FLORISTIC, STRUCTURAL AND PHYSIOGNOMIC RECOVERY OF TROPICAL DRY FOREST IN LA JARRETA, PENÍNSULA DE GUANAHACABIBES.

RECUPERACIÓN FLORÍSTICA, ESTRUCTURAL Y FISIONÓMICA DEL BOSQUE TROPICAL SECO EN LA JARRETA, PENÍNSULA DE GUANAHACABIBES.

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Abstract: In La Jarreta, Peninsula of Guanahacabibes, part of the TDF was assimilated for livestock; at the end of this practice, the vegetation has been recovered, giving place to a mosaic of successional phases, which we aim to recognize, delimit, characterize and analyze its spatial-temporal dynamics. Every successional phase was floristic, structural and physiognomically characterized, and also its rate of change between 1980 and 2009. Recovery of vegetation has been evidence regarding to number of species (148 species distributed in 55 families), typical life forms and structure [D. B. H. (from 1.40 to 9.65 ± 1.07 cm.), height (from 0.52 to 7.74 ± 0.74 m), stem density (from 0.50 to 203± 40 No/0.1 ha) and basal area (from 0.003 to 2.29 ± 0.48) arising an increase of vegetation complexity as regeneration advanced. In conclusion, it has shown a recovery of the structure, floristic composition and physiognomy of tropical dry forest from human impacts decreased

Keywords: ecology, natural regeneration, tropical dry forest, successional phases, forest recovery.

Resumen: En La Jarreta, Península de Guanahacabibes, Cuba, parte del BTS fue asimilado para ganadería; al cese de esta actividad, la vegetación se ha recuperado, generando un mosaico de estadíos sucesionales, los cuales pretendemos reconocer, delimitar, caracterizar y analizar su dinámica espacio-temporal. Se caracterizó florística, estructural y fisionómicamente cada estadío sucesional y se analizó su tasa de cambio entre 1980 y 2009. Se evidencia la recuperación de la vegetación, en cuanto a especies (148 especies distribuidas en 55 familias) formas de vida típicas y estructura [D.A.P. (de 1.40 a 9.65 ± 1.07 cm.), altura (de 0.52 a 7.74 ± 0.74 m), densidad de troncos (de 0.50 a 203 ± 40 No/0.1 ha) y área basal (de 0.003 a 2.29 ± 0.48) generando un aumento en la complejidad de la vegetación según avanza la regeneración. En conclusión se ha evidenciado una recuperación de la estructura, composición florística y fisionomía del bosque tropical seco partir de la disminución de impactos antrópicos.

Palabras claves: ecología, regeneración natural, bosque tropical seco, estadíos sucesionales, recuperación del bosque.

Introduction

Degradation of ecosystems as a consequence of human activity is one of the biggest current environmental problems. Particularly tropical dry forest (hereinafter referred as TDF) is the ecosystem most affected by conversion processes, with more than 16% of its cover transformed by settlements and human activities between 1950 and 1990[1].
In the Caribbean area conspicuous extensions of TDF are located in the North of Colombia and Venezuela. Regarding to insular area the ecosystem is highly represented in Cuba, Haití and Dominican Republic[2]. In Cuba, which is the Caribbean country with the largest surface of TDF, i.e. approximately 65745 Km^2, TDF represents 5,7% of the total forest cover of the country[3; 4].

Although TDF has been considered a highly resilient ecosystem, its succession process is slow, and depends on numerous factors such as low rates of plant growth and regeneration, highly seasonal phenology and stresses from regional water regimes[5; 6]. In addition, the presence of anthropogenic intensive impacts can affect and delays forest recovery process.

In the Biosphere Reserve Peninsula of Guanahacabibes several research projects on TDF have addressed its ecology aspects[7; 8], competitive capacity[9], some aspects of natural regeneration[10], ethnobotany[11], and its distribution inside this area[12]. However the forest recovery process in relation to high intensity impacts (e.g. cattle ranching) has not been studied yet.

This work addresses forest regeneration thought its ecological characterization in order to describe floristic composition, vegetation structure, complexity and similarity degree of successional stages resulting from natural regeneration after stopping cattle ranching practices.

Methods and Materials

Definition and floristic, structural and physiognomic characterization of successional stages:

Successional phases or stages of TDF has been defined as establish Tropi-Dry´s Manual of Methods[13] except for the mature stage, which because of its age (30 years old) is considered a late intermediate stage (hereinafter called advanced phase). When designing the plots, exclusion of livestock (e.g. through barriers) and protection against fire could not be carried out.

A total of 31 plots were placed in the study area: 8 plots were located in pastures, 8 in early phase, 8 in the middle phase and 7 plots in the advanced phase. The size of each sample unit was 20 x 50 m. To facilitate and accelerate the rest of structural and physiognomic measures the plot was divided in 5 subplots of 10 x 20 m each. Sampling of floristic composition, structural characteristic and vegetation physiognomy were conducted in each plot. Also a general site description was conducted including type of substrate, percentage of rockiness, and a detailed floristic list. Botanic materials were compiled.

