PERMANENT VEGETATION PLOTS

PLANT DIVERSITY ASSESSMENT AND MONITORING IN THE BLADEN NATURE RESERVE

Prepared on 6 July 2014

for

Ya'axché Conservation Trust

Steven Brewer, Ph.D.

Plant Ecologist

Belize Foundation for Research and Environmental Education

BFREE

TABLE OF CONTENTS

TABLE OF TABLES

TABLE OF FIGURES

INTRODUCTION AND RATIONALE

The Maya Mountain massif is the largest intact tropical forest within the Maya Forest block, itself the largest intact rainforest north of South America. Most of the forests of the Maya Forest are on limestone, a geological feature that is rare outside of northern Central America and is heavily exploited for its rock and its rich soils for agriculture. Due to their position along the southeastern slope of the Maya Mountains -- which receives some of the highest annual rainfall for northern Central America – the limestone forests of the Bladen Nature Reserve, Maya Mountain Forest Reserve, and Columbia River Forest Reserve appear to one of the most unusual and unique floras in the Maya Forest block. Furthermore, forests on limestone soils appear to be particularly productive food resources for wildlife. Unfortunately due to their proximity to agriculture and human development, forests on limestone soils are under threat of fire and heavy resource exploitation.

Systematic monitoring and inventory of these limestone forests is of paramount importance in detecting unnatural changes and developing management plans to respond to both direct and indirect human influences. To this end, Ya'axche Conservation Trust has begun to establish a system of permanent plots for monitoring biological diversity and physical structure of the forests of the southeastern Maya Mountains, beginning with the Bladen Nature Reserve.

Due to its relatively undisturbed biota, the Bladen Nature Reserve is ideal for observing and quantifying – relatively free from historically heavy human influences – a Belizean flora and fauna that potentially can be monitored as a "natural" reference point for detecting both natural and human-induced future changes in the surrounding landscape. The focus of this report is on two one-hectare plots that Ya'axché has established in the most species-diverse forest in the Maya Forest and in northern Central America. These plots will be useful not only at the local landscape scale, but also as part of a growing network of permanent plots throughout Belize.

METHODS

Two permanent, 1-hectare plots were established on a limestone slope and limestone ridge in the northeastern Bladen Nature Reserve (BNR) (Figure 1). The locations were chosen to represent undisturbed limestone forests and to represent the vegetation along a limestone catena, by complementing two existing permanent 1-hectare plots on alluvium over limestone at the bottom of the catena. Methods of plot establishment, including tree measurements, followed Condit (1998).

All trees greater than or equal to 5 cm diameter at breast height ("DBH"; 1.3m above the ground) were tagged with numbered aluminum tags, mapped to the subplot (10m X10m) level, and identified. Identifications were carried out in the field, and voucher specimens for all species not readily identifiable in the field were collected and identified at the Missouri Botanical Garden (MO) in St. Louis, Missouri, USA. Data analyses were carried out using the PAST software (Hammer, et al. 2001).

Most results are presented for all stems ≥ 5cm DBH, however 10cm DBH is often used as a minimum size class in plot studies in tropical forests, therefore Table 1 in this report includes results for trees stems ≥ 10cm DBH. Basal area for trees was calculated as the area of a circle defined by the diameter of a given stem; this area is often used as an index of biomass.

Diversity measures are presented using numbers of individuals and basal area as two different measures of abundance. Numbers of stems and proportion of total basal area are almost never significantly correlated, as species with many stems tend to be smaller, understory to subcanopy species, and canopy to large emergent trees necessarily have fewer individuals per unit area. Number of stems and basal area each contain their own types of ecological information.

Many types of measures of species diversity exist because diversity has two components: species richness (the number of species present) and evenness or equitability (how equal are the abundances of the species present). Consequently, comparisons of plots with respect to diversity may yield conflicting results, as many diversity metrics weight one diversity component over the other. Therefore comparing diversities of plots, as is done in this study among the four limestone plots analyzed, requires examining a suite of measures of diversity. Compared in this report are rank-abundance curves, diversity profiles, rarefaction curves, and four diversity indices: species richness (S), Shannon's index (H), Fisher's alpha, and the effective number of species. The effective number of species refers to the number of equally-abundant species necessary to obtain the same mean proportional species abundance as that observed in the respective plot. Shannon's index (H) and Fisher's α are commonly used diversity indices in ecological studies.

Condit, R. 1998. *Tropical Forest Census Plots*. Springer-Verlag, Berlin, and R. G. Landes Company, Georgetown, Texas. 212 pp. http://ctfs.arnarb.harvard.edu/Public/pdfs/Condit_1998_CensusPlotsmethodsBook.pdf

Hammer, Ø., Harper, D.A.T., Ryan, P.D. 2001. PAST: Paleontological statistics software package for education and data analysis. Palaeontologia Electronica 4(1): 9pp. http://palaeo-electronica.org/2001_1/past/issue1_01.htm

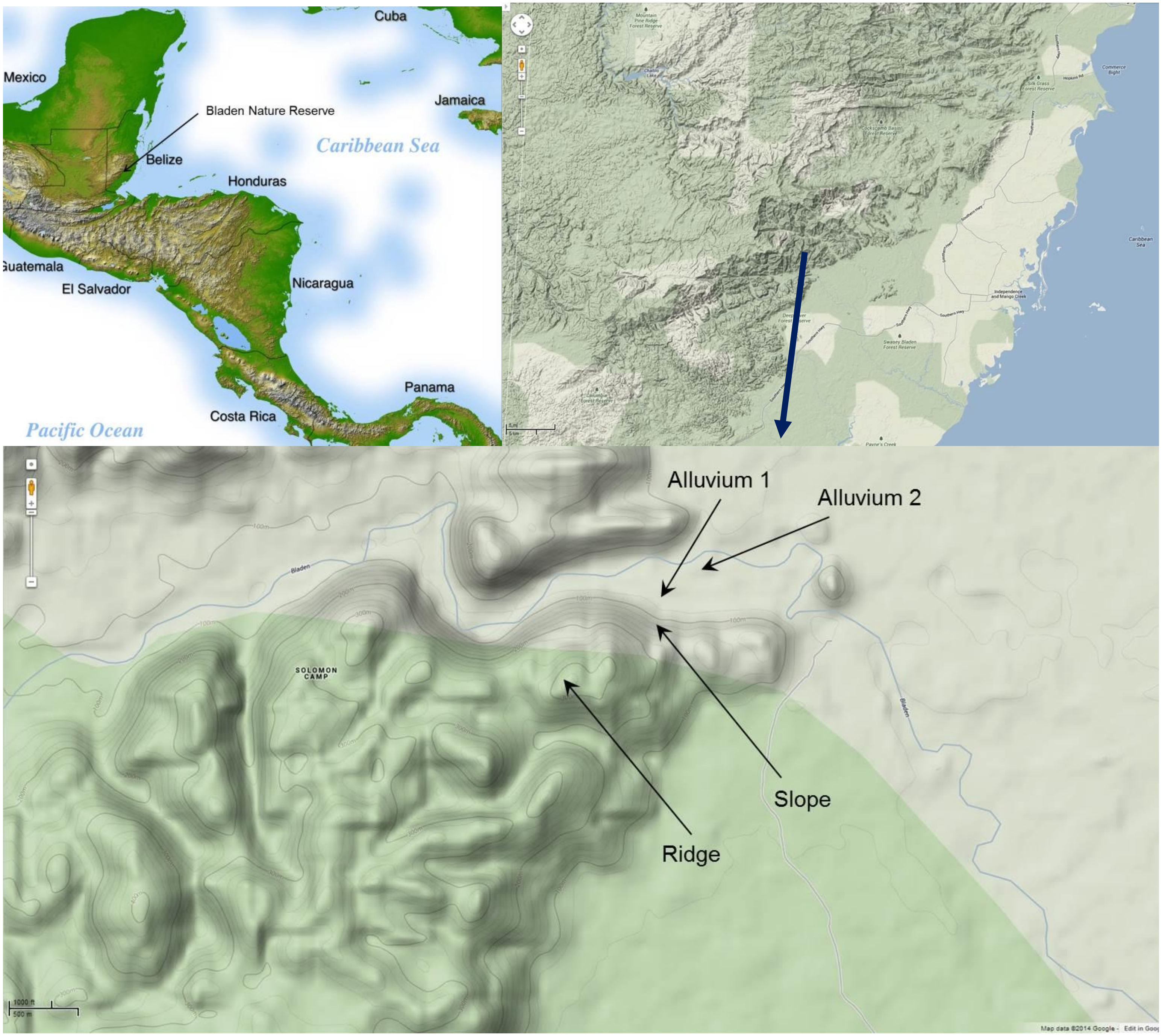

Figure 1. Locations of the four permanent plots in the Bladen Nature Reserve.

RESULTS AND DISCUSSION

Physiognomy

The physical structures of the four plots show increasing density (and thus greater total numbers) of trees with increasing elevation: stem densities nearly doubled from each topographic position from the valley bottom to the next higher position (Table 1, Figures 2 & 3). This trend is driven primarily by proportionately more stems in the smallest size classes, 5-10 cm DBH and 10-20 cm DBH (Table 2), and by a weaker but discernible effect of proportionately fewer trees in the large-stem size classes, on plots at higher elevations. The trend of increasing density of trees with increasing elevation and from flat forests to ridges has been documented throughout the tropics. However, the causal factors of such trends have not been well-elucidated.

In the BNR, the plots on higher elevations have shallower soils, more rapid drainage, and greater exposure to desiccating winds than plots at lower elevations. Tree height is well-known to be positively related to water availability due to physical limitations (mostly via resistance in longer water columns) to plants being able to maintain a positive water status in leaves at greater heights. Therefore with less water available to 'maintain' tree height, trees at higher elevations on limestone may not achieve the height and canopy mass necessary for out-competing other trees for space. Consequently, more trees would be able to grow and physically fit in a given area on ridges, which may account for the higher total stem density and biomass (as basal area) in the ridge plot.

