cyperus digitatus</i> | Cyperaceae | | | | | | | X | | | | 10 |
| <i>Scleria</i> cf. <i>melaleuca</i> | Cyperaceae | | | | | | | X | | | | 10 |
| <i>Mimosa pellita</i> | Fabaceae – Mimosoideae | | | | | | | | | X | | 10 |

P1, Plot 1; P2, Plot 2; P3, Plot 3, etc.; AFreq., absolute frequency.

TABLE 2. Fringing riverine vegetation: Phytosociological data

| Species | Family | Density | | Dominance | | Frequency | | IVI | |
|--|-----------------------------|---------|-------|-----------|-------|-----------|--------|-------|-------|
| | | Ind. | ADen. | RDen. | ADo. | RelD. | AFreq. | | RelF. |
| <i>Inga vera</i> subsp. <i>vera</i> | Fabaceae – Mimosoideae | 54 | 360.0 | 21.69 | 24.91 | 62.12 | 83.33 | 11.36 | 95.17 |
| <i>Calyptanthus lindeniensis</i> | Myrtaceae | 21 | 140.0 | 8.43 | 2.29 | 5.71 | 66.67 | 9.09 | 23.23 |
| <i>Pleuranthodendron lindeni</i> | Salicaceae | 29 | 193.3 | 11.65 | 2.58 | 6.44 | 25.00 | 3.41 | 21.49 |
| <i>Lonchocarpus</i> sp. (Urban 255) | Fabaceae – Faboideae | 19 | 126.7 | 7.63 | 1.57 | 3.91 | 66.67 | 9.09 | 20.63 |
| <i>Chrysophyllum mexicanum</i> | Sapotaceae | 13 | 86.7 | 5.22 | 0.74 | 1.85 | 33.34 | 4.54 | 11.61 |
| <i>Nectandra salicifolia</i> | Lauraceae | 8 | 53.3 | 3.21 | 0.39 | 0.96 | 41.67 | 5.68 | 9.86 |
| <i>Ficus insipida</i> | Moraceae | 7 | 46.7 | 2.81 | 0.98 | 2.44 | 33.33 | 4.55 | 9.79 |
| <i>Casearia corymbosa</i> | Salicaceae | 12 | 80.0 | 4.82 | 0.58 | 1.46 | 25.00 | 3.41 | 9.68 |
| <i>Randia lundelliana</i> | Rubiaceae | 12 | 80.0 | 4.82 | 1.02 | 2.54 | 16.67 | 2.27 | 9.64 |
| <i>Calliandra tergemina</i> | Fabaceae – Mimosoideae | 10 | 66.7 | 4.02 | 0.93 | 2.32 | 16.67 | 2.27 | 8.61 |
| <i>Andira inermis</i> subsp. <i>inermis</i> | Fabaceae – Faboideae | 5 | 33.3 | 2.01 | 0.29 | 0.73 | 33.33 | 4.55 | 7.28 |
| <i>Adelia barbinervis</i> | Euphorbiaceae | 7 | 46.7 | 2.81 | 0.37 | 0.92 | 25.00 | 3.41 | 7.14 |
| <i>Lonchocarpus guatemalensis</i> | Fabaceae – Faboideae | 6 | 40.0 | 2.41 | 0.47 | 1.18 | 25.00 | 3.41 | 7.00 |
| <i>Bauhinia</i> sp. | Fabaceae – Caesalpinioideae | 9 | 60.0 | 3.61 | 0.79 | 1.96 | 8.33 | 1.14 | 6.71 |
| <i>Croton schiedeanus</i> | Euphorbiaceae | 3 | 20.0 | 1.20 | 0.20 | 0.50 | 25.00 | 3.41 | 5.12 |
| <i>Cojoba graciliflora</i> | Fabaceae – Mimosoideae | 5 | 33.3 | 2.01 | 0.76 | 1.89 | 8.33 | 1.14 | 5.04 |
| <i>Calyptanthus bartlettii</i> | Myrtaceae | 5 | 33.3 | 2.01 | 0.15 | 0.37 | 16.67 | 2.27 | 4.65 |
| <i>Cestrum nocturnum</i> | Solanaceae | 2 | 13.3 | 0.80 | 0.07 | 0.17 | 16.67 | 2.27 | 3.25 |
| <i>Eugenia</i> sp. 3 (Urban 323) | Myrtaceae | 2 | 13.3 | 0.80 | 0.07 | 0.17 | 16.67 | 2.27 | 3.25 |
| <i>Erythroxylum rotundifolium</i> | Erythroxylaceae | 2 | 13.3 | 0.80 | 0.04 | 0.09 | 16.67 | 2.27 | 3.17 |
| <i>Picramnia antidesma</i> | Picramniaceae | 2 | 13.3 | 0.80 | 0.03 | 0.09 | 16.67 | 2.27 | 3.16 |
| <i>Myrciaria floribunda</i> | Myrtaceae | 2 | 13.3 | 0.80 | 0.19 | 0.48 | 8.33 | 1.14 | 2.42 |
| <i>Guapira</i> cf. <i>linearibracteata</i> (Urban 322) | Nyctaginaceae | 2 | 13.3 | 0.80 | 0.06 | 0.14 | 8.33 | 1.14 | 2.08 |
| <i>Cassipourea gutanensis</i> | Rhizophoraceae | 1 | 6.7 | 0.40 | 0.13 | 0.31 | 8.33 | 1.14 | 1.85 |
| <i>Miconia albicans</i> | Melastomataceae | 1 | 6.7 | 0.40 | 0.08 | 0.20 | 8.33 | 1.14 | 1.74 |

TABLE 2. (Cont'd).

| Species | Family | Density | | Dominance | | Frequency | | | |
|---|------------------------|---------|---------|-----------|-------|-----------|--------|-------|------|
| | | Ind. | ADen. | RDen. | ADo. | RelD. | AFreq. | RelF. | IVI |
| <i>Sapindus saponaria</i> | Sapindaceae | 1 | 6.7 | 0.40 | 0.08 | 0.20 | 8.33 | 1.14 | 1.74 |
| <i>Acacia angustissima</i> | Fabaceae – Mimosoideae | 1 | 6.7 | 0.40 | 0.06 | 0.14 | 8.33 | 1.14 | 1.68 |
| <i>Eugenia</i> sp. 2 (Urban 131) | Myrtaceae | 1 | 6.7 | 0.40 | 0.05 | 0.12 | 8.33 | 1.14 | 1.66 |
| <i>Hampea stipitata</i> | Malvaceae | 1 | 6.7 | 0.40 | 0.04 | 0.11 | 8.33 | 1.14 | 1.64 |
| <i>Ardisia</i> cf. <i>compressa</i> (Urban 293) | Myrsinaceae | 1 | 6.7 | 0.40 | 0.04 | 0.09 | 8.33 | 1.14 | 1.63 |
| <i>Machaerium</i> sp. 1 (Urban 162) | Fabaceae – Faboideae | 1 | 6.7 | 0.40 | 0.04 | 0.09 | 8.33 | 1.14 | 1.63 |
| <i>Mouriri myrtilloides</i> | Memecylaceae | 1 | 6.7 | 0.40 | 0.04 | 0.09 | 8.33 | 1.14 | 1.63 |
| <i>Byrsonima crassifolia</i> | Malpighiaceae | 1 | 6.7 | 0.40 | 0.03 | 0.06 | 8.33 | 1.14 | 1.60 |
| <i>Hirtella racemosa</i> | Chrysobalanaceae | 1 | 6.7 | 0.40 | 0.03 | 0.06 | 8.33 | 1.14 | 1.60 |
| <i>Astrocaryum mexicanum</i> | Areceaceae | 1 | 6.7 | 0.40 | 0.02 | 0.06 | 8.33 | 1.14 | 1.59 |
| Totals | 21 | 249 | 1660.00 | 100 | 40.78 | 100 | 733.3 | 100 | 300 |

Ind., number of individuals recorded in plot; ADen., absolute density; RDen., relative density; ADo., absolute dominance; RelD., relative dominance; AFreq., absolute frequency (%); RelF., relative frequency; IVI, importance value index.