In plots covered by herbaceous or mixed communities (herbaceous-shrubby) the general herbaceous stratum was determined; the individuals with a D.B.H<5 cm were separately counted in height class (<0.5m; 0.51 to 1.5m; 1.51 to 3m; 3.1 to 4.5 m. y 4.5 to 10m). On the other hand the individuals with D.B.H >5 cm. were taxonomically classified and its D.B.H. and height were measured. In the case of woody elements with multiple trunks, each trunk was independently considered as long as its D.B.H. >5 cm and the bifurcation started lower than 1.30 m of height.

In the plots settled in shrubby-woody communities the number of individual per height class was estimated. The woody elements (tree, shrub or climbers) with D.B.H. >5 cm were taxonomically classified and their D.B.H. and height were measured. Table 1 describes the methods and/or tools used to measure each variable:

Table 1: Methods and/or tools used to quantify the variables used to structurally characterize successional phases in TDF:

Variable	Tools/Methods used to its measure
Floristic composition	Taxonomical identification by experts of the HAC Herbarium, Institute of Ecology and Systematics.
Number of canopy stratum	Visual estimation
Height of each canopy stratum	Visual estimation and clinometers
Number of individual per growth class	Counting of the individuals with D.B.H.<5cm and heights below <0.5m and between 0.51 to 1.5m; 1.51 to 3m; 3.1 to 4.5 m. y 4.5 to 10m.
D.B.H. (cm.)	Diametric tape
Height (m.)	Visual estimation and clinometers
Individual density (No. ind/ha^{-1})	Individuals number / ha^{-1}
Stem density (No. troncos/ ha^{-1})	Stem number/ ha^{-1}
Basal Area(m^2/ha^{-1})	Π (DBH)^2/4

Data were compiled, organized and stored in data bases with MS-Excel format.

II.2.3 Data processing and statistical analysis

Using the information of floristic composition, indexes of α and β diversity (i.e. Specific Richness, Sorensen´s Similarity and Magurran´s Replacement) were determined for each successional phase. Statistical difference between indexes of α and β diversity of successional stages was processed with non-parametric ANOVA which was complemented with the Test of Tukey *a posteriory* (applying SPSS v. 17.0).

In addition, a floristic list per successional stage was made. Information data on botanic family, author and life form of each species was added.

For variables describing vegetation structure (D.B.H., height, basal area, density of individuals and stem density) the mean and the standard deviation were calculated. Values were compared between successional phases trought graphics made in SIGMAPLOT v. 10.0. Statistical differences between the variables on structure of successional phases (density of individual, stem density, D.B.H., height and basal area) was investigated with non-parametric ANOVA of one way, which was complemented with the Test of Tukey *a posteriory* (applying SPSS v. 17.0).

With the purpose of indicating the contribution of each species to the composition of woody elements of vegetation, the Importance Value Index (IVI) was calculated[14; 15]

$$IVI= Fr + Dr + ABr$$

Fr: Relative frequency for each specie ($Fr = (Fi / \sum F) \times 100$)
Ar: Relative density for each specie ($Dr=(Ei / \sum E) \times 100$).
ABr: Relative basal area for each specie ($ABr = (ABi / \sum AB) \times 100$

This analysis was conducted for the middle and advanced phases due to their larger number of woody elements with D.B.H. ≥ 5 cm. Families not detected in these successional phases or families having only herbaceous elements, were not included in this analysis.

The increase in complexity of the ecosystem was quantified through Holdridge's Complexity Index (CHCI)[16] taking into account Lugo's modification[17] for secondary forests.

Results

Floristic, structural and physiognomic characteristics of successional phases in the TDF

In total 148 species of 55 botanical families were listed. Table 2 shows the number of species of each successional phase as an indicator of the community diversity.

Table 2. Statistical Diversity Index α

Successional phases	Pastures	Early phase	Middle phase	Advanced phase
Species richness	79	85	57	60

The floristic list (Annex 1) contains the life form of each species and the species composition of each successional phase.

Regarding β diversity, pastures and early phase are the most similar phases and have 71% of similarity in their floristic composition. Such similarity decreases when the middle phase is reached because the number of species diminishes and also an herbaceous community is replaced by a shrubby community. The similarity continues to decrease towards the advanced phase. Values of Magurran's Replacement Index remains high during the transition of one successional phase into another, which indicates the intensive substitution of species thats hould happen in the transition from a herbaceous community to a forest, Table 3:

Table 3. Ecological Indexes on β diversity in the transition between successional phases. Regarding species the table presents Sorensen's Similarity Index and Magurran's Replacement Index between pastures (P) and early phase (ETe), between ETe and middle phase (EIn), and between middle phase and the advanced phase (EAv).