Basal area is also increasingly greater with increasing elevation along the limestone catena. The slope plot and ridge plots have at least 19% and over 50%, respectively, more total basal area than the alluvium plots, for all trees ≥ 5cm DBH (Table 1). This trend too is driven by the smaller size classes of trees; the proportionate contributions of basal area by trees < 20cm DBH to the entire plot increase by over 75% with each step up in topographic position from the valley bottom to the next higher position (Table 2). The smallest size class of trees measured, those between 5 and 10 cm DBH, contributes about 50% of all of the stems > 5cm DBH to all of the plots, but only 3-11% of the basal area in the plots.

Table 1. Summary of attributes of the four plots on limestone and alluvium. Attributes are divided between those for all individuals in the plot (≥ 5cm DBH) and for individuals ≥ 10cm DBH. Diversity measures are presented using number of individuals and basal area as two different measures of abundance (see Methods).

Attribute	Ridge	Slope	Alluvium 1	Alluvium 2
Maximum Elevation (m)	330	130	60	50
Individuals (N) >5cm DBH	2345	1240	706	676
Species (S)	85	106	114	102
Effective S (e^H)	36.2	42.4	37.9	36.5
Shannon index (H)	3.59	3.75	3.64	3.60
Fisher's α	17.3	27.7	38.5	33.4
Basal Area (cm2)	486,574	379,091	315,322	318,497
Effective S (e^H)	30.7	37.0	33.7	29.5
Shannon index (H)	3.42	3.61	3.52	3.38
Individuals (N) ≥10cm DBH	1142	625	327	354
Species (S)	70	80	91	86
Effective S (e^H)	33.4	37.0	51.6	47.6
Shannon index (H)	3.51	3.61	3.93	3.86
Fisher's α	16.5	24.4	41.8	36.2
Basal Area (cm2)	429,443	354,509	303,063	307,927
Effective S (e^H)	27.6	34.3	30.9	27.5
Shannon index (H)	3.32	3.54	3.43	3.31

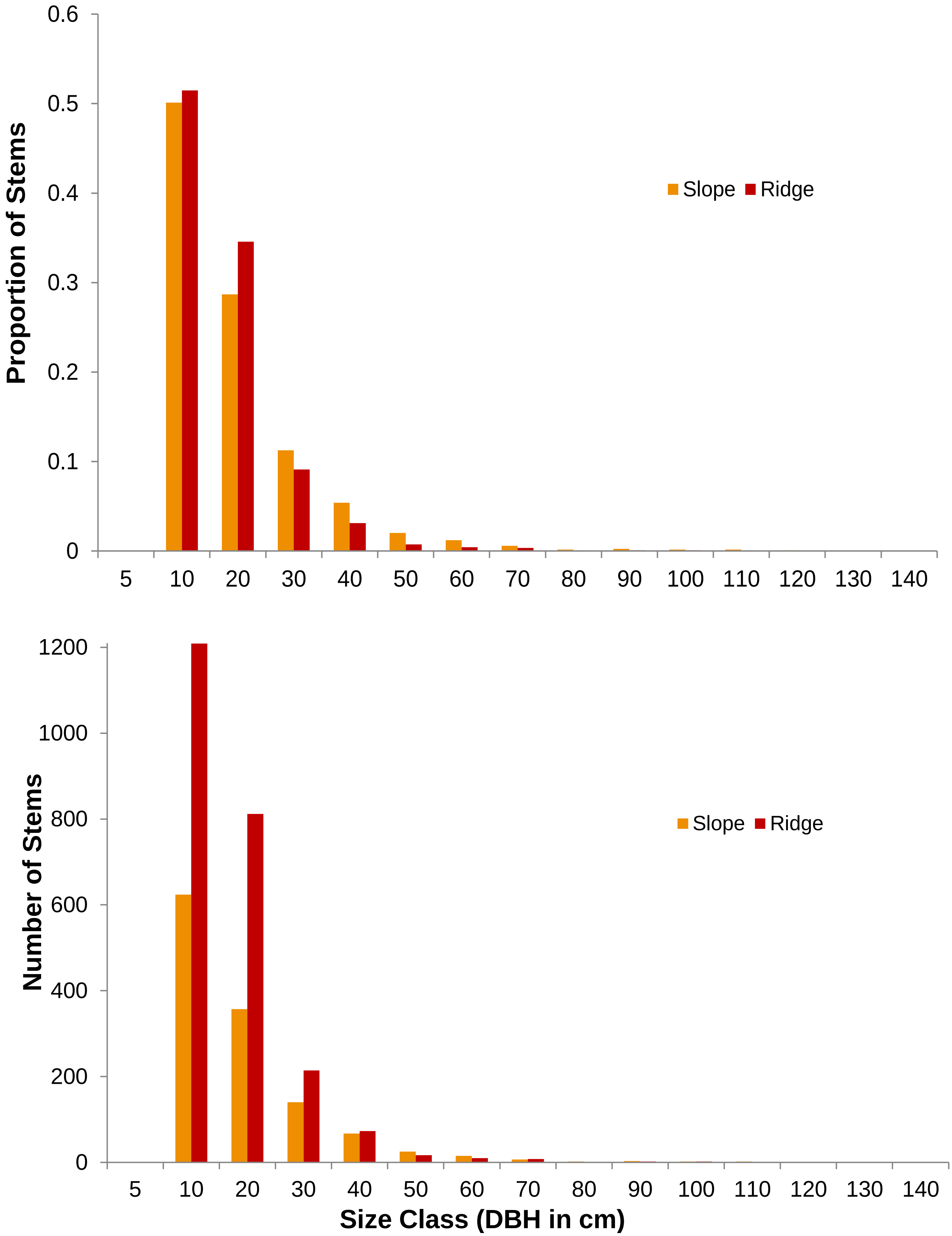

Figure 2. Numbers and proportions of all stems for the Ridge and Slope plots. Size class values represent all values less than the labeled value and equal or greater than the next lower size class.

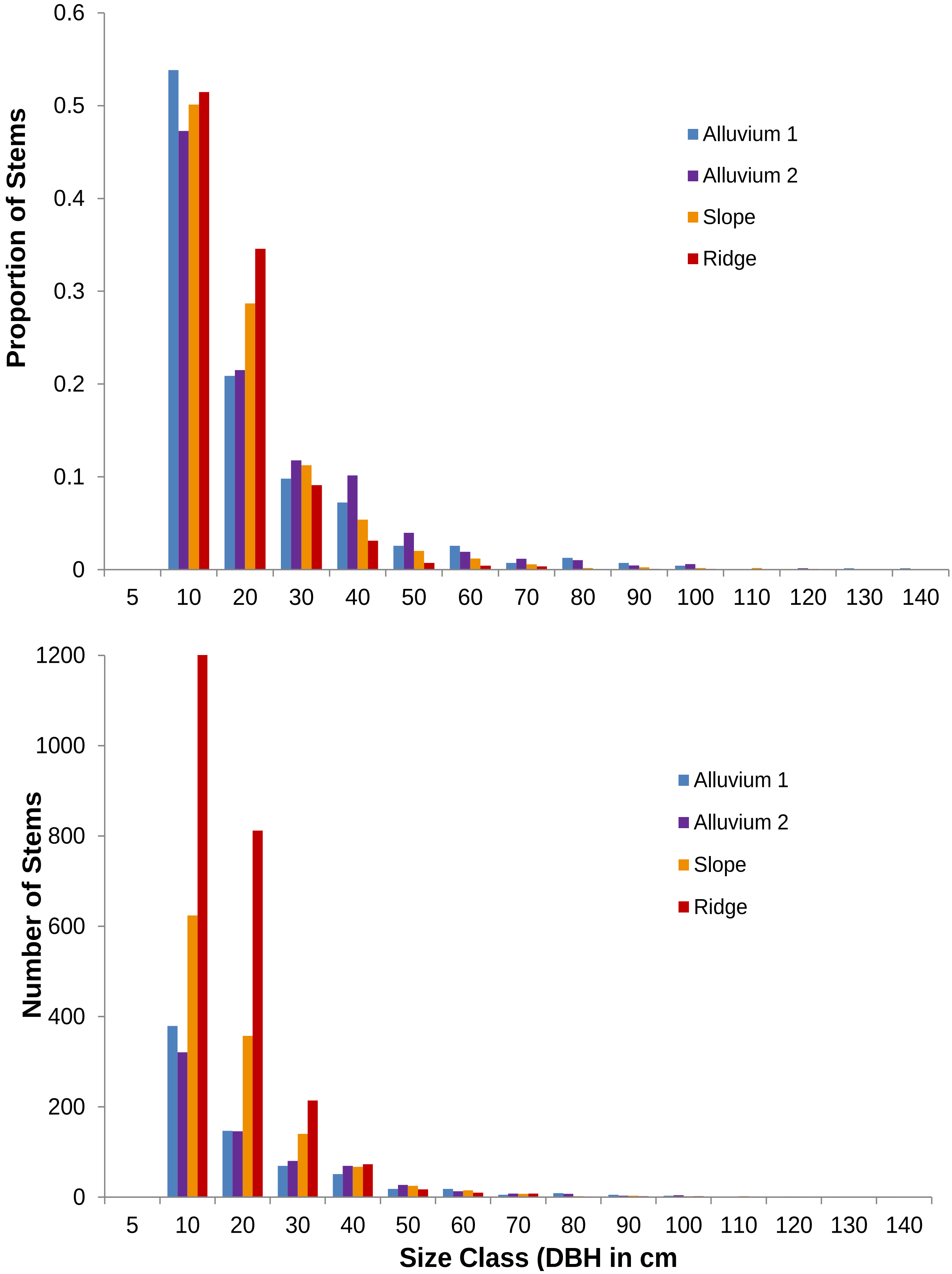

Figure 3. Proportions and numbers of stems by size class for four plots. Size class values represent all values less than the labeled value and equal or greater than the next lower size class.