TABLE 3. Transition association (downstream right bank of Macal River): Phytosociological data

| Species | Family | Density | | Dominance | | Frequency | | IVI | |
|--|-------------------------------|---------|-------|-----------|------|-----------|--------|------|-------|
| | | Ind. | ADen. | RDen. | ADo. | ReID. | AFreq. | | RelF. |
| <i>Astrocaryum mexicanum</i> | <i>Arecaceae</i> | 5 | 33.3 | 6.17 | 2.83 | 28.81 | 50.00 | 5.88 | 40.87 |
| <i>Spondias mombin</i> | <i>Anacardiaceae</i> | 6 | 40.0 | 7.41 | 1.25 | 12.77 | 66.67 | 7.84 | 28.02 |
| <i>Ateleia gummifera</i> | <i>Fabaceae – Faboideae</i> | 9 | 60.0 | 11.11 | 0.84 | 8.60 | 66.67 | 7.84 | 27.56 |
| <i>Cochlospermum vitifolium</i> | <i>Cochlospermaceae</i> | 10 | 66.7 | 12.35 | 0.68 | 6.89 | 50.00 | 5.88 | 25.12 |
| <i>Zuelania guidonia</i> | <i>Salicaceae</i> | 7 | 46.7 | 8.64 | 0.89 | 9.09 | 50.00 | 5.88 | 23.61 |
| <i>Andira inermis</i> subsp. <i>inermis</i> | <i>Fabaceae – Faboideae</i> | 5 | 33.3 | 6.17 | 0.99 | 10.07 | 50.00 | 5.88 | 22.12 |
| <i>Bursera simaruba</i> | <i>Burseraceae</i> | 6 | 40.0 | 7.41 | 0.43 | 4.33 | 66.67 | 7.84 | 19.58 |
| <i>Vitex gaumeria</i> | <i>Verbenaceae</i> | 5 | 33.3 | 6.17 | 0.30 | 3.09 | 50.00 | 5.88 | 15.14 |
| <i>Eugenia</i> sp. 2 (<i>Urban</i> 131) | <i>Myrtaceae</i> | 5 | 33.3 | 6.17 | 0.07 | 0.70 | 50.00 | 5.88 | 12.75 |
| <i>Ficus insipida</i> | <i>Moraceae</i> | 3 | 20.0 | 3.70 | 0.12 | 1.21 | 50.00 | 5.88 | 10.80 |
| <i>Cordia alliodora</i> | <i>Boraginaceae</i> | 3 | 20.0 | 3.70 | 0.29 | 2.98 | 33.33 | 3.92 | 10.60 |
| <i>Lonchocarpus</i> sp. (<i>Urban</i> 255) | <i>Fabaceae – Faboideae</i> | 2 | 13.3 | 2.47 | 0.28 | 2.85 | 33.33 | 3.92 | 9.24 |
| <i>Helicteres guazumifolia</i> (<i>Urban</i> 132) | <i>Malvaceae</i> | 2 | 13.3 | 2.47 | 0.08 | 0.82 | 33.33 | 3.92 | 7.21 |
| <i>Erythroxylum guatemalense</i> | <i>Erythroxylaceae</i> | 2 | 13.3 | 2.47 | 0.06 | 0.60 | 33.33 | 3.92 | 6.99 |
| <i>Lonchocarpus rugosus</i> | <i>Fabaceae – Faboideae</i> | 2 | 13.3 | 2.47 | 0.05 | 0.55 | 33.33 | 3.92 | 6.94 |
| <i>Bauhinia</i> sp. (<i>Urban</i> 30) | <i>Fabaceae – Mimosoideae</i> | 1 | 6.7 | 1.23 | 0.36 | 3.70 | 16.67 | 1.96 | 6.89 |
| <i>Quercus purulhana</i> | <i>Fagaceae</i> | 2 | 13.3 | 2.47 | 0.05 | 0.49 | 16.67 | 1.96 | 4.92 |
| <i>Thevetia ahouai</i> | <i>Apocynaceae</i> | 1 | 6.7 | 1.23 | 0.11 | 1.09 | 16.67 | 1.96 | 4.29 |
| <i>Protium copal</i> | <i>Burseraceae</i> | 1 | 6.7 | 1.23 | 0.08 | 0.77 | 16.67 | 1.96 | 3.96 |
| <i>Randia lundelliana</i> | <i>Rubiaceae</i> | 1 | 6.7 | 1.23 | 0.02 | 0.16 | 16.67 | 1.96 | 3.36 |
| <i>Eugenia</i> sp. 3 (<i>Urban</i> 256) | <i>Myrtaceae</i> | 1 | 6.7 | 1.23 | 0.02 | 0.16 | 16.67 | 1.96 | 3.36 |
| <i>Croton xalapensis</i> | <i>Euphorbiaceae</i> | 1 | 6.7 | 1.23 | 0.01 | 0.13 | 16.67 | 1.96 | 3.33 |
| <i>Lasiantha fruticosa</i> | <i>Asteraceae</i> | 1 | 6.7 | 1.23 | 0.01 | 0.13 | 16.67 | 1.96 | 3.33 |
| Totals | 19 | 81 | 540 | 100 | 9.83 | 100 | 850.00 | 100 | 300 |

Ind., number of individuals recorded in plot; ADen., absolute density; RDen., relative density; ADo., absolute dominance; ReID., relative dominance; AFreq., absolute frequency (%); RelF., relative frequency; IVI, importance value index.

TABLE 4. Oak-dominated savanna: Phytosociological data

| Species | Family | Density | | Dominance | | Frequency | | IVI |
|---|----------------------|---------|--------|-----------|-------|-----------|-------|--------|
| | | Ind. | ADen. | ADo. | ReID. | AFreq. | RelF. | |
| <i>Quercus oleoides</i> | Fagaceae | 161 | 536.7 | 9.91 | 76.55 | 100.00 | 22.22 | 177.69 |
| <i>Byrsonima crassifolia</i> | Malpighiaceae | 18 | 60.0 | 1.41 | 10.89 | 100.00 | 22.22 | 41.93 |
| <i>Pinus caribaea</i> var. <i>hondurensis</i> | Pinaceae | 5 | 16.7 | 0.45 | 3.45 | 83.33 | 18.52 | 24.41 |
| <i>Quercus purulhana</i> | Fagaceae | 12 | 40.0 | 0.89 | 6.90 | 50.00 | 11.11 | 23.89 |
| <i>Andira inermis</i> subsp. <i>inermis</i> | Fabaceae – Faboideae | 4 | 13.3 | 0.16 | 1.23 | 50.00 | 11.11 | 14.30 |
| <i>Xylopia frutescens</i> | Annonaceae | 2 | 6.7 | 0.06 | 0.45 | 33.33 | 7.41 | 8.83 |
| <i>Lonchocarpus</i> sp. (<i>Urban 255</i>) | Fabaceae – Faboideae | 1 | 3.3 | 0.04 | 0.34 | 16.67 | 3.70 | 4.54 |
| <i>Acosmium panamense</i> | Fabaceae – Faboideae | 1 | 3.3 | 0.03 | 0.20 | 16.67 | 3.70 | 4.40 |
| Totals | 5 | 204 | 680.00 | 12.95 | 100 | 450.0 | 100 | 300 |

Ind., number of individuals recorded in plot; ADen., absolute density; RDen., relative density; ADo., absolute dominance; ReID., relative dominance; AFreq., absolute frequency (%); RelF., relative frequency; IVI, importance value index.