Successional Phase	**P-ETe**	**ETe-EIn**	**EIn-EAv**
Sorensen's Similarity Index	0.71	0.58	0.56
Magurran's Replacement Index de Especies (%)	74.26	84.36	71.04

The number of species in the wooden component of the plots increases as the plot age increases in the TDF of the Peninsula of Guanahacabibes [9]. These species represent 16%, 16%, 33% y 48% in the pastures and in the early, middle and advanced phases.

Regarding vegetation physiognomy, 61% out of all the species are trees and shrubs, 30% are herbs, and 9% are lianas and climbers. The percent of species with a certain life form regarding total number of species is shown by successional phase in Table 4:

Table 4. Distribution of life forms in the successional stages plant community:

	% of species with certain life form / total of species present in the successional phase		
Successional phases of TDF	Herbs	Shrubs / Tress	Vines / Climbers
Pasture	42	48	10
Early phase	42	49	9
Middle phase	23	65	12
Advanced Phase	6	80	14

The IVI shows the ecological importance of woody component in the vegetation. Species as *Comocladia platyphylla*, *Oxandra lanceolata*, *Gerascanthus gerascanthoides*, *Drypetes alba*, *Cinnamomun elongatum*, *Malpighia cubensis*, *Trichilia havanensis*, *Pithecellobium lentiscifolium*, *Eugenia axilaris*, *Cupania glabra*, *Chrysophyllum oliviforme*, *Guazuma tomentosa* y *Guazuma ulmifolia* represent the highest values. Results from this index are represented in Figure 1.

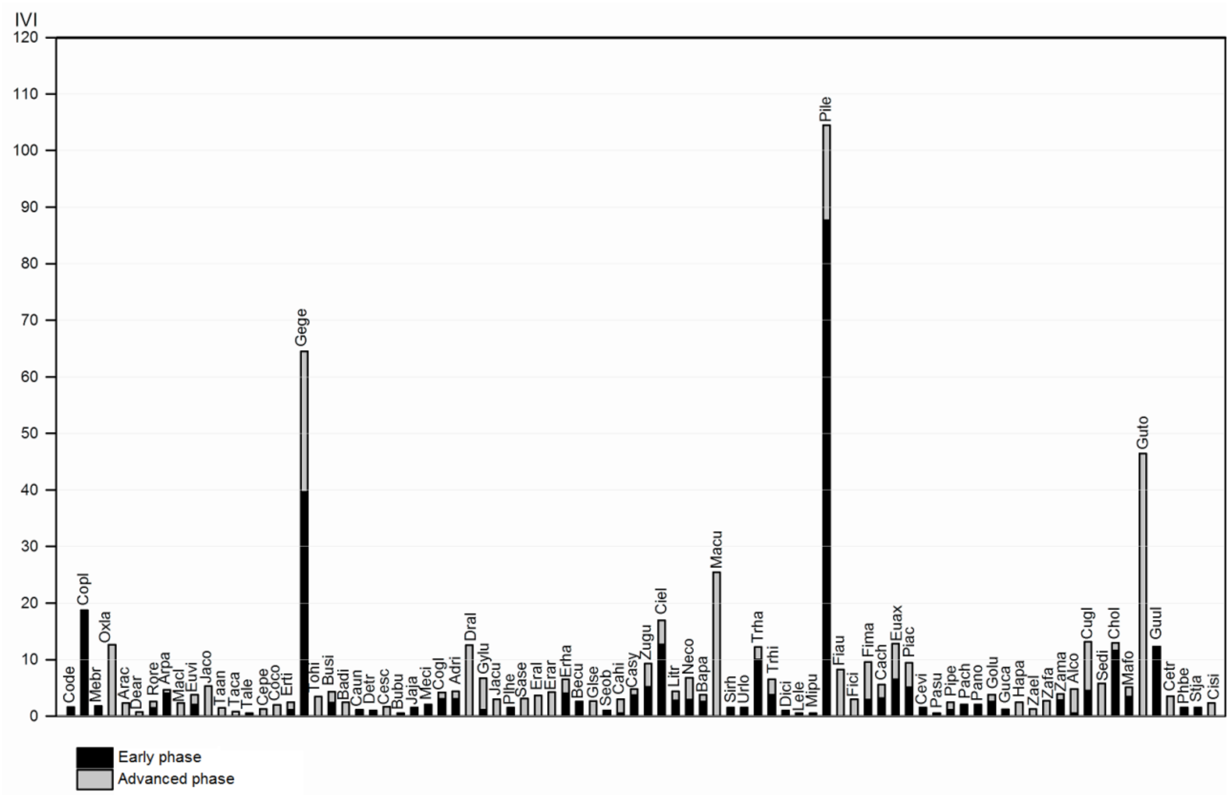

Figure 1: Index of Importance Value for botanical families present in middle and advanced TDF successional phase. Species code refer to floristic list shown in Annex 1.