Taxonomic Diversity

A total of 65 plant families and 227 species were recorded among the nearly 5,000 trees in the four plots. The most important families in species richness among the four plots were the Fabaceae, Rubiaceae, Sapotaceae, Lauraceae, Meliaceae, Apocynaceae, and Moraceae (Appendix 1). The Myrtaceae were clearly more important on the slopes and ridge, the latter of which had lower family richness (36 families) than the other three plots (43-45).

Species diversity combines richness (number of species) with relative abundance, or evenness of distribution of individuals among species, for a given habitat. Species richness alone may be equal between to plots, but if the two plots differ in evenness of abundance, the ecological effects or importance of each species are necessarily lower in the plot with lower evenness. Because diversity incorporates these two components, and because these components may be weighted differently in a diversity index, a plethora of metrics exist for describing this quality of communities using different methods of weighting evenness. Therefore, comparing diversity measures between or among plots may result in different conclusions depending on which metric is chosen.

Two measures of abundance typically used for plants are biomass and individuals. The former is difficult to measure accurately, however for trees basal area offers an index that performs fairly well. Unfortunately, the number of individuals in a species in a specific area is typically only weakly indicative of that species' total biomass for that area. Two equally dense species may have very different totals of biomass, or two species of similar biomass may be very unequal in density of individuals. The ecological importance of each measure of abundance may also be very different. For example, in the ridge plot, *Lysiloma latisiliquum* is ranked 33^{rd} in N (individuals) but 6^{th} in total biomass among the plot's 85 species; *Lysiloma latisiliquum* is only infrequently encountered, however it generally takes up a large space where it is found. Other species may be frequent but small.

Rank-abundance curves are a valuable means of examining species diversity of an area as an initial measure, because these curves provide a means of visually assessing evenness of species in addition to richness. Additionally, rank abundance curves can use biomass data, unlike the most commonly used diversity indices diversity, which use numbers of individuals as indicators of abundance. Figure 4 shows that for the most abundant 30-40% of species in each plot, the plots are comparable in evenness (similar slopes of rank-abundance curves). The rare species in the ridge plot, however, have more uneven species abundances (steeper slope of this part of the curve) than the other plots. The rarer species in the alluvium plots, especially Alluvium 1, are visibly more evenly distributed in abundance than in the other plots.

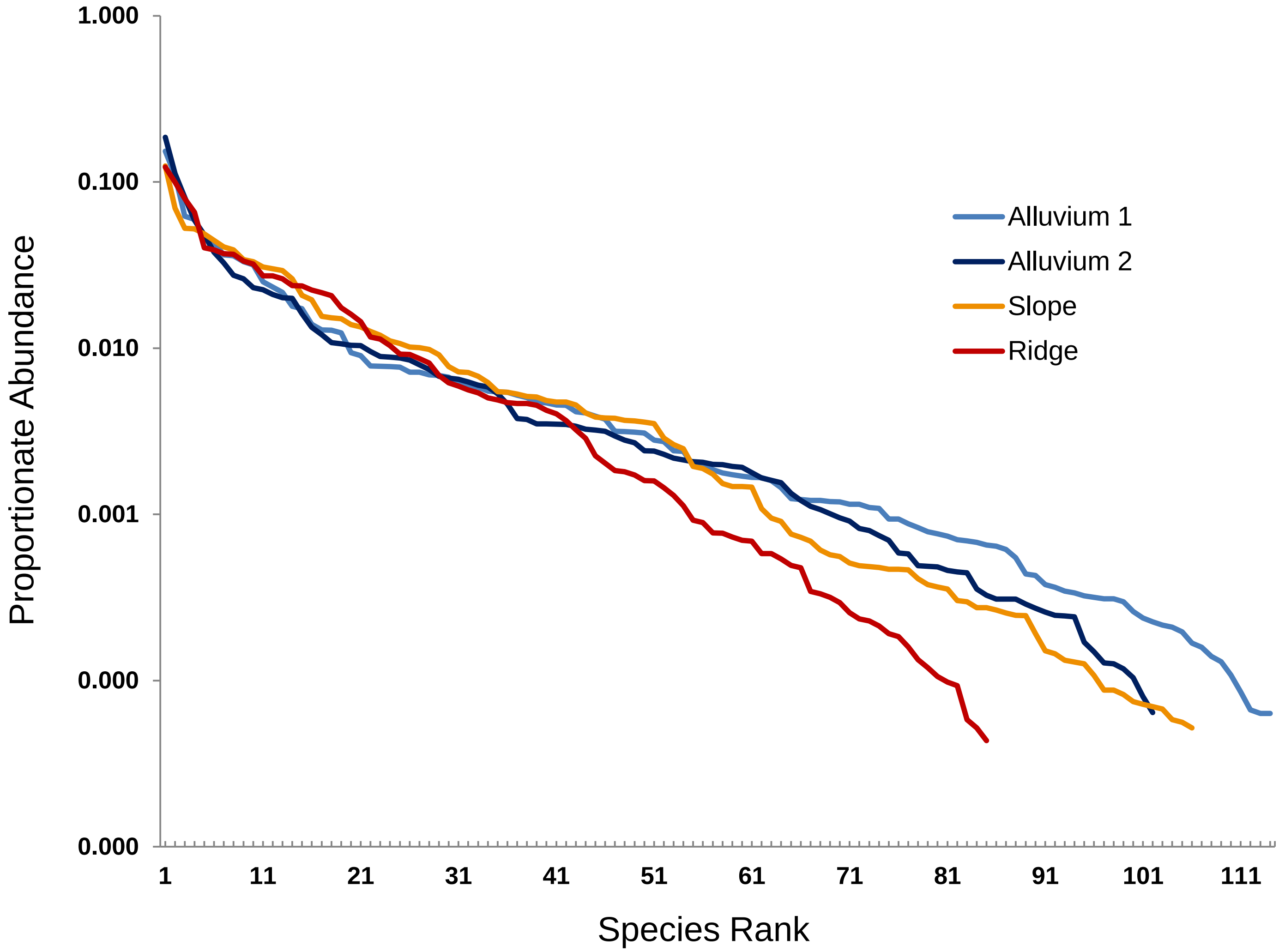

Figure 4. Rank-abundance curves for the four limestone plots from the top of a ridge to adjacent to the Bladen branch of the Monkey River. Proportionate abundance is for biomass expressed as basal area. Species are ranked from first to least abundant on the horizontal axis.

Species richness is the simplest measure of diversity and was highest on the Alluvium 1 plot followed in descending order by the Slope, Alluvium 2, and Ridge plots, but the difference between the slope and alluvium plot is minor (Table 1). Species richness is dependent on abundance of individuals, however, and plots with more individuals will necessarily have more species; all else being equal, the more individuals randomly sampled from an area, the more likely additional species will be recorded. Unfortunately the relationship between increasing richness and increasing individuals is complex and may vary from one environment to the next.

Shannon's index is a popular diversity index because it weights abundance and species richness equally, and because it has been shown to perform consistently. Effective number of species converts Shannon's index into a metric that uses species as the unit of diversity. There are compelling arguments for using the effective number of species for comparing plots with respect to diversity.

Fisher's alpha is an index that is popular in the literature on tropical plots, even though it is relatively insensitive to rare species. This index performs well for large samples (>1,000 individuals), and it operates under the assumption that the abundance of species follows the log series distribution. The abundance distributions were tested for fit to the log-series distribution, and the distribution of the abundance for the trees of the slope and ridge plots do fit the log series; however the trees in the alluvium plots do not. Consequently, Fisher's alpha may be used for comparing the slope and ridge plots with each other, or the two alluvium plots against each other, since their abundance distributions are similar to each other.

Diversity profiles using Hill's series of diversity indices (Figure 4) are useful for examining how the effect of changing the relative weights of evenness and richness of species changes the diversity of a plot and for comparing this effect among plots. Figure 4 shows that the slope plot is significantly more diverse than the ridge plot by all indices of diversity. Whether using basal area or N as measures of abundance, and/or using 5cm or 10 cm as the minimum tree size for inclusion in each plot, all other measures also demonstrate this relationship.