Results of quantitative sampling in the oak-dominated savanna reveal only eight woody species recorded from a total of 204 individuals. *Quercus oleoides* dominates the community and has by far the greatest IVI of all species (IVI=177.69). *Byrsonima crassifolia* has the second greatest IVI in the sample (IVI=41.93). *Pinus caribaea* var. *hondurensis* and *Quercus purulhana* are also common in the association.

DISCUSSION

This study indicates that the riparian vegetation along the Macal is floristically diverse, with over 200 species recorded along a narrow 1.5 km stretch of the river. This figure represents 7% of the flora of Belize as defined by Balick *et al.* (2000). By contrast, the woody flora of oak-dominated savanna is species-poor.

The vegetation in the river channel was sparse and dominated by ruderal species, with none of the woody taxa exceeding 1.5 m in height. The intermittent floods that characterize the hydraulic regime of the Macal River are the most likely factors preventing the development of more structurally complex communities in the channel. A few taxa in the riverine corridor can be viewed as specialists, exhibiting limited distributions and being confined to specific zones in the river channel. Examples of specialized taxa include *Najas wrightiana* and *Marathrum* sp. which grow only on inundated rocks within the fast-flowing stream channel, and *Inga vera* subsp. *vera* and *Calyptanthes bartlettii*. The latter two species are able to withstand frequent inundation and occurred only on islands in the river channel and in the fringing riverine vegetation.

Inga vera subsp. *vera* is the most common tree species along the banks of the river and its presence effectively defines the riparian vegetation here. This species is a common component of riverine vegetation in the Neotropics and is widespread from Mexico to coastal Ecuador (Pennington, 1997). Although *Inga vera* subsp. *vera* and a number of other common species such as *Pleuranthodendron lindenii* and *Calyptanthes lindeniana* dominate the riparian vegetation there is considerable floristic heterogeneity along the river. Examination of plot data in the fringing riverine vegetation reveals that each individual plot varies considerably in its species assemblages. These findings are in line with the work of numerous riparian ecologists who have noted similar variation in vegetation along river corridors (Hupp, 1982; Carbiener & Schnitzler, 1990; Decamps & Tabacchi, 1994; Malanson, 1993).

Clear floristic differences were observed between the fringing riverine vegetation on either side of the river channel. For example, very common genera on the downstream left bank of the river included species of *Piper* and *Costus*; these are entirely absent from the downstream right side of the river. Other species apparently confined to the left bank include *Bactris major* var. *major*, *Chamaedorea ernesti-augustii* and *C. oblongata*. Floristic differences in the fringing riverine vegetation on either side of the river relate to geological differences between the uplands on either side of the channel: for example, *Chamaedorea ernesti-augustii* is known to prefer limestone

areas. Tree species known to occur widely in the Chiquibul forest and which appear confined to the downstream left bank at this site include *Castilla elastica* subsp. *elastica*, *Ceiba pentandra* and *Attalea cohune*. All of these are characteristic of subtropical forests on better soils in Belize, with *Attalea cohune* characteristic of disturbed sites (Henderson *et al.*, 1995). Taxa known to occur on the poorer soils of the Mountain Pine Ridge and which appear to be confined to the downstream right bank include *Miconia albicans* and *Byrsonima crassifolia*. Both these species are characteristic of the oligotrophic soils of neotropical savannas (Lenthall *et al.*, 1999).

The transition community on the downstream right bank of the Macal River is species-rich and structurally heterogeneous. Although *Astrocaryum mexicanum* has the highest IVI of all species sampled (IVI=40.87), the community lacks clearly dominant species. Instead a suite of more or less equally co-dominant taxa comprise the majority of individuals sampled.

The oak-dominated savanna is structurally homogeneous and species-poor compared with all the other communities sampled. *Quercus oleoides* was clearly the dominant species forming the upper canopy in the community. The association had the appearance of an open woodland, with grasses forming a relatively well-developed herbaceous layer typical of a tropical savanna.

The high overall diversity of the Macal River undoubtedly reflects the diverse array of habitats associated with it. These include dry upland sites, terraced rocky slopes, inundated floodplains, recent alluvial deposits, quagmire anaerobic soils, gravel bars, and islands in the river channel. Flooding events are primarily responsible for creating its spatial heterogeneity, with the timing of flooding, its duration, frequency and magnitude all identified as influencing the structure and composition of riverine vegetation (Poff *et al.*, 1997; Richter *et al.*, 1997; Ward *et al.*, 1999).

One of the most significant threats to riverine vegetation in the region is the proposed Chalillo Dam. This project has already flooded the valley upstream from Chalillo to a depth of 400 m and inundated approximately 18 km of riverine habitat on the Macal River and 15 km on the Rascalpulo. In addition, it is highly likely that vegetation downstream from the dam will be affected. Although the precise effects of the dam on the riverine vegetation cannot be predicted, its construction is likely to have substantial ecological consequences for the region. Dams are known to alter the hydraulic regime of rivers and change the timing, duration, frequency and magnitude of floods (Kalliola & Puhakka, 1988; Malanson, 1993; Johansson *et al.*, 1996; Nilsson & Berggran, 2000; Nilsson & Svedmark, 2002). Such alterations to the flow regime reduce the meandering of the channel and result in the loss of spatial heterogeneity in the riparian corridor (Johansson *et al.*, 1996).

Results of this study indicate that the vegetation formations associated with the Macal River are botanically diverse, and include a Belizean endemic. These findings support the work of other authors such as Minty (2001) that these communities are ecologically important, and of considerable conservation value. With the construction of the Chalillo Dam, the future of this riparian habitat is uncertain. The establishment of permanent monitoring plots downstream from the inundated

areas is recommended. These could provide a valuable opportunity to improve our understanding of how dams impact on downstream riverine vegetation.

ACKNOWLEDGEMENTS

We wish to express our gratitude to the Belizean Forest Department for allowing us to work in Belize. Thanks are also due to Isidro and Nicodemus Bol, Enrique Saquil and Chris Minty of the Las Cuevas Research Station who provided field support, and to the herbarium staff at Kew, Edinburgh and the Natural History Museum, London. In particular we are indebted to Caroline Whitefoord at the Natural History Museum for her help with identification of material. In addition, we would like to acknowledge the following taxonomists for their assistance: William Anderson (*Malpighiaceae*), Sandy Atkins (*Verbenaceae*), Ray Harley (*Lamiaceae*), Nicholas Hind (*Asteraceae*), Petra Hoffman (*Euphorbiaceae*), Sandy Knapp (*Solanaceae*), Gwilym Lewis (*Fabaceae*), Simon Mayo (*Araceae*), Eimear Nic Lughadha (*Myrtaceae*), Kevin Nixon (*Fagaceae*), Terry Pennington (*Sapotaceae*), Toby Pennington (*Fabaceae*), Jim Ratter, Steve Renvoize (*Poaceae*), Lulu Rico (*Fabaceae*), Charlotte Taylor (*Rubiaceae*), and Daniela Zappi (*Rubiaceae*).

