ISSN: 2310–3469 RNPS: 2347
Revista Cubana de Ciencias Forestales. 2020; September-December 8(3): 562-577

CFORES REVISTA CUBANA DE CIENCIAS FORESTALES

Translated from the original in spanish

Original article

Structural Characterizayion of the riparian of Cuyaguateje Forest, middle third of the "Vega la Manzanilla" Basin

Caracterización estructural del bosque de ribera del río Cuyaguateje, tercio medio de la cuenca "Vega la Manzanilla"

Caracterização estrutural da floresta da ribeira do flúmen Cuyaguateje, tércio méio da cuenca " Vega la Manzanilla"

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Received: June 22th, 2020.
Approved: October 24 th, 2020.

ABSTRACT

The research was carried out in four hectares of the Cuyaguateje river riparian forest, in the middle third of the basin, the section closest to the urban area of Guane, "Vega La Manzanilla". With the objective of evaluating its structure and composition, 12 plots of 400 m^2 were raised; for the measurement of the diameter ($D_{1,30}$), all individuals with a height greater than 2 m were considered. The floristic composition was evaluated; the horizontal structure was described in terms of frequency, abundance, dominance and Importance Value Index (IVI). The distribution of abundance by diameter classes was also carried out, the mixing ratio was determined and, finally, the margins were compared biologically with the Jaccard similarity index. The vertical structure was evaluated, taking into account three strata: Lower 2 to 5 m, intermediate> 5 to 10 m and upper> 10 m. The main results were: a floristic composition of 29 species, grouped into 18 families and 29 genera. The most dominant families were identified: Meliaceae, Sapindaceae, Mimosaceae, Anacardiaceae, Boraginaceae and Fabaceae; with greater ecological weight, species typical of the riparian flora were identified such as *Samanea saman* Jacq., *Talipariti elatum* Frixell (Sw), *Sapindus saponarius* L., *Guazuma ulmifolia Lam*. and some invasives, which should be watched as: *Bambusa vulgaris* Schrader, *Gmelina arborea* Roxb. there is high similarity between both margins. In general, it was concluded that a heterogeneous forest has been formed, with a high percentage of typical species of riparian forests, which shows a flora characterized by trees with height, and diameter ($D_{1,30}$) above 10 and 0.13 m, respectively.

Keywords: Riparian forest; Cuyaguateje; Composition; Structure.

RESUMEN

La investigación se realizó en cuatro hectáreas del bosque de ribera del río Cuyaguateje, en el tercio medio de la cuenca, tramo más cercano al casco urbano de Guane, "Vega La Manzanilla". Con el objetivo de evaluar su estructura y composición, se levantaron 12 parcelas de 400 m^2; para la medición del diámetro ($D_{1,30}$) se consideraron todos los individuos con altura superior a los 2 m. Se evaluó la composición florística; se describió la estructura horizontal en términos de frecuencia, abundancia, dominancia e Índice de Valor de Importancia (IVI). Se realizó, también, la distribución de abundancia por clases diamétricas, se determinó el cociente de mezcla y, finalmente, se compararon biológicamente, las márgenes con el índice de similitud de Jaccard. La estructura vertical se evaluó, teniendo en cuenta tres estratos: Inferior 2 a 5 m, intermedio > 5 a 10 m y superior >10 m. Como resultados principales se obtuvieron: una composición florística de 29 especies, agrupadas en 18 familias y 29 géneros; se identificaron como familias más dominantes: Meliaceae, Sapindaceae, Mimosaceae, Anacardiaceae, Boraginaceae y Fabaceae; con mayor peso ecológico se identificaron especies propias de la flora ribereña tales como: *Samanea saman* Jacq., *Talipariti elatum* Frixell (Sw), *Sapindus saponarius* L., *Guazuma ulmifolia* Lam. y algunas invasoras, que deben ser vigiladas como: *Bambusa vulgaris* Schrader, *Gmelina arbórea* Roxb; existe alta similitud entre ambas márgenes. De manera general, se concluyó, que se ha formado un bosque heterogéneo, con alto porcentaje de especies típicas de los bosques de ribera, el que muestra una flora caracterizada por árboles con altura, y diámetro ($D_{1,30}$) por encima de los 10 y 0,13 m, respectivamente.