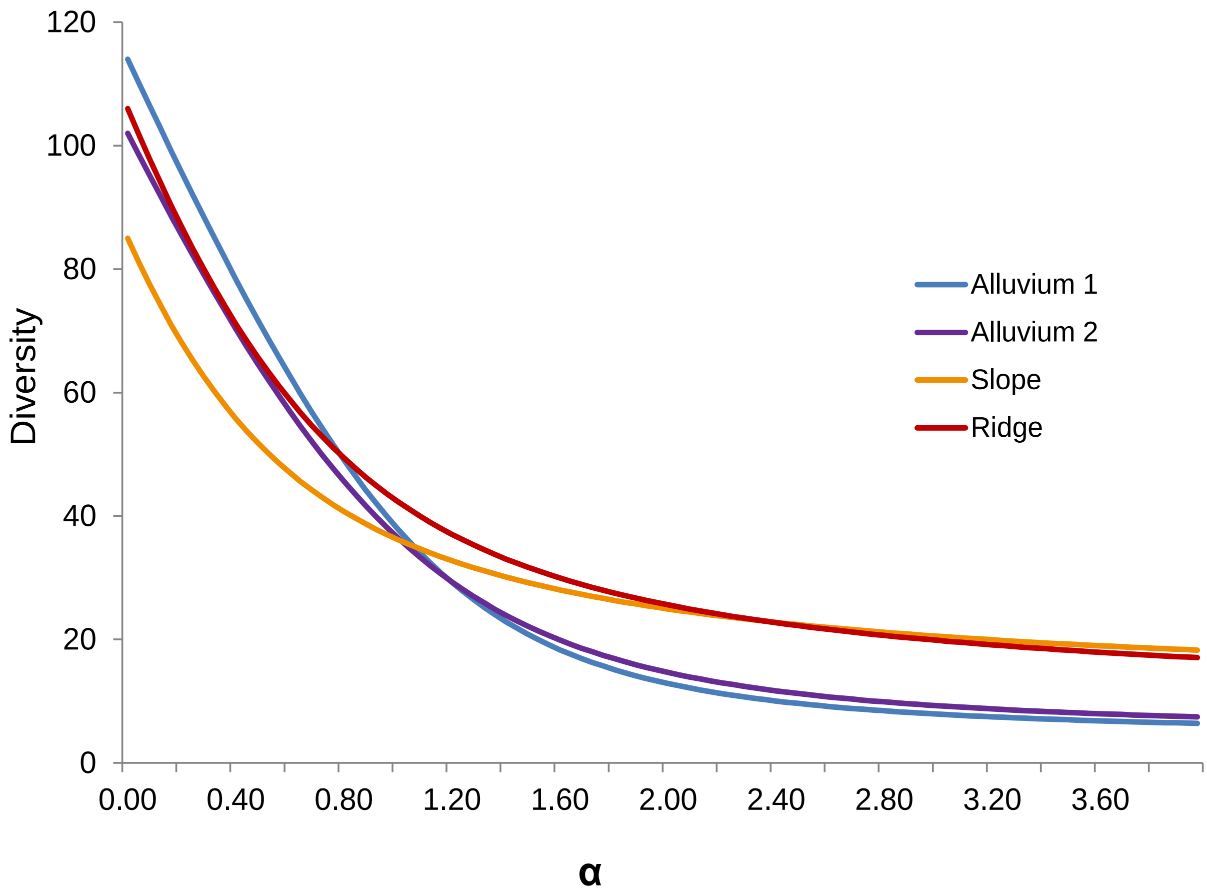

Figure 5. Diversity profiles plotting species diversity (expressed in numbers of species) against values of α, values of which correspond to varying degrees of importance of species richness versus evenness of species abundances in calculating diversity, for each of the four limestone plots. Diversity profiles used here may be interpreted as being more sensitive to rare species for lower values α and more sensitive to abundant species for higher values of α. Three commonly used measures of diversity – species richness (total number of species), Shannon's entropy, and Simpson's dominance index – are related to values of α = 0, 1, and 2, respectively.

Comparing the slope and ridge plots with the alluvium plots, however, produces mixed results that illustrate the contingencies upon which relative diversity levels rest. First, the Shannon's index (H) and the effective number of species show significantly higher diversity in the slope than the alluvium plots, which are the same plots having (until now) the highest recorded tree diversities in northern Central America. However the reverse is true for plots using trees ≥ 10cm DBH. (This minimum size class is often used for plot sampling in the tropics due to the greater efficiency and speed which accompanies this larger size class.) This result, when examined more closely, demonstrates that the contribution of smaller stems (< 20cm DBH) to plot richness and diversity is significantly higher for the slope and ridge plots than for the alluvium plots. For example, individuals < 10cm DBH contribute about equally to the tree densities in all of the plots (c. 50% of all trees are < 10cm DBH in each plot). However, in the ridge and slope plots this size class contributes c. 50% and c. 100%, respectively, more species as a percent of plot richness than in the alluvium plots (Table 1). Second, diversity profiles show that the slope plot is more diverse than the alluvium plots for indices that weight evenness (relative abundance) equal to or higher than species richness (Figure 4).

Table 2. Contributions of smaller-stem size classes to species richness and basal area.

Attribute	Ridge	Slope	Alluvium 1	Alluvium 2
Maximum Elevation (m)	330	130	60	50
Individuals <10cm DBH				
Species	15	28	14	15
% of Plot S	18	26.4	12.3	14.7
% Increase in S	21.4	35.9	14	17.2
% of Total Basal Area	10.7	6.4	3.90	3.3
% of Total Stems	52	50	54	47
Individuals <20cm DBH				
Species	81	97	84	79
% of Plot S	95	92	74	77
% of Total Basal Area	38.8	21.9	11.5	10.6
% of Total Stems	86	79	75	69

Species Composition

The ridge plot is the most unique plot in species composition, sharing only 20% of species with the slope and only 9-11% of species with the alluvium plots. As might be expected, the slope plot is intermediate in similarity to the plots on its neighboring topographic positions. The alluvium plots, being in the same habitat, share the highest similarity values between plots, however they only share just over half of their species.

Table 3. Jaccard indices of similarity (proportions of shared species) between plots.

	Ridge	Slope	Alluvium 1	Alluvium 2
Ridge	1	0.20	0.11	0.09
Slope	0.20	1	0.37	0.34
Alluvium 1	0.11	0.37	1	0.55
Alluvium 2	0.09	0.34	0.55	1

Of the 272 species among all of the plots, 72 (approximately 32%) are restricted to northern Mesoamerica (including the Greater Antilles). Of these species with restricted distributions, 43% were confined to the ridge plot, and 15% each were found only in the slope and alluvium plots. In effect the ridges, being on the most exposed limestone, best represent the factors that have promoted the evolution of species adapted to those conditions found primarily in northern Mesoamerica: unusually higher drainage, pH, and calcium levels than soils on the other substrata (e.g., volcanics, granite, and metasediments) that are widespread throughout the Neotropics. The ridge and slope plots together have the vast majority of these restricted species (68%).

NOTABLE SPECIES

The species profiles below are compiled from those species, discovered in the plots, which are notable because of their rarity, restricted distributions, and/or ecological importance. The importance of plot inventories in discovering rare species cannot be overstated: systematically surveying delineated areas is the most efficient and oftentimes only feasible means of uncovering those species that otherwise would go unnoticed, even after general collecting efforts have been made. The Bladen Nature Reserve has a high proportion of species with very restricted distributions and/or that are rare.

***Annona primigenia* Standl. & Steyerm.**

This species is common in Cayo district but rare in Toledo, where it has been collected only twice (both in the Bladen Nature Reserve, including once on the ridge plot). It is restricted to limestone hilltops in Toledo, in conditions much more like the Cayo (dry limestone) than the rest of the southeastern Maya Mountains.

***Bartholomaea sessiliflora* (Standl.) Standl. & Steyerm.**

The genus name of this species honors Bartolomé de las Casas, "Protector of the Indians". This species is dioecious (with separate male and female individuals, a condition found in only 6% of flowering plant species). It is also regionally rare: it is known from very limited areas in Mexico, Guatemala, and a few limestone ridges in the Bladen Nature Reserve, Belize.

***Beilschmiedia hondurensis* Kosterm.**

This species from the avocado family was previously known only from a few collections in the Columbia Forest Reserve before being collected by Brewer and Stott in the slope plot. It is extremely rare in every country in which it has been found, except Mexico from which most of the known individuals occur. The type specimen was collected in Belize near the Guatemala-Belize Border.

***Bonellia longifolia* (Standl.) B. Ståhl & Källersjö**

Previously placed in *Jacquinia* in the Theophrastaceae, this species is uncommon throughout its range, which extends just into northern Nicaragua. Only three collections have been made from Belize, two of which are in or adjacent to the Bladen Nature Reserve, the other from the Jacinto Hills of Toledo in 1932). Also unusual is that this species is typically is found in dry, deciduous forests of the Yucatan/Quintana Roo, and the Pacific El Salvador/Nicaragua.

Caesalpinia violacea (Mill.) Standl.

This species is unusual in several ways. The wood yields a red dye which, according to Standley's (1930) Flora of the Yucatan: "It is said that this pigment is the one used by the ancient Mayas for imprinting the celebrated "red hand" found on the interior walls of some of the ancient ruined buildings". This species is primarily of the Greater Antilles (Cuba, Hispaniola, Jamaica), however it is common in the Mexican Yucatan peninsula (including Campeche).

The history of this species' occurrence in Belize is equally mysterious. Standley and Steyermark mention *C.* violacea (in their 'Flora of Guatemala') as occurring in Belize, but apparently no specimens have ever been cited for its occurrence in this country. Dwyer & Spellman's 1981 checklist of the Dicotyledoneae of Belize and Balick et al.'s 1999 'Checklist of the vascular plants of Belize' both only cite Standley & Steyermark for proof of its occurrence in Belize. The specimens collected from the Bladen Nature Reserve may constitute the only vouchers for the existence of this species in Belize.

Casimiroa tetrameria Millsp.

Previously collected in Belize only once, by Percy Gentle in 1931 (no locality given), this species is extremely rare outside of Mexico and confined to northern Central America. In addition to the individual collected in the ridge plot, several individuals were located in the area of the plot. Otherwise, no one has seen this species elsewhere in Belize since Gentle's collection.

Chiangiodendron mexicanum T. Wendt

This species has unusual disjunct distributions (occurs in very limited locations that are widely separated) among southeastern Mexico, a few locations in pacific Costa Rica, and one location (so far as known) in the northeastern corner of the Bladen Nature Reserve. In the Bladen Nature Reserve, fewer than twenty individuals have been found so far, all within an areas of less than 2 km^2.

Coccoloba diversifolia Jacq.

Curiously this species has only been documented from three collections in the Toledo district, however Brewer has observed this species as being common in Cayo, Belize, and Corozol Districts, perhaps reflecting how poorly studied are the limestone forests of Belize. One of the most abundant species in the ridge plot (1st in N, 4th in biomass), this species exemplifies the strong floristic affinities that Belizean limestone forests have with the Greater Antilles.