REFERENCES

- BALICK, M. J., NEE, M. N. & ATHA, D. A. (2000). *Checklist of the Vascular Plants of Belize*. Mem. New York Bot. Gard. Vol. 85. New York Botanical Garden Press.
- BRINSON, M. M. (1990). Riverine Forests. In: LUGO, M., BRINSON, M. & BROWN, S. (eds) *Ecosystems of the World 15. Forested Wetlands*. Oxford: Elsevier.
- CARBIENER, R. & SCHNITZLER, A. (1990). Evolution of major pattern models and processes of alluvial forest of the Rhine in the rift valley (France/Germany). *Plant Ecol.* 88: 115–129.
- DECAMPS, H. & TABACCHI, E. (1994). Species richness in vegetation along river margins. In: GILLER, P. S., HILDREW, A. & RAFAELLI, D. D. (eds) *Aquatic Ecology: Scale, Patterns and Processes*. Oxford: Blackwell Scientific Publications.
- GREGORY, S. V., SWAMSON, F. J., MCKEE, W. A. & CUMMINS, K. W. (1991). An ecosystem perspective of riparian zones. *BioScience* 41: 540–551.
- HARCOURT, C. & SAYER, J. (eds) (1996). *The Conservation Atlas of Tropical Forests: The Americas*. London: Simon and Schuster.
- HENDERSON, A., GALEANO, G. & BERNELL, R. (1995). *Field Guide to the Palms of the Americas*. Princeton, NJ: Princeton University Press.
- HUPP, C. R. (1982). Stream-grade variation and riparian-forest ecology along Passage Creek, Virginia. *Bull. Torrey Bot. Club* 109: 488–499.
- HYNES, H. B. N. (1970). *Ecology of Running Waters*. Liverpool: Liverpool University Press.
- IREMONGER, S. & BROKAW, N. V. L. (1995). Vegetation Classification for Belize. In: WILSON, R. (ed.) *Towards a National Protected Area Systems Plan for Belize, Appendix 1*. Programme for Belize, Belize City, Belize.
- JOHANSSON, M. E., NILSSON, C. & NILSSON, E. (1996). Do rivers function as corridors for plant dispersal? *J. Veg. Sci.* 7: 593–598.

- KALLIOLA, R. & PUHAKKA, M. (1988). River dynamics and vegetation mosaicism: a case study of the river Kamajohka, northernmost Finland. *J. Biogeogr.* 15: 703–719.
- KELLMAN, M. & MEAVE, J. (1997). Fire in the tropical gallery forests of Belize. *J. Biogeogr.* 24: 23–34.
- KELLMAN, M. & TACKABERRY, R. (1993). Distribution and tree species coexistence in tropical riparian forest fragments. *Global Ecol. Biogeogr.* 3: 1–9.
- KELLMAN, M., TACKABERRY, R. & RIGG, L. (1998). Structure and function in two tropical gallery forest communities: Implication for forest conservation in fragmented systems. *J. Appl. Ecol.* 35: 195–206.
- LENTHALL, J. C., BRIDGEWATER, S. & FURLEY, P. A. (1999). A phytogeographic analysis of the woody elements of New World savannas. *Edinburgh J. Bot.* 56: 293–305.
- MACDOUGALL, A. & KELLMAN, M. (1992). The understory light regime and patterns of tree seedling in tropical riparian forest patches. *J. Biogeogr.* 78: 667–675.
- MALANSON, G. P. (1993). *Riparian Landscapes*. Cambridge: Cambridge University Press.
- MEAVE, J., KELLMAN, M., MACDOUGALL, A. & ROSALES, J. (1991). Riparian habitats as tropical forest refugia. *Global Ecol. Biogeogr.* 1: 69–76.
- MEERMAN, J. C. & SABIDO, W. (2001). *Central American Ecosystems: Belize. Volume II*. Programme for Belize, Belize City, Belize.
- MINTY, C. (2001). *Wildlife Impact Assessment of Macal River Upper Storage Facility (MRUSF)* (ed. D. A. SUTTON). London: Natural History Museum.
- NILSSON, C. & BERGGRAN, K. (2000). Alterations of riparian ecosystems resulting from river regulation. *BioScience* 50: 783–792.
- NILSSON, C. & SVEDMARK, M. (2002). Basic principles and ecological consequences of changing water regimes: riparian plant communities. *Environ. Manage.* 30: 468–480.
- PENN, M. G., SUTTON, D. A. & MONRO, A. (2004). Vegetation of the Greater Maya Mountains, Belize. *Syst. Biodivers.* 2: 21–44.
- PENNINGTON, T. D. (1997). *The Genus Inga: Botany*. Belgium: Continental Printing.
- PITHER, R. & KELLMAN, M. (2002). Tree species diversity in small, tropical riparian forest fragments in Belize, Central America. *Biodivers. Conserv.* 11: 1623–1636.
- POFF, N. L., ALLAN, J. D., BAIN, M. B., KARR, J. R., PRESTEGARD, K. L., RICHTER, B. D., SPARKS, R. E. & STROMBERG, J. C. (1997). The natural flow regime. *BioScience* 47: 769–784.
- RICHTER, B. D., BAUMGARTNER, J. V., WIGINGTON, R. & BRAUN, D. P. (1997). How much water does a river need? *Freshwater Biol.* 37: 231–249.
- SHEPHERD, G. J. (1995). *FITOPAC: Manual de Usuario*. IB-UNICAMP, Campinas.
- SWANSON, F. J., KRATZ, T. K., CAINE, N. & WOODMANSEE, R. G. (1988). Landform effect on ecosystem patterns and processes. *BioScience* 38: 92–98.
- WARD, J. V., TOCKNER, K. & SCHIEMER, F. (1999). Biodiversity of floodplain river ecosystems: Ecotones and connectivity. *Regulated Rivers: Research and Management* 15: 125–139.
- WRIGHT, A. C. S., ROMNEY, D. H., ARBUCKLE, R. H. & VIAL, V. E. (1959). Land Use in British Honduras: Report of the British Honduras land use team. Land Use Survey Team. In: ROMNEY, D. H. & WRIGHT, A. C. S. (eds) *Colonial Research Publication* 24. London: Her Majesty's Stationery Office.

APPENDIX

Species list with voucher numbers for the Macal River and associated vegetation communities

HA, habit; HAB, habitat; VOU, voucher.

Habit codes: h, herb; s, shrub; t, tree; v, vine; e, epiphyte.