In the pastures and in the early, middle and advanced phase the inventory of individual (by height classes) indicates values of 3494, 33880, 113 and 148 respectively for individuals whose D.B.H. is up to 5 cm and whose height is up to 4.5 m. The tree individuals (D.B.H.>5 cm) are represented by 1130 stems in the middle phase and 1483 stems in the advanced phase. Figure 2 contains a structural description of the different successional phases of the tropical dry forest with quantitative variables like D.B.H., height, density of individuals, stem density, and basal area of wooden individuals.

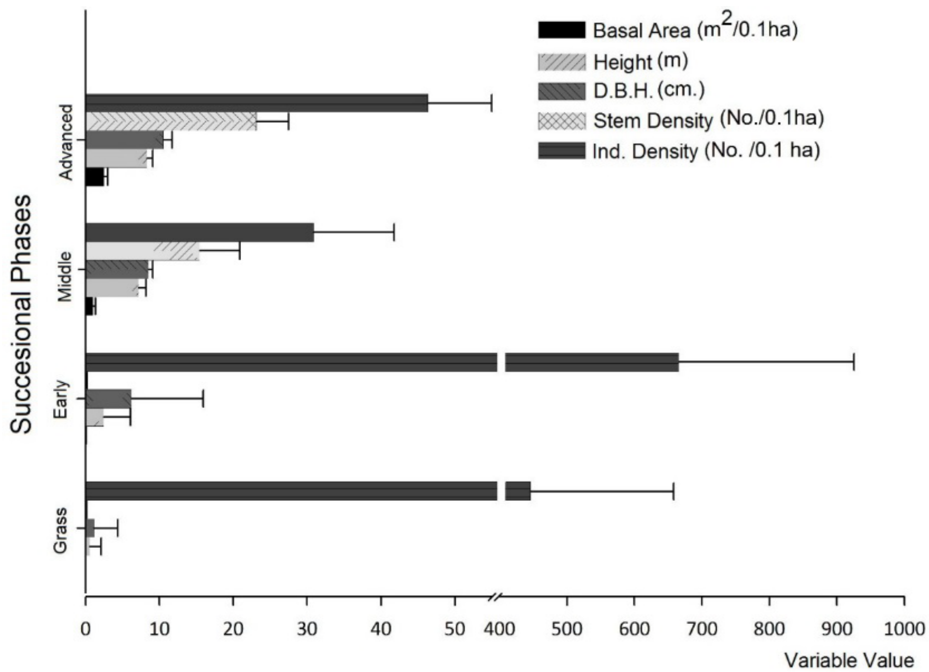

Figure 2**.** Characteristics of the successional phases of the TDF according to stuctural variables.

Results of the ANOVA indicate that the structure of vegetation is transformed along the successional process. The density of individuals diminishes and concentrates towards higher growth classes as the process proceeds from pasture to early phase while it basically becomes zero in the forest community. The other variables (stem density, D.B.H., height and basal area) show a sustained increase, which is typical of the recovery process that takes place in the landscape, Table 5.

Table 5. Results of ANOVA for variables that characterize the structure of the TDF in La Jarreta: Density of Individuals (No. individuals/ha^{-1}); Stem Density (No. Stems /ha^{-1}); D.B.H. (cm.); Height (m.) and Basal Area (m^2/ha^{-1}). Average values ± standard deviation in plots of pasture (8), early phase (8), middle phase (8) and advanced phase (7). Different letters indicate statistical difference between categories as per the Tukey's test. α = 0.01**

Variable		Successional Phase			
		Pasture	**Early**	**Middle**	**Advanced**
Density of Individuals (Ø below5 cm. and split in height classes in m.)	<0.5	4342 ± 2085[b]	6044 ± 2374[b]	0[a]	0[a]
	0.51-1.5	15 ± 22[a]	402 ± 93 [a]	0 [a]	0 [a]
	1.51- 3	10 ± 15[a]	77.6 ± 49.8[b]	0[a]	0[a]
	3.1-4.5	0[a]	0.12 ± 0.35[a]	15.6 ± 14.6[a,b]	9.8 ± 4.0[a]
	4.51-10	0.5 ± 1.41[a]	0.75 ± 1.4[a]	124.8 ± 53.5[b]	185.9 ± 42.2[c]
Stem Density		0.50 ± 1.41[a]	1.00 ± 1.60[a]	141.25 ± 49.82[b]	211.86 ± 39.78[c]

D.A.P.	1.04 ± 2.94[a]	5.67 ± 8.92[a,b]	7.79 ± 0.55[a,b]	9.65 ± 1.07[b]
Height (> 5cm. de Ø)	0.52 ± 1.46[a]	2.23 ± 3.35[a]	6.58 ± 0.94[b]	7.74 ± 0.74[b]
Basal Area	0.002 ± 0.007 [a]	0.019 ± 0.031[a]	0.90 ± 0.38[b]	2.29 ± 0.47[c]

As an outcome of the increase in the values of these variables vegetation complexity increases as the forest structure develops. This variable had values that ranged from very low in the pastures and early phase up to much higher values in the middle and advanced phases, Table 6.