Eugenia chahalana Lundell

This species is known only from the northeastern Bladen Nature Reserve, where it is one of the most common understory trees on upper limestone slopes and hill tops, and from north-central Guatemala. The genus *Eugenia* is particularly diverse and dominant in all kinds of forest in Belize, however particular species appear to be segregated by geological substrate.

Glossostipula concinna (Standl.) Lorence

In Belize *Glossostipula concinna* is confined to the Bladen Nature Reserve, where it is a characteristic species of limestone ridge- and hill-tops. The species appears to be confined to a few locations in northern Mesoamerica; two specimens reportedly belonging to this species from Panama and Nicaragua are apparently done so in error. This species is capable of root-sprouting and has a very distinctly sinuously fluted-fenestrated trunk with spreading branches that are capable of rooting where they touch the soil surface after elongate branches has drooped down to the ground.

***Guettarda davidseorum* Lorence**

Guettarda davidseorum was described as a species new to science in 2001 and is only known from limestone hilltops in in the Bladen Nature Reserve. Previously to Brewer and Stott's collection from the ridge plot, the fruits were unknown because the species had only been collected in flower. The fruits are distinctive and have a red-velvety appearance.

***Licaria areolata* Lundell**

Prior to two collections by Brewer in the Bladen Nature Reserve, this species was known only from the type specimen collected nearly a half-century ago in Guatemala. This is one of the less-common species on the slope plot.

***Lonchocarpus schiedeanus* (Schltdl.) Harms**

Lonchocarpus schiedeanus occurs from Mexico to Panama, however its presence in Belize has only recently been documented: from the BFREE reserve (Brewer in 2011) and the Bladen Nature Reserve (Brewer & Stott in 2014) of Toledo District, and the coastal hills of the Belize District (Brewer in 2014). It is apparently quite rare in Belize and restricted to limestone and alluvium over limestone.

***Lysiloma auritum* (Schltdl.) Benth.**

This species occurs primarily on the pacific side of Central America, from southeastern Mexico to northwestern Costa Rica. It's occurrence in Belize has only been documented from a couple of specimens from the Bladen Nature Reserve (Brewer & Stott 6811) and The Cockscomb Basin Wildlife Preserve (Brewer & Goodwin 4188).

***Macrolobium* sp. nov.**

Two individuals of this species are currently known, both from the northeastern Bladen Nature Reserve, and one of these is in the slope plot. The species has only been collected in non-reproductive condition, but the species is by all indications new to science and is a new record of the genus for Belize. The species vegetatively superficially resembles *Macrolobium costaricense.* The slope plot individual is massive and easily exceeds 45m in height.

***Malpighia souzae* Miranda**

This species is of low abundance on the slope plot, however it was previously known from only three collections made over a half-century ago in a small area near Edwards Central road in the Columbia Forest Reserve. The species appears to be uncommon in the Yucatan peninsula, from where the type specimen originates. The fruits are quite edible and are unusually large for the genus.

***Mortoniella pittieri* Woodson**

This species is so unusual it was describe twice by the same person in the space of nine years. It is found in central Nicaragua, in a small area on the Costa Rica/Nicaragua border, and in the northeastern Bladen Nature Reserve in the Alluvium plots. Perhaps its wind-dispersed seeds account for the large disjunction in its distribution.

Mortoniodendron vestitum Lundell

Mortoniodendron vestitum is a rather poorly known species for Belize and illustrates how plots studies uncover cryptic and less common species. It has been collected only a few times in the Bladen Nature Reserve (Toledo) and once in the Runaway Creek Nature Reserve (Belize), all collections from permanent plots and leading to discoveries in Cayo district. This tree is capable of being very large, as illustrated from individuals in the slope and alluvium plots.

Ottoschulzia pallida Lundell

Ottoschulzia pallida is one of the most abundant tree species on limestone ridges (12^{th} and 4^{th} in numbers and biomass, respectively in the ridge plot) in the Bladen Nature Reserve, the only location for which this species is known in Belize. Outside of the BNR, the species is known from only a few locations in Guatemala and Quintana Roo, being most common in The state of Campeche, Mexico. The genus is primarily Caribbean in distribution.

Oxandra belizensis (Lundell) Lundell

Originally described by C. Lundell in 1941 as *Amyris belizensis* Lundell in the Rutaceae (Citrus family), based on a sterile specimen, Lundell transferred the species to the genus *Oxandra* in the Annonaceae (Soursop family) in 1974, apparently after examining specimens for describing other species in the genus. (Balick et. al (1999)'s checklist of the flora of Belize missed this transfer.) *Oxandra proctori*, the only other species of *Oxandra* listed in Balick et. al (1999) is likely a synonym for *Oxandra belizensis.* The revision of the genus *Oxandra* is scheduled to be finished in 2014.

Plinia peroblata (Lundell) Lundell

This species is endemic to Belize. *Plinia peroblata* was first collected near the Hummingbird Highway in 1955 by Percy Gentle and was not collected again for nearly 50 more years, when Brewer collected it in the Alluvium plots in the Bladen Nature Reserve. The species tends to be an understory tree and is found mostly near streams.

Prunus myrtifolia (L.) Urb.

Prunus is the same genus that includes plums, cherries, peaches, nectarines, apricots and almonds. The tropical species are being revised for the Flora Mesoamericana project, and it appears that the names *Prunus lundelliana* and *P. tikalana* are synonyms of *Prunus myrtifolia.* This species is notable because of its preference for limestone ridges and the highest ridges on soils derived from volcanics and sedimentary rocks. Although it has a widespread distribution in the Neotropics, it is apparently restricted at the local scale (confined to a few limited locations in the countries in which it is found).

Randia genipifolia (Standl. & Steyerm.) Lorence

This species is has a very limited distribution, being confined to a small area of the eastern Petén and the southeastern Maya Mountains as well as the littoral zone forests near the mouth of the Rio Grande. It appears to be very uncommon where found.

Sideroxylon floribundum Griseb.

Sideroxylon floribundum is very limited in its distribution in southeastern Mexico, Petén (Guatemala), Jamaica and the Toledo District, Belize. It appears to be confined to upper slopes and ridges of limestone in southeastern Belize.

APPENDICES

Appendix 1. Families sorted by number of species for the plots (number of families in parentheses).

RIDGE (36)		SLOPE (45)		ALLUVIUM 1 (45)		ALLUVIUM 2 (43)	
Fabaceae	10	Fabaceae	12	Fabaceae	13	Fabaceae	14
Rubiaceae	9	Lauraceae	8	Rubiaceae	10	Rubiaceae	8
Myrtaceae	6	Rubiaceae	8	Sapotaceae	7	Sapotaceae	7
Sapotaceae	5	Sapotaceae	7	Lauraceae	6	Apocynaceae	6
Euphorbiaceae	4	Meliaceae	6	Meliaceae	6	Moraceae	6
Sapindaceae	4	Moraceae	6	Apocynaceae	5	Meliaceae	5
Apocynaceae	3	Apocynaceae	3	Melastomataceae	4	Annonaceae	4
Lauraceae	3	Arecaceae	3	Annonaceae	3	Lauraceae	4
Moraceae	3	Malvaceae	3	Burseraceae	3	Malvaceae	4
Salicaceae	3	Myrtaceae	3	Chrysobalanaceae	3	Boraginaceae	3
Anacardiaceae	2	Salicaceae	3	Euphorbiaceae	3	Euphorbiaceae	3
Arecaceae	2	Sapindaceae	3	Malvaceae	3	Palmae	3
Burseraceae	2	Urticaceae	3	Moraceae	3	Salicaceae	3
Clusiaceae	2	Anacardiaceae	2	Palmae	3	Anacardiaceae	2
Combretaceae	2	Annonaceae	2	Rutaceae	3	Burseraceae	2
Malpighiaceae	2	Boraginaceae	2	Salicaceae	3	Rutaceae	2
Oleaceae	2	Burseraceae	2	Sapindaceae	3	Urticaceae	2
Polygonaceae	2	Combretaceae	2	Anacardiaceae	2	Bignoniaceae	1
Rutaceae	2	Euphorbiaceae	2	Boraginaceae	2	Bombacaceae	1
Annonaceae	1	Malpighiaceae	2	Combretaceae	2	Calophyllaceae	1
Bignoniaceae	1	Putranjivaceae	2	Flacourtiaceae	2	Cannabaceae	1
Celastraceae	1	Achariaceae	1	Myristicaceae	2	Caricaceae	1
Chrysobalanaceae	1	Actinidaceae	1	Tiliaceae	2	Chrysobalanaceae	1
Ebenaceae	1	Araliaceae	1	Urticaceae	2	Clusiaceae	1
Icacinaceae	1	Calophyllaceae	1	Araliaceae	1	Combretaceae	1
Malvaceae	1	Caricaceae	1	Bignoniaceae	1	Elaeocarpaceae	1
Meliaceae	1	Chrysobalanaceae	1	Bombacaceae	1	Flacourtiaceae	1
Menispermaceae	1	Clusiaceae	1	Cannabaceae	1	Lamiaceae	1
Ochnaceae	1	Ebenaceae	1	Capparidaceae	1	Melastomataceae	1
Pentaphylacaceae	1	Melastomataceae	1	Caricaceae	1	Myristicaceae	1
Primulaceae	1	Myristicaceae	1	Clusiaceae	1	Myrtaceae	1
Rhamnaceae	1	Nyctaginaceae	1	Ebenaceae	1	Olacaceae	1
Rosaceae	1	Ochnaceae	1	Elaeocarpaceae	1	Oleaceae	1
Simaroubaceae	1	Olacaceae	1	Malpighiaceae	1	Piperaceae	1
Turneraceae	1	Oleaceae	1	Olacaceae	1	Polygonaceae	1
Verbenaceae	1	Picramniaceae	1	Oleaceae	1	Putranjivaceae	1
		Piperaceae	1	Piperaceae	1	Rhizophoraceae	1
		Polygonaceae	1	Polygonaceae	1	Sapindaceae	1
		Rhamnaceae	1	Putranjivaceae	1	Tiliaceae	1
		Rhizophoraceae	1	Rhizophoraceae	1	Ulmaceae	1
		Simaroubaceae	1	Simaroubaceae	1	Verbenaceae	1
		Ulmaceae	1	Ulmaceae	1		
		Violaceae	1	Violaceae	1		

Appendix 2. Taxa identified in the ridge plot, sorted by plant family.