Habitat codes: a, aquatic; rc, riverine channel; fr, fringing riverine; rt, riverine transition; s, savanna.

| | HA | HAB | VOU |
|--|-----|-------|------------------|
| SPERMATOPHYTA | | | |
| Acanthaceae | | | |
| <i>Aphelandra scabra</i> (Vahl) Sm. | s | rt | Urban 151 (E) |
| <i>Blechum pyramidatum</i> (Lam.) Urb. | h | fr | Urban 401 (E) |
| <i>Dicliptera sexangularis</i> (L.) Juss. | h | fr | Urban 83 (E) |
| <i>Justicia breviflora</i> (Nees) Rusby | h | fr | Urban 88 (E) |
| <i>Justicia spicigera</i> Schltldl. | s | rt | Urban 388 (E) |
| <i>Odontonema callistachyum</i> (Schltldl. & Cham.) Kuntze | s | fr | Urban 110 (E) |
| <i>Odontonema tubaeforme</i> (Bertol.) Kuntze | s | fr | Urban 291 (E) |
| <i>Ruellia geminiflora</i> Kunth | h | fr/rt | Urban 70 (E) |
| Amaranthaceae | | | |
| <i>Gomphrena serrata</i> L. | h | fr | Urban 231 (E) |
| Anacardiaceae | | | |
| <i>Metopium brownei</i> (Jacq.) Urb. | t | rt | Urban 266 (E) |
| <i>Spondias mombin</i> L. | t | rt | Urban 265 (E) |
| Annonaceae | | | |
| <i>Xylopia frutescens</i> Aubl. | t | rt | Urban 347 (E) |
| Apocynaceae | | | |
| <i>Allamanda cathartica</i> L. | s | fr | Dwyer 12283 (MO) |
| <i>Thevetia ahouai</i> (L.) A.DC. | s | rt | Urban 258 (E) |
| Araceae | | | |
| <i>Anthurium schlechtendalii</i> Kunth subsp. <i>schlechtendalii</i> | h | rt | Urban 247 (E) |
| <i>Philodendron dwyeri</i> Croat | h | rt | Dwyer 12334 (MO) |
| <i>Philodendron radiatum</i> Schott var. <i>radiatum</i> | h/e | fr | Urban 203 (E) |
| <i>Syngonium podophyllum</i> Schott | h/e | fr | Urban 210 (E) |
| <i>Araceae</i> sp. 1 | h | fr | Urban 121 (E) |
| <i>Araceae</i> sp. 2 | h | fr | Urban 155 (E) |
| Araliaceae | | | |
| <i>Dendropanax arboreus</i> (L.) Decne. & Planch. | t | fr | Urban 175 (E) |
| <i>Oreopanax obtusifolius</i> L.O.Williams | t | rt | Urban 269 (E) |
| Areceaceae | | | |
| <i>Acrocomia aculeata</i> (Jacq.) Lodd. ex Mart. | p | rt | No voucher |
| <i>Astrocaryum mexicanum</i> Liebm. ex Mart. | p | fr/rt | No voucher |
| <i>Attalea cohune</i> Mart. | p | rt | No voucher |
| <i>Bactis major</i> Jacq. var. <i>major</i> | p | rt | No voucher |
| <i>Chamaedorea ernesti-gustii</i> H.Wendl. | p | rt | No voucher |

| | | | |
|--|---|-------|-------------------|
| <i>Chamaedorea oblongata</i> Mart. | p | rt | No voucher |
| <i>Chamaedorea tepejilote</i> Liebm. | p | rt | No voucher |
| <i>Cryosophila stauracantha</i> (Heynh.) R.Evans | p | rt | Urban 292 (E) |
| <i>Desmoncus orthacanthos</i> Mart. | p | rt | Urban 394 (E) |
| Asteraceae | | | |
| <i>Acmella filipes</i> (Greenm.) R.K.Jansen | h | rt | Dwyer 10165 (MO) |
| <i>Ageratum houstonianum</i> Mill. | h | fr | Urban 61 (E) |
| <i>Ageratum peckii</i> B.L.Rob. | h | rt | Dwyer 12318 (MO) |
| <i>Chromolaena glaberrima</i> (DC.) R.M.King & H.Rob. | h | rt | Dwyer 12278 (MO) |
| <i>Lasianthaea fruticosa</i> (L.) K.M.Becker | t | rt | Urban 257 (E) |
| <i>Melampodium costaricense</i> Steussy | h | fr | Urban 97 (E) |
| <i>Smilax uvedalius</i> (L.) Mack. ex Small | h | fr | Urban 86 (E) |
| <i>Sphagneticola trilobata</i> (L.) Pruski | h | fr | Urban 49 (E) |
| <i>Symphytichum expansum</i> (Poepp. & Spreng.) G.L.Nesom | h | rc | Urban 24 (E) |
| Bignoniaceae | | | |
| <i>Amphilophium paniculatum</i> (L.) Kunth | v | fr/rt | Urban 239 (E) |
| <i>Paragonia pyramidata</i> (Rich.) Bureau | v | fr/rt | Urban 396 (E) |
| <i>Pithecoctenium crucigerum</i> (L.) A.H.Gentry | v | rt | Dwyer 12332A (MO) |
| <i>Pseudocatalpa caudiculata</i> (Standl.) A.H.Gentry | v | t | Urban 428 (E) |
| <i>Tynanthus guatemalensis</i> Donn.Sm. | v | rt | Dwyer 10189 (MO) |
| Boraginaceae | | | |
| <i>Cordia alliodora</i> (Ruiz & Pav.) Oken. | t | rt | No voucher |
| Bromeliaceae | | | |
| <i>Tillandsia</i> sp. | h | rt | Urban 237 (E) |
| Burseraceae | | | |
| <i>Bursera simaruba</i> (L.) Sarg. | t | rt | Urban 241 (E) |
| <i>Protium copal</i> (Schltdl. & Cham.) Engl. | t | rt | Urban 254 (E) |
| Buxaceae | | | |
| <i>Buxus barlettii</i> Standl. | s | rt | Urban 45 (E) |
| Campanulaceae | | | |
| <i>Lobelia cardinalis</i> L. | h | rc | Urban 359 (E) |
| <i>Lobelia xalapensis</i> Kunth | h | rt | Dwyer 12332 (MO) |
| Cannabaceae | | | |
| <i>Celtis iguanaea</i> (Jacq.) Sarg. | s | fr | Urban 313 (E) |
| Celastraceae | | | |
| <i>Hippocratea volubilis</i> L. | v | fr | Urban 164 (E) |
| Chrysobalanaceae | | | |
| <i>Hirtella racemosa</i> Lam. | t | fr | Urban 156 (E) |
| Clusiaceae | | | |
| <i>Clusia guatemalensis</i> Hemsl. | t | fr | Urban 200 (E) |
| <i>Clusia</i> sp. | t | fr | Urban 199 (E) |
| <i>Vismia camparaguey</i> Sprague & L.Riley | s | fr/rt | Urban 168 (E) |
| Cochlospermaceae | | | |
| <i>Cochlospermum vitifolium</i> (Willd.) Spreng. | t | rt | Urban 235 (E) |

Combretaceae

Bucida burceras L. t fr Urban 194 (E)

Commelinaceae

Commelina diffusa Burm.f. h fr Urban 93 (E)
Tradescantia zanoria (L.) Sw. h fr Urban 303 (E)
Tripogandra serrulata (Vahl) Handlos h fr Urban 77 (E)

Convolvulaceae

Ipomoea cf. *umbraticola* House v rc/fr Urban 90 (E)
Merremia cissoides (Griseb.) Hallier f. v fr/rt Urban 275 (E)

Costaceae

Costus cf. *pictus* D.Don h fr Urban 290 (E)

Cucurbitaceae

Melothria pedula L. v fr Urban 75 (E)
Momordica charantia L. v fr Urban 66 (E)

Cyclanthaceae

Asphundia sp. h rt Urban 74 (E)

Cyperaceae

Cyperus articulatus L. var. *articulatus* h fr Urban 103 (E)
Cyperus digitatus Roxb. h fr Urban 38 (E)
Cyperus haspan L. h fr Urban 331 (E)
Cyperus ligularis L. h fr Urban 224 (E)
Eleocharis elegans (Kunth) Roem. & Schult. h rc Dwyer 12328 (MO)
Eleocharis interstincta (Vahl) Roem. & Schult. h rc Urban 98 (E)
Eleocharis retroflexa (Poir.) Urb. h rc Urban 23 (E)
Fimbristylis dichotoma (L.) Vahl h rc Urban 362 (E)
Rhynchospora cephalotes (L.) Vahl h fr Urban 196 (E)
Rhynchospora nervosa (Vahl) Boeckeler h rt Urban 272 (E)
Scleria latifolia Sw. h fr Urban 391 (E)
Scleria cf. *melaleuca* Rchb. ex Schltld. & Cham. h fr Urban 50 (E)