Table 6. Holdridge's Complexity Index (CHCI) in the successional phases of the TDF.

Successional Phases	**CHCI**
Pastures	1.56×10^{-4}
Early Phase	$1 \times 10^{-3} \pm 0.001$
Middle Phase	2.22 ± 1.15
Advanced Phase	8.33 ± 4.23

Discussion:

Currently, the TDF in La Jarreta are composed by a mosaic of successional stages, which range from herbaceous, mixed herbaceous-shrubby communities up to forest as a result of regeneration.

In terms of the species richness obtained for successional stages, our values are in the order of those reported by Gentry for other American sites. i.e. between 16 and 169 species in the forest's floristic component[18], other authors have also obtained similar figures to ours for various communities in the Caribbean, Southland Central America, including Heybrock[19; 20; 21; 22; 23; 24; 25; 26; 27].

Lugo[28] argue that TDF of the Antilles have low floristic diversity. However, in our floristic inventory, as well as in those by Delgado[7], more species have been reported for the middle and latest age in Guanahacabibes TDF than those found by Gentry[18] for some places like the Dominican Republic, Motozintla (Mexico), Argentina, Los Llanos (Venezuela) Madagascar and India. This leads us to think that despite the short recovery time the site has reached a number of species similar to sites with more advanced secondary succession.

Although a significant increase in species number from one phase to another was not detected, 44 species become more common. When comparing with the most preserved area in the peninsula (Carabelita, i.e. 47 years in recovery), where 68 plant species were inventoried[9] it can be said that the TDF floristic component shows signs of recovery after 30 years after abandonment.

In the physiognomic aspect, the decrease of herbaceous life forms and the increase of shrubs and trees are prominent as succession proceeds. The latter life form dominates in the advanced stage of the TDF. This phenomenon may have been produced by an accelerated grow of shrubs into the grassland and has been reported by some authors as post-livestock effect[29; 30; 31; 32] which helps to accelerate the formation of forest patch. However, there is a dominance of legumes, vines and creepers, which indicates the secondary character of vegetation.

Registered similarity values are higher than those obtained by González-Iturbe[33]. Regarding the replacement, the largest similarity value occurs in the transition from early to middle phase as it is an abrupt transformation in the structure and composition of vegetation, and a critical step towards forest recovery. Cingolani[34] found that, in production landscapes, grazing increased beta diversity.

The findings regarding the Importance Value Index do not match those reported by Gentry for the dominant plant families in the West Indies. Highlighted botanical families include *Boraginaceae* which is represented by opportunistic plants and *Euphorbiaceae*, this one considered the third largest in Central America followed by *Anacadiaceae*[35]. Vines and climbers, mainly grouped in the family *Malpighiaceae* act as an indicator of the secondary condition of this vegetation[36; 37; 38].

Although Lugo[28] state that legumes are not dominant in the TDF in the Caribbean and Florida, this group appears to be abundant in the intermediate stage and dominates the late stage, particularly represented by the botanical family Mimosaceae. This finding is consistent with other reports[33; 39; 40; 41; 42; 43; 44; 45]. The dominance of legumes was also found in pastures and early phases with the presence of *Acacia farnesiana*. Although at the time the study was conducted *Acacia farnesiana* bushes had been cut as part of treatment for the recovery of the site, it covers large areas in all successional stages. Some author[43; 45; 47] found that the genre *Acacia* dominated in man-disturbed sites. Other researching reports dominance of *Fabaceae* species[25; 26; 37; 48], and *Caesalpinaceae* species[43; 45].

Regarding vegetation structure, an increase in the values of variables D.B.H., height, stem density, density of individuals and basal area is evident as post-abandonment proceeds. The values we find for forest structure are similar to those reported by Chinea in a forest with 38 years of secondary succession regarding density and height of individuals, and are different regarding basal area and number of species.

Similar behaviour and values have been found regarding basal area, D.B.H., height, number of individuals and number of stems; number of stems in mexican TDF[33] diameter and stem density and regarding density data[37]. Our reports of basal area in the advanced phase are similar to values obtained by Gentry in places like Guanacaste (Costa Rica), Chamela (Mexico), Argentina, Galerazamba (Colombia), Jauneche (Ecuador), Tarapoto (Peru), Boca de Uchire and Los Llanos (Venezuela), Belinga, Madagascar and Tanzania[18]. TDF in Guabahacabibes has a tendency to slow the growth in height and diameter of the cup, and to increase its diameter as adaptation to create more resistance to wind[7].