Palabras clave: Bosque ribera; Cuyaguateje; Composición; Estructura.

RESUMO

A investigação realizou se em quatro hectares da floresta da ribeira do flúmen Cuyaguateje, no tércio meio da cuenca, distância mais perto à cidade de Guane "Vega La Manzanilla". Com o objetivo de avaliar a sua estrutura e composição, levantaram se 12 sertões de 400 m^2; para a medição do diâmetro ($D_{1,30}$) se consideraram todos os indivíduos com altura superior aos 2 m. Avaliou se a composição florística; descreveu se, além disso, a estrutura horizontal em termos de frequência, abundância, dominância e índice de Valor de Importância (IVI); mesmo assim, determinou se o índice de Simpson que expressa a dominância das espécies e o seu recíproco; realizou se a distribuição da abundância por classes diamétricas, determinou se o cociente de mistura e compararam se biologicamente as margens com o índice de similitude de Jaccard. A estrutura vertical avaliou se tendo em conta três estratos: Inferior 2 a 5 m, intermédio> 5 a 10 m e superior >10 m. Como resultados principais obtiveram se: uma composição florística de 29 espécies, agrupadas em 18 famílias e 29 gêneros: identificaram se como famílias mais dominantes: Meliaceae, Sapindaceae, Mimosaceae, Anacardiaceae, Boraginaceae e Fabaceae; com maior peso ecológico se identificaram espécies próprias da flora ribeirense tais como: *Samanea saman* Jacq., *Talipariti elatum* Frixell (Sw), *Sapindus saponarius* L., *Guazuma ulmifolia* Lam. e algumas invasoras que devem ser custodiadas como: *Bambusa vulgaris* Schrader, *Gmelina arbórea* Roxb; existe elevada similitude entre ambas margens. De jeito geral, concluiu se que se ter formado uma floresta heterogênea com alta porcentagem de espécies típicas das

ISSN: 2310–3469 RNPS: 2347
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florestas de ribeira, a=o que mostra uma vegetação caracterizada pelas árvores com altura e diâmetro ($D_{1,30}$) por acima dos 10 e 0,13 m, respetivamente.

Palavras chave: Floresta ribeira; Cuyaguateje; Composição; Estrutura.

INTRODUCTION

Forests are an essential solution to the problems linked to climate change and the mitigation of its effects, fundamental elements of food security and the improvement of livelihoods (FAO, 2016). However, each year the forests that protect freshwater ecosystems are more degraded (Mitjans, 2012).

Flores *et al*., (2017) refer that in various parts of the world, there has been a warning about the seriousness of the environmental situation, expressed in different degrees of deterioration of natural ecosystems, among which the following stand out: riparian forests.

The ribera, gallery, riparian, ciliary forest or Hydroregulatory Forest Belt (HFB) forests, as they are also called, are distinguished by being of greater density, containing a greater amount of biomass, being structurally more complex, and having a greater number of evergreen species, according to Lamprecht (1990). In tropical regions, they have great diversity and heterogeneity, being made up of trees with an irregular distribution, which causes tree communities to differ along the river (Guevara *et al.,* 2008).

In Cuba, since 1999, reforestation plans have been carried out in most aquatic systems (Mitjans, 2012); In some cases, local actors have been included in the rehabilitation of these ecosystems, an example of this is the work carried out in the Guane municipality, on the banks of the Cuyaguateje river, in the period 2003-2010.

Logically, the favorable conditions of this area in terms of humidity, soil fertility, as well as floods, which cause seeds to arrive from the area of the basin that discharges into the river, together with the anthropic factor from a positive approach (protector of the ecosystem), constantly promote changes in the structure and composition of the species of this ecosystem. In this regard, Chazdon (2014) maintains that the change of structure and species follows a successional process, and the time elapsed of human or natural disturbance plays an important role and states: "Regenerating (secondary) and restored forests are the nexus between conservation and development, and between the social and natural sciences".