Species sorted by Family	**Family**
Astronium graveolens Jacq.	Anacardiaceae
Metopium brownei (Jacq.) Urb.	Anacardiaceae
Annona primigenia Standl. & Steyerm.	Annonaceae
Aspidosperma megalocarpon Müll. Arg.	Apocynaceae
Aspidosperma spruceanum Benth. ex Müll. Arg.	Apocynaceae
Plumeria rubra L.	Apocynaceae
Cryosophila stauracantha (Heynh.) R. Evans	Arecaceae
Sabal mauritiiformis (H. Karst.) Griseb. & H. Wendl.	Arecaceae
Tabebuia chrysantha (Jacq.) G. Nicholson	Bignoniaceae
Bursera simaruba (L.) Sarg.	Burseraceae
Protium copal (Schltdl. & Cham.) Engl.	Burseraceae
Wimmeria bartlettii Lundell	Celastraceae
Hirtella americana L.	Chrysobalanaceae
Calophyllum brasiliense Cambess.	Clusiaceae
Clusia rosea Jacq.	Clusiaceae
Bucida buceras L.	Combretaceae
Byrsonima bucidifolia Standl.	Combretaceae
Diospyros salicifolia Humb. & Bonpl. ex Willd.	Ebenaceae
Croton arboreus Millsp.	Euphorbiaceae
Drypetes lateriflora (Sw.) Krug & Urb.	Euphorbiaceae
Gymnanthes lucida Sw.	Euphorbiaceae
Sebastiania tuerckheimiana (Pax & K. Hoffm.) Lundell	Euphorbiaceae
Acacia cookii Saff.	Fabaceae
Acacia gentlei Standl.	Fabaceae
Caesalpinia violacea (Mill.) Standl.	Fabaceae
Erythrina berteroana Urb.	Fabaceae
Lecointea amazonica Ducke	Fabaceae
Lonchocarpus guatemalensis Benth.	Fabaceae
Lonchocarpus schiedeanus (Schltdl.) Harms	Fabaceae
Lysiloma latisiliquum (L.) Benth.	Fabaceae
Pterocarpus rohrii Vahl	Fabaceae
Swartzia cubensis (Britton & P. Wilson) Standl.	Fabaceae
Ottoschulzia pallida Lundell	Icacinaceae
Licaria peckii (I.M. Johnst.) Kosterm.	Lauraceae
Nectandra coriacea (Sw.) Griseb.	Lauraceae
Ocotea sp. cf.	Lauraceae
Bunchosia lindeniana A. Juss.	Malpighiaceae
Bunchosia swartziana Griseb.	Malpighiaceae
Pseudobombax ellipticoideum A. Robyns	Malvaceae
Swietenia macrophylla King	Meliaceae
Hyperbaena mexicana Miers	Menispermaceae
Ficus obtusifolia Kunth	Moraceae
Ficus crassinervia Desf. ex Willd.	Moraceae
Pseudolmedia spuria (Sw.) Griseb.	Moraceae

Appendix 2 (con'td.) Taxa identified in the ridge plot, sorted by plant family.

Species sorted by Family	**Family**
Eugenia aeruginea DC.	Myrtaceae
Eugenia chahalana Lundell	Myrtaceae
Eugenia sp. 1	Myrtaceae
Eugenia sp. 2	Myrtaceae
Eugenia sp. 3	Myrtaceae
Eugenia sp. 4	Myrtaceae
Ouratea lucens (Kunth) Engl.	Ochnaceae
Chionanthus oblanceolatus (B.L. Rob.) P.S. Green	Oleaceae
Chionanthus panamensis (Standl.) Stearn	Oleaceae
Ternstroemia tepezapote Schltdl. & Cham.	Pentaphylacaceae
Coccoloba acapulcensis Standl.	Polygonaceae
Coccoloba diversifolia Jacq.	Polygonaceae
Bonellia longifolia (Standl.) B. Ståhl & Källersjö	Primulaceae
Krugiodendron ferreum (Vahl) Urb.	Rhamnaceae
Prunus myrtifolia (L.) Urb.	Rosaceae
Exostema mexicanum A. Gray	Rubiaceae
Glossostipula concinna (Standl.) Lorence	Rubiaceae
Guettarda combsii Urb.	Rubiaceae
Guettarda davidseorum Lorence	Rubiaceae
Machaonia lindeniana Baill.	Rubiaceae
Morinda panamensis Seem.	Rubiaceae
Randia petenensis Lundell	Rubiaceae
Rubiaceae 7143	Rubiaceae
Stenostomum lucidum (Sw.) C.F. Gaertn.	Rubiaceae
Casimiroa tetrameria Millsp.	Rutaceae
Zanthoxylum procerum Donn. Sm.	Rutaceae
Bartholomaea sessiliflora (Standl.) Standl. & Steyerm.	Salicaceae
Casearia tremula (Griseb.) Griseb. ex C. Wright	Salicaceae
Laetia thamnia L.	Salicaceae
Allophylus cominia (L.) Sw.	Sapindaceae
Allophylus psilospermus Radlk.	Sapindaceae
Exothea paniculata (Juss.) Radlk.	Sapindaceae
Matayba apetala Radlk.	Sapindaceae
Manilkara chicle (Pittier) Gilly	Sapotaceae
Manilkara staminodella Gilly	Sapotaceae
Pouteria amygdalina (Standl.) Baehni	Sapotaceae
Pouteria reticulata (Engl.) Eyma	Sapotaceae
Sideroxylon floribundum Griseb.	Sapotaceae
Simarouba amara Aubl.	Simaroubaceae
Erblichia odorata Seem.	Turneraceae
Rehdera penninervia Standl. & Moldenke	Verbenaceae

Appendix 3. Ridge Plot species sorted by number of stems (N) and by basal area (an index of biomass equal to the sum of the cross-sectional areas of stems, in cm^2).

Rank	Species sorted by N	N	Species sorted by BA	BA (cm^2)
1	*Coccoloba diversifolia*	204	*Manilkara staminodella*	59892
2	*Eugenia aeruginea*	198	*Metopium brownei*	48599
3	*Pouteria reticulata*	154	*Glossostipula concinna*	38556
4	*Eugenia chahalana*	144	*Coccoloba diversifolia*	31971
5	*Metopium brownei*	131	*Ottoschulzia pallida*	19544
6	*Glossostipula concinna*	119	*Lysiloma latisiliquum*	18963
7	*Laetia thamnia*	88	*Bucida buceras*	17988
8	*Protium copal*	77	*Pouteria amygdalina*	17836
9	*Prunus myrtifolia*	75	*Pouteria reticulata*	16278
10	*Pseudolmedia spuria*	71	*Prunus myrtifolia*	15576
11	*Lonchocarpus guatemalensis*	70	*Bursera simaruba*	13238
12	*Ottoschulzia pallida*	65	*Eugenia chahalana*	13234
13	*Guettarda combsii*	61	*Lonchocarpus guatemalensis*	12738
14	*Cryosophila stauracantha*	59	*Eugenia aeruginea*	11578
15	*Bursera simaruba*	52	*Byrsonima bucidifolia*	11525
16	*Drypetes lateriflora*	52	*Ficus crassinervia*	10908
17	*Pouteria amygdalina*	51	*Protium copal*	10478
18	*Manilkara staminodella*	48	*Sideroxylon floribundum*	10074
19	*Croton arboreus*	39	*Calophyllum brasiliense*	8511
20	*Bartholomaea sessiliflora*	38	*Pterocarpus rohrii*	7783
21	*Byrsonima bucidifolia*	34	*Guettarda combsii*	7015
22	*Pterocarpus rohrii*	31	*Laetia thamnia*	5677
23	*Nectandra coriacea*	28	*Drypetes lateriflora*	5518
24	*Ouratea lucens*	27	*Erythrina berteroana*	5050
25	*Acacia gentlei*	26	*Pseudobombax ellipticoideum*	4470
26	*Matayba apetala*	26	*Pseudolmedia spuria*	4454
27	*Bucida buceras*	25	*Matayba apetala*	4214
28	*Aspidosperma spruceanum*	22	*Acacia gentlei*	3955
29	*Sideroxylon floribundum*	22	*Aspidosperma spruceanum*	3335
30	*Exostema mexicanum*	19	*Croton arboreus*	3005
31	*Hirtella americana*	19	*Wimmeria bartlettii*	2881
32	*Lysiloma latisiliquum*	19	*Bartholomaea sessiliflora*	2728
33	*Zanthoxylum procerum*	19	*Cryosophila stauracantha*	2624
34	*Pseudobombax ellipticoideum*	17	*Ternstroemia tepezapote*	2443
35	*Calophyllum brasiliense*	15	*Simarouba amara*	2378
36	*Erythrina berteroana*	15	*Chionanthus panamensis*	2292
37	*Guettarda davidseorum*	13	*Bonellia longifolia*	2265
38	*Casearia tremula*	12	*Exostema mexicanum*	2264
39	*Gymnanthes lucida*	12	*Zanthoxylum procerum*	2203
40	*Ternstroemia tepezapote*	11	*Krugiodendron ferreum*	2057
41	*Bunchosia swartziana*	10	*Nectandra coriacea*	1959
42	*Randia petenensis*	10	*Swartzia cubensis*	1780
43	*Wimmeria bartlettii*	9	*Ouratea lucens*	1570
44	*Simarouba amara*	8	*Hirtella americana*	1395
45	*Chionanthus panamensis*	7	*Sebastiania tuerckheimiana*	1096

Appendix 3 (cont'd). Ridge Plot species sorted by number of stems (N) and by basal area.