Although there is evidence of structure gain throughout successional stages this process has been slow. Therefore the dimensions achieved by vegetation are lower than in other sites with similar conditions. This delay may be related to the fact that half of the species in the ecosystem are of slow growth, the environment where this species exist are poor in resources. Also, the later stages are subjected to selective logging, i.e. this limits the structural development into more mature stages.

Conclusions

During the short time forest regeneration has taken place, the recovery of floristic, structural and physiognomic characteristics of vegetation indicate the effectiveness of the regeneration process.

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Annex 1**.** Floristic list of La Jarreta, Guanahacabibes, Cuba. P-Pastures, Ete-Early phase, EIn-Intermediate phase, EAv-Advanced phase.

Botanic Family	***Specie***		**Author**	**Life Form or Habit**	**Successional Phase in which the specie exist**			
	Code	**Cientific Name**			**P**	**ETe**	**EIn**	**EAv**
ACANTHACEAE	Blbr	*Blechumbrowneii*	Juss	Herb		**X**		
AMARANTHACEAE	Goas	*Gomphrenaserrata*	L.	Herb	**X**			
ANACARDIACEAE	Code	*Comocladiadentata*	Jacq.	Shrub	**X**	**X**	**X**	**X**
	Copl	*Comocladiaplatyphylla*	A. Rich. exGriseb.	Shrub		**X**	**X**	
	Mebr	*Metopiumbrownei*	(Jacq) Urb.	Shrub			**X**	
ANNONACEAE	Ansq	*Annonasquamosa*	L.	Tree	**X**			
	Oxla	*Oxandralanceolata*	(Sw.) Baill.	Tree				**X**
APOCYNACEAE	Plob	*Plumeriaobtusa*	L	Shrub				
ARACEAE	Arac	*Aracea spp.*		Palma				**X**
ARALIACEAE	Dear	*Dendropanaxarboreus*	(L.) Dec. etPlanch.	Shrub				**X**
ARECACEAE	Rore	*Roystonearegia*	(Kunth) O. F. Cook	Tree			**X**	**X**
ARISTOLOCHIACEAE	Arpa	*Aristolochiapassifloraefolia*	A. Rich.	Climber	**X**	**X**	**X**	**X**

ASCLEPIADACEAE	Ascu	*Asclepiascurassavica*	L.	Herb	X			
	Macl	*Marsdeniaclausa*	R.Br.	Vine				X
ASTERACEAE	Cavi	*Calyptocarpusvialis*	Less.	Herb	X			
	Cafl	*Capparisflexuosa*	L.	Tree	X	X		
	Emro	*Emilia fosbergii*	Nicolson	Herb	X			
	Euvi	*Eupatorium villosum*	Sw.	Herb	X	X	X	X
	Trpr	*Tridaxprocumbens*	L.	Herb	X	X		
	Xait	*Xanthium italicum*	Moretti	Herb	X	X		
BIGNONIACEAE	Crcu	*Crescentiacujete*	L.	Tree				
	Jaco	*Jacaranda coerulea*	(L.) Juss.	Tree				X
	Taan	*Tabebuiaangustata*	Britt	Tree				X
	Taca	*Tabebuiacalcicola*	Britt.	Tree	X	X		X
	Tale	*Tabebuialepidota*	(Kunth) Britton	Tree			X	
	Test	*Tecomastans*	(L.) Juss. ex Kunth –	Shrub	X			
BOMBACACEAE	Cepe	*Ceibapentandra*	(L.) Gaertn	Tree				X
BORAGINACEAE	Coco	*Cordiacollococca*	L.	Shrub				X
	Erti	*Ehretiatinifolia*	L.	Tree			X	X
	Gege	*Gerascanthusgerascanthoides*	L.	Tree	X	X	X	X
	Hehu	*Heliotropiumhumifusum*	H.B. y K.	Tree	X			
	Ocsa	*Ocimum sanctum*	L.	Tree	X	X		
	Tohi	*Tournefortiahirsutissima*	L.	Vine				X
BURSERACEAE	Busi	*Burserasimaruba*	(L.) Sargent.	Tree			X	X
CAESALPINACEAE	Badi	*Bauhinia divaricata*	L.	Shrub	X			X
	Caek	*Cassia ekmaniana*	Urb.	Tree	X	X		
	Caun	*Cassia uniflora*	Mill.	Tree	X	X	X	
	Dein	*Desmodiumincanum*	DC.	Herb		X		
	Desc	*Desmodiumscorpiurus*	(Sw.) Pesv.	Herb		X		
	Detr	*Desmodiumtriflorum*	(L.) DC.	Herb		X	X	
	Swcu	*Swartziacubensis*	(Britt. etWils.) Standl.	Tree				
CECROPIACEAE	Cesc	*Cecropiaschreberiana*	Mig.	Tree				X
COMBRETACEAE	Bubu	*Bucidabuceras*	L.	Tree		X	X	
COMMELINACEAE	Coer	*Commelinaerecta var. erecta*	L.	Herb		X		
CONVOLVULACEAE	Ipac	*Ipomoea acuminata*	R. et S.	Climber	X	X		
	Iptr	*Ipomoea triloba*	L.	Climber		X		
	Jaja	*Jacquemontiajamaicensis*	(Jacq.) Hall. F.	Climber	X	X	X	
	Meci	*Merremiacissoides*	(Lam.) Hall. f.	Climber	X	X	X	
CORDIACEAE	Cogl	*Cordiaglobosa var. humilis*	(Jacq.) Borhidi	Herb	X	X	X	X
CYPERACEAE	Scme	*Scleriamelaleuca*	C. Presl ex C.B. Clarke	Herb	X			
EUPHORBIACEAE	Acol	*Acidocrotonoligostemon*	Urb.	Shrub		X		
	Adri	*Adeliaricinella*	L.	Tree	X	X	X	X
	Dral	*Drypetes alba*	Poir	Shrub	X	X		X
	Gylu	*Gymnantheslucida*	Sw.	Tree			X	X
	Jacu	*Jatrophacurcas*	L.	Tree				X
	Juar	*Julocrotonargenteus*	L.	Shrub	X			
	Plhe	*Platyginehexandra*	Müll. Arg.	Tree		X	X	