Dilleniaceae

Davilla kunthii A.St.-Hil. s rt No voucher
Doliocarpus dentatus (Aubl.) Standl. v fr Urban 185 (E)
 subsp. *dentatus*

Dioscoreaceae

Dioscorea sp. v fr Urban 312 (E)

Erythroxylaceae

Erythroxylum guatemalense Lundell s rt Urban 244 (E)
Erythroxylum rotundifolium Lunan s fr Urban 144 (E)

Euphorbiaceae

Acalypha arvensis Poepp. s fr Urban 64 (E)
Acalypha diversifolia Jacq. t fr Urban 218 (E)
Acalypha leptopoda Müll.Arg. h fr Urban 29 (E)
Acalypha villosa Jacq. s fr Urban 33 (E)
Acalypha sp. s fr Urban 126 (E)
Adelia barbinervis Schltld. & Cham. t fr Urban 31 (E)

| | | | |
|--|---|----|--------------------|
| <i>Chamaesyce hypericifolia</i> (L.) Millsp. | h | rt | Dwyer 10759 (MO) |
| <i>Chamaesyce thymifolia</i> (L.) Millsp. | h | rt | Spellman 1390 (MO) |
| <i>Cnidoscolus aconitifolius</i> (Mill.) I.M.Johnst. | t | fr | Urban 400 (E) |
| <i>Cnidoscolus schiedeanus</i> Schldtl. | t | fr | Urban 217 (E) |
| <i>Croton xalapensis</i> Kunth | t | fr | Urban 40 (E) |
| <i>Euphorbia</i> sp. | h | fr | Urban 91 (E) |
| <i>Ricinus communis</i> L. | h | fr | Urban 87 (E) |

Fabaceae – Faboideae

| | | | |
|--|-----|-------|---------------|
| <i>Acosmium panamense</i> (Benth.) Yakovlev | t | rt | Urban 349 (E) |
| <i>Andira inermis</i> (W.Wright) DC. subsp. <i>inermis</i> | t | fr/rt | Urban 28 (E) |
| <i>Ateleia gummifera</i> (DC.) D.Dietr. | t | rt | Urban 202 (E) |
| <i>Centrosema</i> sp. | v | fr/rt | Urban 53 (E) |
| <i>Crotalaria cajanifolia</i> Kunth | h | fr | Urban 85 (E) |
| <i>Desmodium incanum</i> DC. | h | fr | Urban 143 (E) |
| <i>Lonchocarpus guatemalensis</i> Benth. | t | fr/rt | Urban 36 (E) |
| <i>Lonchocarpus rugosus</i> Benth. | s/t | fr/rt | Urban 167 (E) |
| <i>Lonchocarpus</i> sp. | t | fr/rt | Urban 255 (E) |
| <i>Machaerium</i> sp. | v | fr | Urban 162 (E) |
| <i>Mucuna</i> sp. | v | fr | Urban 73 (E) |
| <i>Rhynchosia</i> sp. | v | fr | Urban 67 (E) |
| <i>Vigna luteola</i> (Jacq.) Benth. | v | fr | Urban 84 (E) |

Fabaceae – Mimosoideae

| | | | |
|--|---|-------|---------------|
| <i>Acacia angustissima</i> (Mill.) Kuntze | t | fr | Urban 130 (E) |
| <i>Acacia gentlei</i> Standl. | t | fr | Urban 105 (E) |
| <i>Calliandra tergemina</i> (L.) Benth. var. <i>emarginata</i> (Willd.) Barneby | s | rc/fr | Urban 148 (E) |
| <i>Cojoba graciliflora</i> (S.F.Blake) Britton & Rose | t | fr | Urban 114 (E) |
| <i>Inga vera</i> Willd. subsp. <i>vera</i> | t | rc/fr | Urban 26 (E) |
| <i>Mimosa hondurana</i> Britton | v | fr | Urban 95 (E) |
| <i>Mimosa pellita</i> Humb. & Bonpl. ex Willd. var. <i>pellita</i> | s | rc/fr | Urban 94 (E) |
| <i>Mimosa somnians</i> Humb. & Bonpl. ex Willd. subsp. <i>somnians</i> var. <i>somnians</i> | v | fr | Urban 63 (E) |

Fabaceae – Caesalpinioideae

| | | | |
|---|---|-------|--------------------|
| <i>Bauhinia</i> sp. | s | rc/fr | Urban 30 (E) |
| <i>Bauhinia unguolata</i> L. | s | rt | Dwyer 12285 (MO) |
| <i>Schizolobium parahyba</i> (Vell.) S.F.Blake | t | rt | No voucher |
| <i>Senna cobanensis</i> (Britton & Rose) H.S.Irwin & Barneby | s | rt | Spellman 1397 (MO) |

Fagaceae

| | | | |
|--|---|------|---------------|
| <i>Quercus oleoides</i> Schldtl. & Cham. | t | rt/s | Urban 333 (E) |
| <i>Quercus purulhana</i> Trel. | t | s | Urban 267 (E) |

Gentianaceae

| | | | |
|---|---|----|---------------|
| <i>Schultesia lisianthoides</i> (Griseb.) Benth. & Hook.f. ex Hemsl. | h | fr | Urban 191 (E) |
|---|---|----|---------------|

Gesneriaceae

| | | | |
|--|---|----|------------------|
| <i>Achimenes erecta</i> (Lam.) H.P.Fuchs | h | fr | Dwyer 12324 (MO) |
|--|---|----|------------------|

Hydrocharitaceae

| | | | |
|---------------------------------|---|---|---------------|
| <i>Najas wrightiana</i> A.Braun | h | a | Urban 405 (E) |
|---------------------------------|---|---|---------------|

Lamiaceae

| | | | |
|-------------------------------|---|-------|--------------|
| <i>Salvia urica</i> Epling | h | fr/rt | Urban 41 (E) |
| <i>Vitex gaumeria</i> Greenm. | t | fr/rt | Urban 79 (E) |

Lauraceae

| | | | |
|---|---|----|--------------|
| <i>Nectandra salicifolia</i> (Kunth) Nees | t | fr | Urban 13 (E) |
|---|---|----|--------------|

Loranthaceae

| | | | |
|--|---|----|---------------|
| <i>Phthirusa pyrifolia</i> (Kunth) Eichler | v | fr | Urban 220 (E) |
|--|---|----|---------------|

Lythraceae

| | | | |
|---|---|----|------------------|
| <i>Cuphea calophylla</i> Cham. & Schltldl. | h | rc | Urban 25 (E) |
| <i>Cuphea decandra</i> Aiton var. <i>purpusii</i> (Brandege) Bacig. | s | rc | Dwyer 10750 (MO) |
| <i>Cuphea utriculosa</i> Koehne | h | rc | Urban 21 (E) |

Malpighiaceae

| | | | |
|---|---|---------|---------------|
| <i>Bunchosia lindeniana</i> A.Juss. | s | rt | Urban 415 (E) |
| <i>Byrsonima crassifolia</i> (L.) Kunth | t | fr/rt/s | Urban 157 (E) |
| <i>Heteropterys laurifolia</i> (L.) A.Juss. | s | fr | Urban 170 (E) |
| <i>Stigmaphyllon ellipticum</i> (Kunth) A.Juss. | v | rt | Urban 278 (E) |