Mitjans (2012) carries out studies on rehabilitation from a social and participatory approach in 23 hectares of the Cuyaguateje riparian forest, asserting the importance of the inclusion of the community in the restoration of forest ecosystems. Since then, a passive restoration has been developed in this ecosystem, eliminating the barriers that hindered regeneration, for which the committed participation of farmers has been key. In this regard, FAO (2010) states that participatory forestry has become increasingly common during the last 25 years and is related to the promotion of forests, through the participation of communities Despite having rehabilitated the area, the structure of the forest that has been formed is not known. Knowing the structure allows, being aware of how the individuals are distributed in the available space, at the same time, it is a practical way of observing how and where the trees are competing, according to Lamprecht (1990).

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The structural characteristics also allow to be aware of the dynamics of the forest, define its structure and composition, and design the appropriate management plan for its development.

Characterizing the structure and composition of the riparian forest of the Cuyaguateje River, in the middle third of the basin, "Vega La Manzanilla", constitutes the central objective of this research.

MATERIALS Y METHODS

Localization

The research was done in the four hectares of the riparian forest of the Cuyaguateje river in the area closest to the urban area of Guane "Vega La Manzanilla,", the one that belongs to the Cooperativa de Crédito y Servicio (CCS) Menelao Mora and is located at coordinates 22011" 780 `and 2201" 100' North latitude and 84003" 820 ` and 84005" 130' West longitude. Area where floods occur frequently in rainy periods (Figure 1).

Figure 1. - Localization of studied area

Methodology

A systematic sampling was carried out and 12 plots of 400 m² (20 m x 20 m) were inventoried, 6 in each margin, distributed throughout the area at an approximate distance of 200 m between them. This was validated with the area-species curve method, following the Ramírez criteria (2017).

The margins were identified following a gradient from North to South, those located to the left and right were identified as margin 1 and margin 2, respectively (Mitjans, 2012).

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In each plot the diameter (D_{130}) and height were measured taking into account all individuals greater than 2 m. All species were identified in the field, their identification corroborated with specialists in Botany, the Red List of the Flora of Cuba (González *et al.,* 2016) and the studies of Oviedo *et al*., (2012) those that were used to classify autochthonous, allochthonous and invasive species.

Alpha diversity was evaluated through species richness, described as the number of species in each margin, considered the most important indicator of diversity according to Moreno (2001). The Simpson index, which expresses the dominance of the species and its reciprocal, was also determined, which is influenced by the importance of the most dominant species, according to the previous author (Equation 1).

$$\lambda = \sum p^2 \quad (1)$$

Where:
Pi = proportional abundance of species i, that is, the number of individuals of species i, divided by the total number of individuals in the sample.

In order to compare the difference between the margins, the Jaccard similarity index was used through the expression proposed by Moreno (2001) (Equation 2).

$$I_J = \frac{c}{a+b-c} \quad (2)$$

Where:
a = number of species present in margin 1.
b = number of species present in margin 2.
c = number of species common on both margins.

The Mixture Quotient (CM) indicator of the homogeneity or heterogeneity of the forest was determined, with the following formula (Equation 3).

$$CM = S/N \quad (3)$$

Where:
CM= mixing ratio.
S= total number of species in the sample.
N = total number of individuals in the sample.

The horizontal structure was determined from the parameters abundance, dominance and frequency, in absolute and relative values of each species and the Index of Value of Ecological Importance (IVI).

Absolute abundance (Aa) = number of individuals per species with respect to the total number of individuals found in the study area (ni) (Equation 4).

$$\textbf{Relative abundance}\ (Ar\%) = \left(\frac{ni}{n}\right) * 100 \quad (4)$$

Where:
ni = number of individuals of *i-th species.*
n = number of total individuals in the sample.