Rank	Species by Stems	N	Species by Basal Area	BA (cm^2)
46	*Krugiodendron ferreum*	7	*Gymnanthes lucida*	989
47	*Swartzia cubensis*	7	*Exothea paniculata*	891
48	*Bonellia longifolia*	5	*Manilkara chicle*	877
49	*Allophylus cominia*	4	Rubiaceae 7143	839
50	*Eugenia* sp. 1	4	*Guettarda davidseorum*	778
51	*Manilkara chicle*	4	*Plumeria rubra*	774
52	*Sebastiania tuerckheimiana*	4	*Morinda panamensis*	703
53	*Chionanthus oblanceolatus*	3	*Casearia tremula*	633
54	*Coccoloba acapulcensis*	3	*Ocotea* sp. cf.	547
55	*Exothea paniculata*	3	*Sabal mauritiiformis*	449
56	*Ficus crassinervia*	3	*Randia petenensis*	434
57	Rubiaceae 7143	3	*Lonchocarpus schiedeanus*	376
58	*Stenostomum lucidum*	3	*Coccoloba acapulcensis*	375
59	*Allophylus* psilospermus	2	*Machaonia lindeniana*	355
60	*Annona primigenia*	2	*Casimiroa tetrameria*	340
61	*Diospyros salicifolia*	2	*Allophylus cominia*	335
62	*Erblichia odorata*	2	*Stenostomum lucidum*	283
63	*Eugenia* sp. 2	2	*Bunchosia swartziana*	282
64	*Eugenia* sp. 3	2	*Erblichia odorata*	263
65	*Hyperbaena mexicana*	2	*Swietenia macrophylla*	240
66	*Lecointea amazonica*	2	*Ficus obtusifolia*	232
67	*Lonchocarpus schiedeanus*	2	*Licaria peckii*	167
68	*Morinda panamensis*	2	*Eugenia* sp. 1	162
69	*Sabal mauritiiformis*	2	*Allophylus* psilospermus	154
70	*Swietenia macrophylla*	2	*Lecointea amazonica*	143
71	*Tabebuia chrysantha*	2	*Acacia cookii*	125
72	*Acacia cookii*	1	*Chionanthus oblanceolatus*	114
73	*Aspidosperma megalocarpon*	1	*Aspidosperma megalocarpon*	111
74	*Astronium graveolens*	1	*Annona primigenia*	103
75	*Bunchosia lindeniana*	1	*Eugenia* sp. 2	93
76	*Caesalpinia violacea*	1	*Eugenia* sp. 3	89
77	*Casimiroa tetrameria*	1	*Diospyros salicifolia*	77
78	*Clusia rosea*	1	*Caesalpinia violacea*	65
79	*Eugenia* sp. 4	1	*Rehdera penninervia*	58
80	*Ficus obtusifolia*	1	*Hyperbaena mexicana*	51
81	*Licaria peckii*	1	*Tabebuia chrysantha*	48
82	*Machaonia lindeniana*	1	*Eugenia* sp. 4	45
83	*Ocotea* sp. cf.	1	*Clusia rosea*	28
84	*Plumeria rubra*	1	*Astronium graveolens*	25
85	*Rehdera penninervia*	1	*Bunchosia lindeniana*	21

Appendix 4. Taxa identified in the slope plot, sorted by plant family.

Species sorted by Family	Family
Chiangiodendron mexicanum T. Wendt	Achariaceae
Saurauia yasicae Loes.	Actinidaceae
Astronium graveolens Jacq.	Anacardiaceae
Spondias radlkoferi Donn. Sm.	Anacardiaceae
Cymbopetalum mayanum Lundell	Annonaceae
Oxandra belizensis (Lundell) Lundell	Annonaceae
Aspidosperma megalocarpon Müll. Arg.	Apocynaceae
Aspidosperma spruceanum Benth. ex Müll. Arg.	Apocynaceae
Stemmadenia donnell-smithii (Rose) Woodson	Apocynaceae
Dendropanax arboreus (L.) Decne. & Planch.	Araliaceae
Astrocaryum mexicanum Liebm. ex Mart.	Arecaceae
Cryosophila stauracantha (Heynh.) R. Evans	Arecaceae
Sabal mauritiiformis (H. Karst.) Griseb. & H. Wendl.	Arecaceae
Bourreria mollis Standl. c.f.	Boraginaceae
Cordia stellifera I. M. Johnst.	Boraginaceae
Bursera simaruba (L.) Sarg.	Burseraceae
Protium copal (Schltdl. & Cham.) Engl.	Burseraceae
Calophyllum brasiliense Cambess.	Calophyllaceae
Jacaratia dolichaula (Donn. Sm.) Woodson	Caricaceae
Hirtella americana L.	Chrysobalanaceae
Garcinia intermedia (Pittier) Hammel	Clusiaceae
Terminalia amazonia (J.F. Gmel.) Exell	Combretaceae
Terminalia oblonga (Ruiz & Pav.) Steud.	Combretaceae
Diospyros digyna Jacq.	Ebenaceae
Adelia barbinervis Schltdl. & Cham.	Euphorbiaceae
Sebastiania tuerckheimiana (Pax & K. Hoffm.) Lundell	Euphorbiaceae
Acacia gentlei Standl.	Fabaceae
Andira inermis (W. Wright) DC.	Fabaceae
Bauhinia divaricata L.	Fabaceae
Dialium guianense (Aubl.) Steud.	Fabaceae
Lecointea amazonica Ducke	Fabaceae
Lonchocarpus schiedeanus (Schltdl.) Harms	Fabaceae
Lysiloma auritum (Schltdl.) Benth.	Fabaceae
Macrolobium sp.	Fabaceae
Myroxylon balsamum (L.) Harms	Fabaceae
Ormosia schippii Pierce ex Standl. & Steyerm.	Fabaceae
Swartzia simplex Spreng. (*S. ochnacea*)	Fabaceae
Vatairea lundellii (Standl.) Killip ex Record	Fabaceae
Beilschmiedia hondurensis Kosterm. c.f.	Lauraceae
Cinnamomum triplinerve (Ruiz & Pav.) Kosterm.	Lauraceae
Lauraceae	Lauraceae
Licaria areolata Lundell	Lauraceae
Nectandra lundellii C.K. Allen	Lauraceae
Nectandra salicifolia (Kunth) Nees	Lauraceae
Ocotea cernua (Nees) Mez	Lauraceae
Ocotea veraguensis (Meisn.) Mez	Lauraceae

Appendix 4 (cont'd.). Taxa identified in the slope plot, sorted by plant family.

Species sorted by Family	Family
Bunchosia lindeniana A. Juss.	Malpighiaceae
Malpighia souzae Miranda	Malpighiaceae
Mortoniodendron vestitum Lundell	Malvaceae
Quararibea funebris (La Llave) Vischer	Malvaceae
Trichospermum mexicanum (DC.) Baill.	Malvaceae
Mouriri myrtilloides (Sw.) Poir.	Melastomataceae
Cedrela odorata L.	Meliaceae
Guarea petenensis Coronado	Meliaceae
Guarea tuerckheimii C. DC.	Meliaceae
Trichilia minutiflora Standl.	Meliaceae
Trichilia moschata Sw.	Meliaceae
Trichilia pallida Sw.	Meliaceae
Brosimum alicastrum Sw.	Moraceae
Castilla elastica Sessé	Moraceae
Ficus insipida Willd.	Moraceae
Ficus obtusifolia Kunth	Moraceae
Pseudolmedia spuria (Sw.) Griseb.	Moraceae
Trophis mexicana (Liebm.) Bureau	Moraceae
Compsoneura mexicana (Hemsl.) Janovec	Myristicaceae
Eugenia aeruginea DC.	Myrtaceae
Pimenta dioica (L.) Merr.	Myrtaceae
Plinia peroblata (Lundell) Lundell	Myrtaceae
Neea psychotrioides Donn. Sm.	Nyctaginaceae
Ouratea lucens (Kunth) Engl.	Ochnaceae
Heisteria media S. F. Blake	Olacaceae
Chionanthus oblanceolatus (B. L. Rob.) P. S. Green	Oleaceae
Picramnia antidesma Sw.	Picramniaceae
Piper schippianum Trel. ex Standl.	Piperaceae
Coccoloba diversifolia Jacq.	Polygonaceae
Drypetes brownii Standl.	Putranjivaceae
Drypetes lateriflora (Sw.) Krug & Urb.	Putranjivaceae
Krugiodendron ferreum (Vahl) Urb.	Rhamnaceae
Cassipourea guianensis Aubl.	Rhizophoraceae
Alseis yucatanensis Standl.	Rubiaceae
Faramea occidentalis (L.) A. Rich.	Rubiaceae
Guettarda combsii Urb.	Rubiaceae
Morinda panamensis Seem.	Rubiaceae
Palicourea tetragona (Donn. Sm.) C.M. Taylor & Lorence	Rubiaceae
Posoqueria latifolia (Rudge) Roem. & Schult.	Rubiaceae
Simira salvadorensis Standl.	Rubiaceae
Stenostomum lucidum (Sw.) C.F. Gaertn.	Rubiaceae
Casearia commersoniana Cambess.	Salicaceae
Laetia thamnia L.	Salicaceae
Pleuranthodendron lindenii (Turcz.) Sleumer	Salicaceae
Cupania belizensis Standl.	Sapindaceae
Exothea paniculata (Juss.) Radlk.	Sapindaceae
Talisia oliviformis (Kunth) Radlk.	Sapindaceae

Appendix 4 (cont'd.). Taxa identified in the slope plot, sorted by plant family.