Malvaceae

| | | | |
|---|---|----|---------------|
| <i>Byttneria aculeata</i> (Jacq.) Jacq. | v | fr | Urban 71 (E) |
| <i>Ceiba pentandra</i> (L.) Gaertn. | v | rt | No voucher |
| <i>Hampea stipitata</i> S.Watson | s | fr | Urban 301 (E) |
| <i>Hampea trilobata</i> Standl. | t | rt | Urban 268 (E) |
| <i>Helicteres guazumifolia</i> Kunth | s | rt | Urban 132 (E) |
| <i>Herissantia crispa</i> (L.) Brizicky | h | fr | Urban 81 (E) |
| <i>Luehea speciosa</i> Willd. | t | fr | Urban 338 (E) |
| <i>Melochia lupulina</i> Sw. | s | fr | Urban 134 (E) |
| <i>Waltheria indica</i> L. | h | fr | Urban 68 (E) |

Marantaceae

| | | | |
|--------------------------------------|---|----|---------------|
| <i>Calathea lutea</i> (Aubl.) G.Mey. | h | fr | Urban 319 (E) |
| <i>Calathea</i> sp. | h | fr | Urban 122 (E) |
| <i>Maranta gibba</i> Sm. | h | fr | Urban 76 (E) |

Melastomataceae

| | | | |
|---------------------------------------|---|---------|---------------|
| <i>Arthrostemma parvifolium</i> Cogn. | h | fr | Urban 135 (E) |
| <i>Miconia albicans</i> (Sw.) Triana | s | fr/rt/s | Urban 115 (E) |
| <i>Miconia prasina</i> (Sw.) DC. | s | fr | Urban 193 (E) |

Memecylaceae

| | | | |
|--|---|----|---------------|
| <i>Mouriri myrtilloides</i> (Sw.) Poir. subsp. <i>parvifolia</i> (Benth.) Morley | t | fr | Urban 160 (E) |
|--|---|----|---------------|

Moraceae

| | | | |
|---|-----|----|---------------|
| <i>Castilla elastica</i> Sessé subsp. <i>elastica</i> | sap | fr | Urban 314 (E) |
| <i>Ficus insipida</i> Willd. | t | fr | Urban 117 (E) |

Myrsinaceae

| | | | |
|--------------------------------|---|----|---------------|
| <i>Ardisia compressa</i> Kunth | s | fr | Urban 111 (E) |
| <i>Parathesis</i> sp. 1 | t | fr | Urban 47 (E) |
| <i>Parathesis</i> sp. 2 | t | fr | Urban 109 (E) |

Myrtaceae

| | | | |
|---|---|-------|------------------|
| <i>Calyptanthes bartlettii</i> Standl. | s | rc/fr | Urban 22 (E) |
| <i>Calyptanthes lindeniana</i> O.Berg | s | rc/fr | Urban 112 (E) |
| <i>Eugenia vacana</i> Lundell | s | fr | Dwyer 10747 (MO) |
| <i>Eugenia</i> sp. 1 | s | fr | Urban 131 (E) |
| <i>Eugenia</i> sp. 2 | s | fr | Urban 323 (E) |
| <i>Eugenia</i> sp. 3 | t | rt | Urban 256 (E) |
| <i>Myrciaria floribunda</i> (H.West ex Willd.) O.Berg | s | fr | Urban 181 (E) |

Nyctaginaceae

| | | | |
|---|---|----|---------------|
| <i>Guapira linearibracteata</i> (Heimerl) Lundell | t | fr | Urban 322 (E) |
|---|---|----|---------------|

Ochnaceae

| | | | |
|-----------------------------------|---|----|---------------|
| <i>Ouratea nitida</i> (Sw.) Engl. | t | fr | Urban 188 (E) |
|-----------------------------------|---|----|---------------|

Onagraceae

| | | | |
|---|---|----|---------------|
| <i>Ludwigia octavalis</i> (Jacq.) P.H.Raven | s | rc | Urban 368 (E) |
|---|---|----|---------------|

Orchidaceae

| | | | |
|---|---|----|------------------|
| <i>Habenaria monorrhiza</i> (Sw.) Rehb.f. | h | rt | Dwyer 12279 (MO) |
|---|---|----|------------------|

Oxalidaceae

| | | | |
|--|---|----|---------------|
| <i>Biophytum dendroides</i> (Kunth) DC. | h | rc | Urban 223 (E) |
| <i>Oxalis frutescens</i> L. subsp. <i>angustifolia</i> (Kunth) | h | fr | Urban 51 (E) |

Papaveraceae

| | | | |
|-----------------------------|---|----|--------------|
| <i>Argemone mexicana</i> L. | h | fr | Urban 39 (E) |
|-----------------------------|---|----|--------------|

Passifloraceae

| | | | |
|---|---|----|---------------|
| <i>Passiflora foetida</i> L. | v | rt | Urban 279 (E) |
| <i>Passiflora guatemalensis</i> S.Watson | v | rt | Urban 382 (E) |
| <i>Passiflora xiikzodz</i> J.M.MacDougal subsp. <i>xiikzodz</i> | v | fr | Urban 54 (E) |

Phyllanthaceae

| | | | |
|--|---|----|---------------|
| <i>Phyllanthus</i> cf. <i>compressus</i> Kunth | h | rc | Urban 366 (E) |
|--|---|----|---------------|

Picramniaceae

| | | | |
|--------------------------------|---|----|---------------|
| <i>Picramnia antidesma</i> Sw. | t | fr | Urban 297 (E) |
|--------------------------------|---|----|---------------|

Piperaceae

| | | | |
|------------------------------------|---|----|---------------|
| <i>Piper amalago</i> L. | s | fr | Urban 107 (E) |
| <i>Piper jacquemontianum</i> Kunth | s | fr | Urban 302 (E) |
| <i>Piper hispidum</i> Sw. | s | fr | Urban 309 (E) |

Plantaginaceae

| | | | |
|--|---|----|------------------|
| <i>Mecardonia procumbens</i> (Mill.) Small | s | rc | Urban 18 (E) |
| <i>Scoparia dulcis</i> L. | h | rt | Dwyer 10761 (MO) |

Poaceae

| | | | |
|---|---|-------|---------------|
| <i>Arundinella berteroniana</i> (Schult.) Hitchc. & Chase | h | rc/fr | Urban 16 (E) |
| <i>Cryptochloa striciflora</i> (E.Fourn.) Swallen | h | rc/fr | Urban 304 (E) |
| <i>Eragrostis</i> sp. | h | rc | Urban 363 (E) |
| <i>Hymenache amplexicaulis</i> (Rudge) Nees | h | rc/fr | Urban 27 (E) |
| <i>Lasiacis rugelii</i> (Griseb.) Hitchc. var. <i>rugelii</i> | h | fr | Urban 166 (E) |
| <i>Olyra latifolia</i> L. | h | fr | Urban 320 (E) |
| <i>Oplismenus hirtellus</i> (L.) P.Beauv. | h | fr | Urban 389 (E) |