	Sase	*Saviasessiliflora*	(Sw.) willd.	Tree				X
ERYTHROXYLACEAE	Eral	*Erythroxylumalaternifolium*	A. Rich.	Shrub				X
	Erar	*Erythroxylumareolatum*	L.	Shrub				X
	Erha	*Erythroxylumhavanensis*	(Jacq.) Bisse	Shrub	X	X	X	X
FABACEAE	Anin	*Andirainermis*	(Sw.) HBK	Tree	X			
	Alva	*Alysicarpusvaginalis*	(L.) DC.	Herb	X			
	Becu	*Behaimiacubensis*	Griseb.	Shrub			X	
	Chpy	*Chamaecristapygmaea*	(DC.) Britton	Shrub	X			
	Devi	*Desmanthusvirgatus*	(L.) Willd.	Shrub	X			
	Glse	*Gliricidiasepium*	(Jacq.) Kunth ex Walp.	Tree		X		X
	Insu	*Indigoferasuffruticosa*	Mill.	Herb	X	X		
	Rhsw	*Rhynchosiaswartzii*	(Vail) Urb.	Herb	X	X		
	Seob	*Sennaobtusifolia*	(L.) Irwin y Barneby	Tree	X	X	X	
	Seoc	*Sennaoccidentalis*	(L.) Link.	Herb	X	X		
FLACOURTIACEAE	Cahi	*Caseariahirsuta*	Sw.	Tree	X	X	X	X
	Casp	*Caseariaspinescens*	(Sw.) Griseb.	Tree	X	X		
	Casy	*Caseariasylvestris*	Sw.	Herb	X	X	X	X
	Zugu	*Zuelaniaguidonia*	(Sw.) Britt. et. Millsp.	Tree			X	X
LAMIACEAE	Hysu	*Hyptissuaveolens*	(L.) Poit.	Herb	X	X		
	Ocgr	*Ocimumgratissimum*	L.	Herb		X		
LAURACEAE	Ciel	*Cinnamomunelongatum*	(Nees) Kosterm.	Tree			X	X
	Litr	*Licariatriandra*	(Nees) Kosterm.	Tree		X	X	X
	Neco	*Nectandracoriacea*	(Sw.) Griseb.	Shrub	X	X	X	X
MALPIGHIACEAE	Bapa	*Banisteriopsispauciflora*	(Kunth.) C.B. Robinson	Climber			X	X
	Macu	*Malpighiacubensis*	H.B.K.	Vine	X	X		X
	Stsa	*Stigmaphyllumsagraeanum*	A. Juss.	Tree	X	X		
	Trri	*Triopterysrigida*	Sw.	Herb		X		
MALVACEAE	Brsp	*Briquetiaspicata*	(Kunth) Fryxell	Herb	X			
	Sirh	*Sidarhombifolia*	L.	Herb	X	X	X	
	Urlo	*Urenalobata*	L.	Herb	X	X	X	
	Wihe	*Wissadulahernandioides*	L.	Herb		X		
MELIACEAE	Trha	*Trichiliahavanensis*	Jacq.	Tree	X	X	X	X
	Trhi	*Trichiliahirta*	L.	Tree	X	X	X	X
MENISPERMACEAE	Hyra	*Hyperbaenaracemosa*	Urb.	Tree				
MIMOSACEAE	Acfa	*Acacia farnesiana*	(L.) Willd	**Tree**	X	X		
	Algl	*Albaremaglauca*	(Urb.) Barneby y J. W.Grimes	Tree		X		
	Dici	*Dichrostachyscinerea*	(L.) Wight y Arn.	Tree	X	X	X	
	Lele	*Leucaenaleucocephala*	(Lam.) DeWit	Tree	X	X	X	
	Mipu	*Mimosa pudica*	L.	Shrub	X	X	X	
	Pile	*Pithecellobiumlentiscifolium*	(A. Rich.)Wr.	Herb	X	X	X	X
	Sasa	*Samaneasaman*	(Jacq.) Merrill.	Tree	X	X		
MORACEAE	Fiau	*Ficusaurea*	Nutt.	Tree	X			X
	Fici	*Ficuscitrifolia*	Mill	Tree				X
	Fima	*Ficus maxima*	Mill.	Tree		X	X	X
MYRTACEAE	Cach	*Calyptrantheschytraculia*	(L.) Sw	Tree			X	X