Species sorted by Family	Family
Chrysophyllum venezuelanense (Pierre) T. D. Penn.	Sapotaceae
Manilkara chicle (Pittier) Gilly	Sapotaceae
Manilkara staminodella Gilly	Sapotaceae
Pouteria amygdalina (Standl.) Baehni	Sapotaceae
Pouteria campechiana (H.B.K.) Baehni	Sapotaceae
Pouteria durlandii (Standl.) Baehni	Sapotaceae
Pouteria reticulata (Engl.) Eyma	Sapotaceae
Simarouba amara Aubl.	Simaroubaceae
Ampelocera hottlei (Standl.) Standl.	Ulmaceae
Cecropia peltata L.	Urticaceae
Coussapoa oligocephala Donn. Sm.	Urticaceae
Myriocarpa obovata Donn. Sm.	Urticaceae
Rinorea hummelii Sprague	Violaceae

Appendix 5. Slope Plot species sorted by number of stems (N) and by basal area (an index of biomass equal to the sum of the cross-sectional areas of stems, in cm^2).

Rank	Species by Stems	N	Species by Basal Area	BA (cm^2)
1	Acacia gentlei	19	*Cedrela odorata*	11122
2	Adelia barbinervis	1	*Diospyros digyna*	12947
3	Alseis yucatanensis	17	*Brosimum alicastrum*	26376
4	Ampelocera hottlei	8	*Manilkara staminodella*	12540
5	Andira inermis	1	*Mortoniodendron vestitum*	7399
6	Aspidosperma megalocarpon	3	*Alseis yucatanensis*	14804
7	Aspidosperma spruceanum	50	*Drypetes brownii*	47308
8	Astrocaryum mexicanum	58	*Macrolobium sp.*	4536
9	Astronium graveolens	3	*Dialium guianense*	7869
10	Bauhinia divaricata	9	*Calophyllum brasiliense*	5704
11	Beilschmiedia hondurensis	1	*Pleuranthodendron lindeni*	2725
12	Bourreria mollis	1	*Stenostomum lucidum*	15438
13	Brosimum alicastrum	8	*Coussapoa oligocephala*	2359
14	Bunchosia lindeniana	1	*Dendropanax arboreus*	9926
15	Bursera simaruba	1	*Aspidosperma spruceanum*	11374
16	Calophyllum brasiliense	6	*Chrysophyllum venezuelanense*	5086
17	Casearia commersoniana	1	*Pouteria amygdalina*	5766
18	Cassipourea guianensis	5	*Pouteria reticulata*	16884
19	Castilla elastica	1	*Pimenta dioica*	3844
20	Cecropia peltata	29	*Manilkara chicle*	4051
21	Cedrela odorata	1	*Krugiodendron ferreum*	2938
22	Chiangiodendron mexicanum	4	*Aspidosperma megalocarpon*	2011
23	Chionanthus oblanceolatus	24	*Andira inermis*	1439
24	Chrysophyllum venezuelanense	9	*Terminalia amazonia*	1457
25	Cinnamomum triplinerve	1	*Terminalia oblonga*	1392
26	Coccoloba diversifolia	2	*Chiangiodendron mexicanum*	1838
27	Compsoneura mexicana	23	*Astronium graveolens*	1927
28	Cordia stellifera	2	*Oxandra belizensis*	19804
29	Coussapoa oligocephala	1	*Heisteria media*	11672
30	Cryosophila stauracantha	3	*Quararibea funebris*	18473
31	Cupania belizensis	5	*Sebastiania tuerckheimiana*	5898
32	Cymbopetalum mayanum	2	*Trichilia moschata*	1362
33	Dendropanax arboreus	20	*Pouteria campechiana*	5250
34	Dialium guianense	5	*Bauhinia divaricata*	3814
35	Diospyros digyna	22	*Pseudolmedia spuria*	19955
36	Drypetes brownii	51	*Lecointea amazonica*	1543
37	Drypetes lateriflora	1	*Pouteria durlandii*	3726
38	Eugenia aeruginea	1	*Coccoloba diversifolia*	1726
39	Exothea paniculata	2	*Malpighia souzae*	1941
40	Faramea occidentalis	5	*Licaria areolata*	2077
41	Ficus insipida	1	*Hirtella americana*	941
42	Ficus obtusifolia	1	*Garcinia intermedia*	2707
43	Garcinia intermedia	15	*Trichilia minutiflora*	2057

Appendix 5 (cont'd.). Slope Plot species sorted by number of stems (N) and by basal area

Rank	Species by Stems	N	Species by Basal Area	BA (cm^2)
44	Guarea petenensis	22	*Casearia commersoniana*	581
45	Guarea tuerckheimii	4	*Cecropia peltata*	4187
46	Guettarda combsii	1	*Acacia gentlei*	3454
47	*Heisteria media*	76	*Protium copal*	4775
48	*Hirtella americana*	4	*Lonchocarpus schiedeanus*	661
49	*Jacaratia dolichaula*	2	*Compsoneura mexicana*	1798
50	*Krugiodendron ferreum*	3	*Cordia stellifera*	556
51	*Laetia thamnia*	4	*Sabal mauritiiformis*	2571
52	*Lauraceae*	1	*Guarea tuerckheimii*	558
53	*Lecointea amazonica*	8	*Ocotea veraguensis*	995
54	*Licaria areolata*	6	*Ampelocera hottlei*	737
55	*Lonchocarpus schiedeanus*	4	*Chionanthus oblanceolatus*	1385
56	*Lysiloma auritum*	1	*Ouratea lucens*	553
57	*Macrolobium sp.*	1	*Cupania belizensis*	714
58	*Malpighia souzae*	6	*Neea psychotrioides*	410
59	*Manilkara chicle*	12	*Trophis mexicana*	1090
60	*Manilkara staminodella*	5	*Guarea petenensis*	1433
61	*Morinda panamensis*	3	*Guettarda combsii*	216
62	*Mortoniodendron vestitum*	3	*Myroxylon balsamum*	360
63	*Mouriri myrtilloides*	3	*Morinda panamensis*	289
64	*Myriocarpa obovata*	2	*Nectandra salicifolia*	231
65	*Myroxylon balsamum*	3	*Posoqueria latifolia*	186
66	*Nectandra lundellii*	1	*Beilschmiedia hondurensis*	184
67	*Nectandra salicifolia*	2	*Ormosia schippii Pierce*	212
68	*Neea psychotrioides*	3	*Rinorea hummelii*	1796
69	*Ocotea cernua*	3	*Swartzia simplex*	193
70	*Ocotea veraguensis*	4	*Trichospermum mexicanum*	182
71	*Ormosia schippii Pierce*	2	*Simarouba amara*	135
72	*Ouratea lucens*	3	*Stemmadenia donnell-smithii*	275
73	*Oxandra belizensis*	74	*Lauraceae*	115
74	*Picramnia antidesma*	1	*Cassipourea guianensis*	261
75	*Pimenta dioica*	6	*Lysiloma auritum*	113
76	*Piper schippianum*	11	*Talisia oliviformis*	139
77	*Pleuranthodendron lindeni*	1	*Bursera simaruba*	104
78	*Plinia peroblata*	1	*Spondias radlkoferi*	97
79	*Posoqueria latifolia*	1	*Cryosophila stauracantha*	156
80	*Pouteria amygdalina*	22	*Laetia thamnia*	143
81	*Pouteria campechiana*	21	*Simira salvadorensis*	94
82	*Pouteria durlandii*	19	*Saurauia yasicae*	93
83	*Pouteria reticulata*	79	*Trichilia pallida*	177
84	*Protium copal*	41	*Faramea occidentalis*	176
85	*Pseudolmedia spuria*	134	*Jacaratia dolichaula*	101
86	*Psychotria chiapensis*	1	*Picramnia antidesma*	50
87	*Quararibea funebris*	72	*Bunchosia lindeniana*	49
88	*Rinorea hummelii*	40	*Cinnamomum triplinerve*	48

Appendix 5 (cont'd.). Slope Plot species sorted by number of stems (N) and by basal area

Rank	Species by Stems	N	Species by Basal Area	BA (cm^2)
89	*Sabal mauritiiformis*	10	*Mouriri myrtilloides*	104
90	*Saurauia yasicae*	2	*Myriocarpa obovata*	72
91	*Sebastiania tuerckheimiana*	15	*Ocotea cernua*	177
92	*Simarouba amara*	1	*Nectandra lundellii*	41
93	*Simira salvadorensis*	2	*Astrocaryum mexicanum*	1332
94	*Spondias radlkoferi*	1	*Cymbopetalum mayanum*	57
95	*Stemmadenia donnell-smithii*	3	*Piper schippianum*	344
96	*Stenostomum lucidum*	16	*Ficus insipida*	33
97	*Swartzia simplex*	2	*Plinia peroblata*	33
98	*Talisia oliviformis*	2	*Adelia barbinervis*	31
99	*Terminalia amazonia*	2	*Exothea paniculata*	55
100	*Terminalia oblonga*	1	*Vatairea lundellii*	28
101	*Trichilia minutiflora*	15	*Eugenia aeruginea*	27
102	*Trichilia moschata*	6	*Castilla elastica*	26
103	*Trichilia pallida*	6	*Drypetes lateriflora*	26
104	*Trichospermum mexicanum*	2	*Ficus obtusifolia*	22
105	*Trophis mexicana*	13	*Psychotria chiapensis*	21
106	*Vatairea lundellii*	1	*Bourreria mollis*	20