Absolute frequency (Fa) = percentage of plots in which a species appears, 100% = existence of the species in all plots (Equation 5).

$$\textbf{Relative frequency}\ (Fr\%) = \left(\frac{Fi}{Ft}\right) * 100 \quad (5)$$

Where:
Fi = Absolute frequency of *i-th species.*
Ft = total frequencies in the sample

Dominance: proportion of the ground or basal area occupied by the stem of a tree of a species in relation to the total area (Equation 6).

$$\textbf{Absolute dominance}\ (Da) = Gi/Gt \quad (6)$$

Where:
Gi = Basal area in m^2 for the iésima species.
Gt = Basal area in m^2 of all *species.*

Relative dominance (Equation 7).

$$(\boldsymbol{D\%}) = Dr = \left(\frac{Das}{Dat}\right) * 100 \quad (7)$$

Relative dominance

Where:
DaS = absolute dominance of one species.
DaT = absolute dominance of all species.

Ecological importance value index (IVI)

The ecological importance value index (IVI) was calculated according to the expression proposed by Curtis and Macintosh 1950). This index expresses the ecological importance of each species (Equation 8).

$$IVI = Ar + Dr + Fr \quad (8)$$

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The species were grouped by ecological importance into: high (IVI≥15), medium (15> IVI≥5) and low (IVI <5) following the criteria of Gutiérrez *et al.,* (2015).

Abundance of individuals by diameter class

The distribution of abundance by diameter classes was determined with an interval width of 10 cm, obtaining six classes: I (2,5-12,5), II (12,6-22,6), III (22,7-32,7) IV (32,8-42,8) V (42,9-52,9) y VI (>53).

Vertical structure

The vertical structure was described in three strata: Lower 2 to 5 m, intermediate> 5 to 10 m and upper> 10 m (Mitjans, 2012).

RESULTS AND DISCUSSION

Floristic composition and diversity

There 282 individuals, 29 species, 29 genera and 18 families were registered; 25 species on margin 1 and 24 on margin 2 (Appendix). The 66 % of the species (19/29) are native, described among the species proposed in the list of riparian species of Cuba by Herrera (2010).

The rehabilitation process that was developed through natural regeneration as the predominant method, led to the incorporation and abundance of autochthonous species such as: *Talipariti elatum* Frixell (Sw), *Sapindus saponarius* L., *Guazuma ulmifolia* Lam., *Trichilia hirta* L., *Swietenia mahagoni* L., *Lonchocarpus domingensis* (Pers). DC., *Tabebuia angustata* Britt., *Gerascanthus gerascantoides* L., those that have acquired a resilience that has allowed them to be less vulnerable to stresses or natural disturbances (floods), which coincides with Mitjans (2012). This researcher asserted that the species that settle on the banks of the Cuyaguateje over time would accumulate matter and energy, forming a system that is more resistant to natural and anthropic disturbances and therefore less vulnerable to stress.

Ten allochthonous species were identified, of which five were potentially invasive: *Acacia mangium* Willd., *Samanea saman* Jacq., *Gmelina arborea* Roxb., *Melicocas bijugata* Jacq. and *Mangifera indica* L. and five invasive *Bambusa vulgaris* Schrader ex Wendland, *Terminalia catappa* L., *Delonix regia* J. Hooker, *Psidium guajava* L. and *Leucaena leucosefala* (Lam.) of Wit.

Although these invasive allochthonous species are part of the recovery of this area and help to protect the banks, the harmful effects of the same must be taken into account, in this regard Oviedo *et al*., (2012) pointed out "... the detrimental effects of invasive plant species are well recognized and programs have been developed at local, regional, national and global scales to curb their proliferation and mitigate their present and future impacts". It is important to keep in mind that water ecosystems are susceptible to being easily invaded, given the soil and humidity conditions they present.

Natural factors such as floods intervene in this composition, which lead to the arrival of seeds from the upper part of the basin, and anthropogenic factors related to local actors who visit the area for recreational purposes who sometimes carry fruit trees for their food and leave its seeds.