	Euax	*Eugenia axillaris*	(Sw.) Willd.	Tree	X		X	X
	Psgu	*Psidiumguajava*	L.	Tree	X	X		
NYCTAGINACEAE	Piac	*Pisoniaaculeata*	L.	Vine	X	X	X	X
PAPAVERACEAE	Aram	*Argemoneamericana*	L.	Herb		X		
	Levi	*Lepidiumvirginicum*	L.	Herb	X	X		
PAPILONACEAE	Cevi	*Centrosemavirginianum*	(L.) Benth.	Herb	X	X	X	
PASSIFLORACEAE	Pasu	*Passiflorasuberosa*	L.	Herb	X	X	X	
PHYTOLACCACEAE	Phic	*Phytolaccaicosandra*	L	Tree	X	X		
PICRAMNIACEAE	Pipe	*Picramniapentandra*	Sw.	Tree			X	X
POACEAE	Cyda	*Cynodondactylon*	L.	Herb	X	X		
	Dian	*Dichanthiumannulatum*	Forssk.) Stapf	Herb	X			
	Pach	*Panicumchrysopsidifolium*	*Nash.*	Herb	X	X	X	
	Pano	*Paspalumnotatum*	Flüegge	Herb	X	X	X	
	Sege	*Setariageniculata*	(L.) Beauv.	Herb		X		
	Soha	*Sorghum halepense*	(L.) Pers.	Herb	X	X		
	Spin	*Sporobolusindicus*	L.	Herb	X	X		
PORTULACACEAE	Popi	*Portulacapilosa*	L.	Herb		X		
RHAMNACEAE	Coar	*Colubrinaarborescens*	(Mill.) Sarg.	Tree				X
	Golu	*Gouanialupuloides*	(L.) Urb.	Vine			X	X
RUBIACEAE	Anlu	*Antirhealucida*	(Sw.) Benth.et Hook. f.	Tree				
	Guca	*Guettardacalyptrata*	A. Rich.	Tree			X	
	Hapa	*Hamelia patens*	Jacq.	Tree		X		X
RUTACEAE	Zael	*Zanthoxylum elephantiasis*	Macfad.	Tree		X		X
	Zafa	*Zanthoxylumfagara*	(L.) Sargent.	Tree	X	X		X
	Zama	*Zanthoxylummartinicense*	(Lam.) DC.	Tree		X	X	X
SAPINDACEAE	Alco	*Allophylluscominia*	(L.) Sw.	Tree		X	X	X
	Cugl	*Cupaniaglabra*	Sw.	Tree	X	X	X	X
	Sedi	*Serjaniadiversifolia*	(Jacq.) Radlk.	Vine	X	X	X	X
SAPOTACEAE	Chol	*Chrysophyllumoliviforme*	L.	Tree		X	X	X
	Mafo	*Mastichodendronfoetidissimun*	(Jacq.) Cronq.	Tree			X	X
SOLANACEAE	Soto	*Solanumtorvum*	Sw.	Tree		X		
STERCULIACEAE	Guto	*Guazumatomentosa*	H.B.K.	Tree	X			X
	Guul	*Guazumaulmifolia*	Lam.	Tree	X	X	X	
TURNERACEAE	Tuac	*Turneraacaulis*	Griseb.	Tree		X		
ULMACEAE	Cetr	*Celtistrinervia*	Lam.	Tree				X
	Trfl	*Tremafloridana*	(Britt) Standl.	Tree				
URTICACEAE	Urba	*Urerabaccifera*	(L.) Gaudich.	Shrub	X	X		
VERBENACEAE	Laca	*Lantana camara*	L.	Tree	X	X		
	Lare	*Lantana reticulata*	Pers.	Herb	X	X		
	Phbe	*Phyla betulifolia*	(Kunth) Greene	Herb	X	X	X	
	Prla	*Privalappulacea*	(L.) Pers.	Herb	X			
	Stja	*Stachytarphetajamaicensis*	(L.) Vahl.	Herb	X	X	X	
	Tacu	*Tamoneacurassavica*	(L.) Pers.	Herb		X		
	Vidi	*Vitexdivaricata*	Sw	Tree				
VITACEAE	Cisi	*Cissussicyoides*	L.	Vine	X			X

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