| | | | |
|--|---|----|------------------|
| <i>Panicum laxum</i> Sw. | h | rc | Urban 364 (E) |
| <i>Tripsacum latifolium</i> Hitchc. | h | fr | Urban 58 (E) |
| Podostemaceae | | | |
| <i>Marathrum</i> sp. | h | a | Urban 427 (E) |
| Polygalaceae | | | |
| <i>Bredemeyera lucida</i> (Benth.) Klotzsch, ex Hassk. | s | fr | Urban 404 (E) |
| <i>Polygala paniculata</i> L. | h | rc | Urban 19 (E) |
| <i>Polygala</i> sp. | h | rc | Urban 72 (E) |
| Polygonaceae | | | |
| <i>Coccoloba belizensis</i> Standl. | t | fr | Urban 184 (E) |
| <i>Polygonum persicarioides</i> Kunth | h | fr | Urban 226 (E) |
| <i>Polygonum punctatum</i> Elliott | h | fr | Urban 82 (E) |
| Primulaceae | | | |
| <i>Anagallis pumila</i> Sw. | h | fr | Dwyer 12330 (MO) |
| Proteaceae | | | |
| <i>Roupala montana</i> Aubl. | s | fr | Urban 154 (E) |
| Rhizophoraceae | | | |
| <i>Cassipourea guianensis</i> Aubl. | t | fr | Urban 347 (E) |
| Rosaceae | | | |
| <i>Photinia microcarpa</i> Standl. | t | fr | Urban 173 (E) |
| Rubiaceae | | | |
| <i>Guettarda deamii</i> Standl. | s | fr | Urban 129 (E) |
| <i>Guettarda macrosperma</i> Donn.Sm. | s | fr | Urban 35 (E) |
| <i>Hamelia halycosa</i> Donn.Sm. | s | rt | Dwyer 10179 (MO) |
| <i>Hamelia patens</i> Jacq. var. <i>patens</i> | s | fr | Urban 171 (E) |
| <i>Lindenia rivalis</i> Benth. | s | rc | Urban 177 (E) |
| <i>Mitracarpus hirtus</i> (L.) DC. | h | rt | Dwyer 10171 (MO) |
| <i>Morinda panamensis</i> Seem. | s | fr | Urban 403 (E) |
| <i>Oldenlandia corymbosa</i> L. | h | rt | Dwyer 12331 (MO) |
| <i>Psychotria costivenia</i> Griseb. | s | rt | Urban 139 |
| <i>Psychotria mexicae</i> Standl. | s | rt | Dwyer 10193 (MO) |
| <i>Psychotria nervosa</i> Sw. | s | fr | Urban 43 (E) |
| <i>Psychotria poeppigiana</i> Müll.Arg. | s | fr | Urban 392 (E) |
| <i>Psychotria pubescens</i> Sw. | s | rt | Dwyer 11557 (MO) |
| <i>Randia lundelliana</i> Standl. | s | fr | Urban 145 (E) |
| <i>Spermacoce verticillata</i> L. | h | rc | Urban 17 (E) |
| Salicaceae | | | |
| <i>Casearia corymbosa</i> Kunth | s | fr | Urban 32 (E) |
| <i>Pleuranthodendron lindenii</i> (Turcz.) Sleumer | t | fr | Urban 284 (E) |
| <i>Prockia crucis</i> L. | s | rt | Urban 240 (E) |
| <i>Zuelania guidonia</i> (Sw.) Britton & Millsp. | t | rt | Urban 259 (E) |
| Sapindaceae | | | |
| <i>Cardiospermum grandiflorum</i> Sw. | v | fr | Urban 289 (E) |
| <i>Paullinia</i> cf. <i>pinnata</i> L. | v | fr | Urban 390 (E) |

| | | | |
|--|---|-------|------------------|
| <i>Paullinia</i> sp. | v | fr | Urban 163 (E) |
| <i>Sapindus saponaria</i> L. | t | fr | Urban 180 (E) |
| <i>Serjania hundellii</i> Croat | v | rc/fr | Urban 230 (E) |
| Sapotaceae | | | |
| <i>Chrysophyllum mexicanum</i> Brandegee ex Standl. | s | fr | Urban 125 (E) |
| Smilacaceae | | | |
| <i>Smilax</i> sp. | v | fr | Urban 150 (E) |
| <i>Smilax velutina</i> Killip & C.V.Morton | v | rf | Dwyer 12275 (MO) |
| Solanaceae | | | |
| <i>Capsicum annuum</i> L. var. <i>glabriusculum</i> (Dunal) Heiser & Pickersgill | h | fr | Urban 308 (E) |
| <i>Cestrum nocturnum</i> L. | s | fr | Urban 296 (E) |
| <i>Solanum erythrotrichum</i> Fernald | h | fr | Urban 315 (E) |
| <i>Solanum torvum</i> Sw. | s | fr | Dwyer 10751 (MO) |
| Theophrastaceae | | | |
| <i>Deherainia smaragdina</i> (Planch. & Linden) Decne. subsp. <i>smaragdina</i> | s | fr | Urban 393 (E) |
| Turneraceae | | | |
| <i>Turnera aromatica</i> Arbo | s | fr | Urban 59 (E) |
| Ulmaceae | | | |
| <i>Ampelocera hottlei</i> (Standl.) Standl. | t | fr | Urban 104 (E) |
| Urticaceae | | | |
| <i>Cecropia obtusifolia</i> Bertol. | t | rt | No voucher |
| <i>Pilea microphylla</i> (L.) Liebm. | h | rc | Urban 352 (E) |
| Verbenaceae | | | |
| <i>Citharexylum caudatum</i> L. | s | fr | Urban 48 (E) |
| <i>Lantana camara</i> L. | s | rt | Urban 243 (E) |
| <i>Stachytarpheta cayennensis</i> (Rich.) Vahl | s | rt | Urban 60 (E) |
| Violaceae | | | |
| <i>Hybanthus oppositifolius</i> (L.) Taub. | h | fr | Urban 52 (E) |
| Vitaceae | | | |
| <i>Vitis tiliifolia</i> Humb. & Bonpl. ex Roem. & Schult. | h | fr | Urban 212 (E) |
| PINOPHYTA | | | |
| Pinaceae | | | |
| <i>Pinus caribaea</i> Morlet var. <i>hondurensis</i> (Sénéclauze) W.H.Barrett & Golfari | t | s | No voucher |
| LYCOPODIOPHYTA | | | |
| Selaginellaceae | | | |
| <i>Selaginella pallescens</i> (C.Presl) Spring | h | fr | Urban 140 (E) |
| <i>Selaginella umbrosa</i> Lem. ex Hieron. | h | fr | Urban 385 (E) |

POLYPODIOPHYTA**Adiantaceae**

- | | | | |
|---------------------------------|---|----|----------------------|
| <i>Adiantum latifolium</i> Lam. | h | fr | <i>Urban</i> 205 (E) |
| <i>Adiantum trapeziforme</i> L. | h | fr | <i>Urban</i> 395 (E) |

Aspleniaceae

- | | | | |
|---------------------------------------|---|----|----------------------|
| <i>Tectaria mexicana</i> (Feé) Morton | h | fr | <i>Urban</i> 189 (E) |
|---------------------------------------|---|----|----------------------|

Blechnaceae

- | | | | |
|--------------------------------|---|----|----------------------|
| <i>Blechnum occidentale</i> L. | h | fr | <i>Urban</i> 206 (E) |
|--------------------------------|---|----|----------------------|

Schizaeaceae

- | | | | |
|-----------------------------------|---|----|----------------------|
| <i>Lygodium heterodoxum</i> Kunze | v | fr | <i>Urban</i> 215 (E) |
| <i>Lygodium venustum</i> Sw. | v | fr | <i>Urban</i> 152 (E) |

Thelypteridaceae

- | | | | |
|--|---|----|----------------------|
| <i>Thelypteris hispidula</i> (Decne.) C.F.Reed | h | fr | <i>Urban</i> 207 (E) |
|--|---|----|----------------------|