The most representative families were: Meliaceae with 4 species and 43 individuals, Sapindaceae 3 species and 33 individuals, Mimosaceae 3 species and 38 individuals, Anacardiaceae 3 species and 16 individuals, Boraginaceae 2 species and 17 individuals and Fabaceae 2 species and 13 individuals, the others are only represented by one species (Figure 2). Rodríguez *et al*., (2018) agree that they are families that develop in gallery forests.

In the Malvaceae family, despite being represented by a single species, 17 individuals of *T. elatum* were counted in it. The damaging effects of invasive plant species are well recognized, and programs have been developed at local, regional, national and global scales to stop their proliferation and mitigate their present and future impacts".

Another element to consider is that water ecosystems are susceptible to being easily invaded, given the soil and humidity conditions they present (Herrero, 2003). In addition, the *Verbenaceae* family was found, represented by G. arborea, turning out to be the one with the highest abundance (37), a species introduced in this area in 2005 (Mitjans, 2012) with proven economic value (Gonzáles and Serrano, 2004), it must be monitored, because it is an exotic and potentially invasive species, due to its high multiplication and propagation capacity (Oviedo *et al*., 2012).

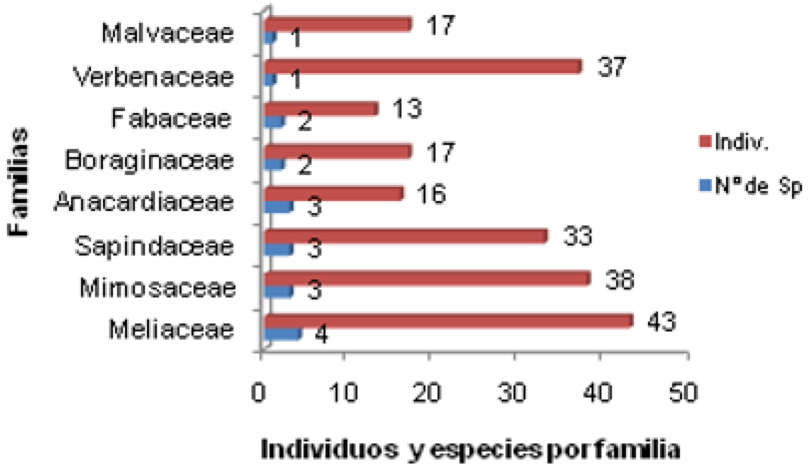

Figure 2. - Number of species and individuals per family present on the banks of the Cuyaguateje river, in the middle third of the basin, CCS Menelao Mora "Vega La Manzanilla"

Simpson index

The Table 1 presents the values corresponding to biodiversity, expressed by the Simpson index and its reciprocal, which show the dominance and diversity of species for each one of the sampling plots, in general, the diversity in each one of the plots resulted with values between 3.19 and 13.50 in margin 1 and between 7.5 and 12 in margin 2, which denotes high disparity between the plots, similar disparity found by Mitjans (2012), who referred that the Lower values are fundamentally given by anthropogenic limitations and not by the characteristics of relief, fertility and soil moisture, which show similarity between the plots, according to the characterization carried out, in this case, the position of the plots also affects in the difference, an example of this is the plot with the highest diversity index (6), in which 27 individuals distributed in 12 species were observed, with a height greater than 2 m; and it is located at a point where the river makes a bend that reduces the speed of the water in the floods, which leads to the deposit and remain for a longer time, the seeds of different species that come in the upper part of the basin (Figure 3).

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Table 1. - Dominance index and its reciprocal, of individuals with $D_{1,30}$ ≥ 2.5 cm per plots in each margin

Margin 1			Margin 2		
Plot	**Dominance (D)**	**Diversity (I/D)**	**Plot**	**Dominance (D)**	**Diversity (I/D)**
1	0,18	5,52	2.1	0,133	7,5
2	0,31	3,19	2.2	0,124	8,05
3	0,11	9,38	2.3	0,123	8,12
4	0,12	8,67	2.4	0,083	12,0
5	0,19	5,34	2.5	0,087	11,48
6	0,07	13,50	2.6	0,091	10,93

Figure 3.- Localization of study plots

Mixing ratio (CM)

The mixing ratio presented a value of 1: 9, indicating that for every 9 individuals sampled it is possible to find a different species and, therefore, this type of forest should be considered heterogeneous.

Jaccard's coefficient of similarity

A large number of species (20) share both margins (Table 2), hence the high value of the Jaccard index (0.69). There is coincidence with the studies carried out by Mitjans (2012), who found high similarity between the species that share the Cuyaguateje margins, the same one mentioned that climatic factors (temperature, humidity, precipitation), soil type and position influence this similarity. latitudinal and the species that exist in the upper part of the basin and around the banks.

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Table 2. - Species that share both margins of the banks of the Cuyaguateje, in the middle third of the basin

Shared species
Acacia mangium **Willd**
Samanea saman **(Jacq.)**
Cordia collococca **L.**
Trichilia hirta **L.**
Bambusa vulgaris **Schrader ex Wendland**
Swietenia mahagoni **L**
Cedrela odorata **L**
Gmelina arborea **Roxb**
Lonchocarpus domingensis **(Pers). DC.**
Comocladia dentata **Jacq.**
Cupania americana **L.**
Guazuma ulmifolia **Lam.**
Tabernaemontana citrifolia **L.**
Sapindus saponarius **L.**
Talipatiti elatum **Frixell (Sw)**
Melicocas bijugata **Jacq.**
Mangifera indica **L.**
Tabebuia angustata **Britt.**
Gerascanthus gerascantoides **L.**
Guarea guidonia **L. Sleumer**

Characterization of horizontal structure

As can be seen in the table presented, in the appendix the most abundant species in the area in ascending order are: *G. arborea*, *S. saman*, *S. saponarius*, *T. citrifolia*, *T. hirta*, *T. elatum*, *G. ulmifolia*, *A. mangium*, *S. mahagoni* and *L. domingensis*. The presence of G. arborea with greater abundance shows how this invasive species has established itself in the area, as is the case with *A. mangium*, which must be taken into account in the management of this ecosystem.

They are also among the most abundant *T. elatum, S. mahagoni*, autochthonous species of recognized economic value; that Herrero (2003) proposed them for the reconstruction or enrichment of the riverbanks.

In general, the presence of species typical of riparian forests is observed such as: *S. saman, S. saponarius, T. hirta, T. citrifolia, T. elatum, G. ulmifolia. L. domingensis, T. angustata* and *G. gerascantoides*, which coincides with the results obtained by Mitjans (2012) referring to this author as the most representative: *G. ulmifolia, S. saman, S. saponaria, L. domingensis, S. mombin, T. hirta*. It seems to indicate that the necessary requirements (environmental, survival strategy and site characteristics) are given for the development of these species. Sanchún *et al.* (2016) report that the source of seeds and dispersal agents also influence these results.

The most common species are: in descending order: *G. arbórea, S. saman, T. elatum, S. saponarius, G. ulmifolia* and *T. hirta.* The most dominant was *B. vulgaris*, with seedlings up to 200 culms with diameters between 4 and 5 cm each being observed; Despite being recognized as invasive (Oviedo *et al.*, 2012) it has great environmental importance due to the coverage it provides to the environment where it grows, the retention of water in the soil, and erosion control. Considered the most widespread and adapted species to Cuban ecosystems, effective in conserving water (López, 2018). On the other hand, the physical qualities, its low cost and availability, make this plant the ideal material for the construction of houses, furniture, decorative utilitarian articles and crafts (González, 2013).

Other species that have recognized economic value were also found, with high dominance, such as: *G. arbórea, T. elatum, A. mangium*.

Diameter structure

The number of individuals per diameter class, the representative number (55 and 71) in classes II and III (Figure 4), causes a distribution that moves away from the inverted J shape observed by Mitjans (2012) in the studied area. Distribution that characterizes the heterogeneous forest in the advanced succession stage, according to Chokkalingam and De Jong (2001).

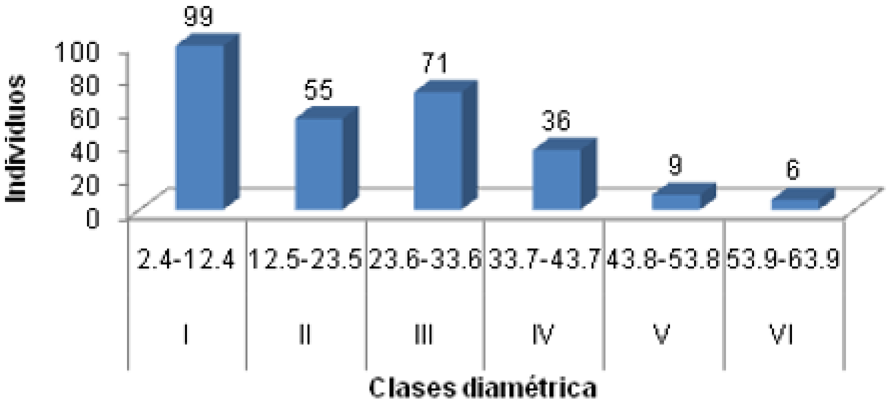

Figure 4. - Distribution of individuals by diameter class in the area under study

Importance value index (IVI)

Five species were identified that have high ecological importance (> 15), in the medium category (15> IVI ≥5) 14 and low (<5) were identified 10. The five species with high ecological importance are: *B. vulgaris, G arborea, S. saman*, *T. elatum, S. saponarius, G. ulmifolia* and among the species of lower ecological weight are: *A. enermis, P. guajava, L. leucocephala, D. regia, T. catappa* (Table 3, appendix).

Vertical structure

The different strata or floors that characterize the forest on both margins (Figure 5), show 93 individuals with height between 2 to 5m, 64 with values between> 5 to 10 m and 125 greater than 10 m. In both margins, the largest number of individuals was observed in the stratum above 10m. The highest height was recorded with values of 21 m (*B. vulgaris*); 34 individuals were recorded with values greater than 15 m, among which are fast growing species such as: *G. arbórea, T. elatum, S. mangium, B. vulgaris.*

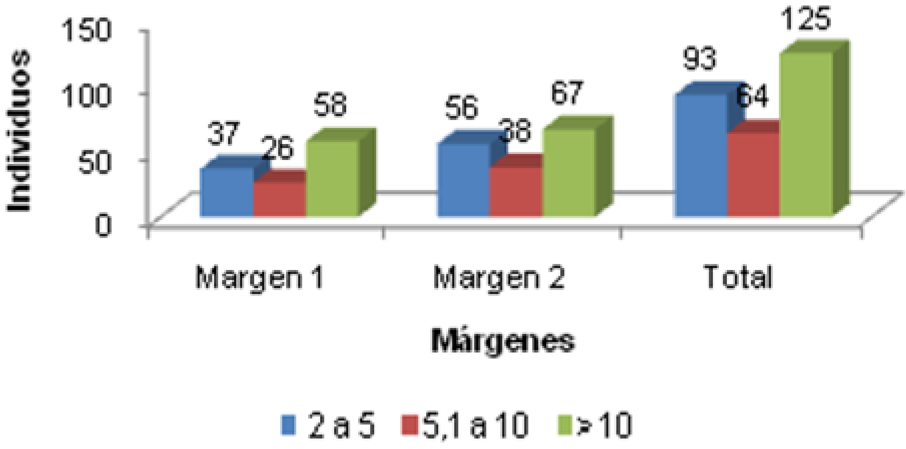

Figure 5. - Vertical structure distributed in three height classes (margins 1 and 2 of the area under study

CONCLUSIONS

There 282 individuals, 29 species, 29 genera and 18 families were registered; 25 species on margin 1 and 24 on margin 2, high similarity between the margins. Ten invasive allochthonous species were identified, five of them point to potentially invasive. The families with the greatest species richness were: *Meliaceae, Sapindaceae, Mimosaceae, Anacardiaceae* and *Boraginaceae.*

Five species with high ecological weight were found (*B. vulgaris, G. arborea, S. saman T. elatum, S. saponarius*), of which only *G. arborea* is not among the proposals for the protection of aquatic systems from Cuba.

The studied ecosystem showed a certain tendency to heterogeneity, evidenced in the disparity in height, diameter, Simpson index and mixing ratio, the latter presenting a high value.

After eight years of passive restoration, changes in the vertical and horizontal structure were observed, with an increase in $D_{1.30}$ and height, although *B. vulgaris* and *G. arborea* remain as the species with the highest IVI.

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APPENDIX

Appendix. - Species present in the riverside forest of the Cuyaguateje river, in the middle third of the basin, CCS Menelao Mora "Vega La Manzanilla"

Species	Family	Ar.	Fr.	Dr.	IVI.
Bambusa vulgaris* Schrader ex Wendland.*	Poaceae	2,13	5,769	62,23	70,126
Gmelina arborea* Roxb.*	Verbenaceae	13,12	7,692	9,90	30,715
Samanea saman* (Jacq.)*	Mimosaceae	8,16	5,769	3,57	17,496
Talipariti elatum* Frixell (Sw)	Malvaceae	6,03	5,769	3,57	15,371
Sapindus saponarius* L.	Anacardiaceae	7,45	5,769	1,79	15,002
Guazuma ulmifolia* Lam.	Sterculiaceae.	5,32	4,808	3,46	13,582
Trichilia hirta* L.	Meliaceae	6,38	5,769	0,32	12,467
Swietenia mahagoni* L	Meliaceae	4,61	3,846	2,40	10,858
Acacia mangium* Willd.*	Mimosaceae	4,61	2,885	3,36	10,853
Tabernaemontana citrifolia* L.	Apocynaceae.	6,38	3,846	0,13	10,361
Lonchocarpus domingensis* (Pers). DC.	Fabaceae	4,26	3,846	1,87	9,975
***Spondias mombin* L ***	Anacardiaceae	2,84	3,846	1,19	7,876
Tabebuia angustata* Britt	Bignonaceae	2,84	3,846	0,83	7,51
Gerascanthus gerascantoides* L.	Boraginaceae	2,48	3,846	1,09	7,418
Cordia collococca* L.	Boraginaceae	1,77	3,846	1,11	6,729
Cephalanthus occidentalis* L.	Rubiaceae	3,19	2,885	0,17	6,251
Guarea guidonia* L. Sleumer.	Meliaceae	2,84	2,885	0,19	5,906
Melicocas bijugata* Jacq.*	Sapindaceae	2,13	2,885	0,17	5,185
Cupania americana* L.	Sapindaceae	2,13	2,885	0,13	5,146
Cedrela odorata* L.	Meliaceae	2,13	1,923	0,70	4,753
Mangifera indica* L.*	Anacardiaceae	1,42	2,885	0,05	4,357
Simaruba glauca* DC.	Simarubaceae	1,77	1,923	0,47	4,167
***Roystonea regia* HBK O. F. Cook. ***	Arecaceae	1,06	1,923	0,51	3,501
Comocladia dentata* Jacq.	Anacardiaceae	1,42	1,923	0,15	3,491
Terminalia catappa* L.*	Combretaceae,	1,06	1,923	0,29	3,273
Delonix regia* J. Hooker.*	Caesalpinaceae	1,06	1,923	0,07	3,055
Leucaena leucocephala* (Lam.) de Wit. *	Mimosaceae	0,71	0,962	0,17	1,843
Psidium guajava* L.*	Myrtaceae	0,35	0,962	0,09	1,401
Andira enermis* Sw	Fabaceae	0,35	0,962	0,02	1,334

Ar- Relative abundance, Fr- Relative frequency, Dr- Relative dominance and IVI-Ecological importance value index. * Native, ** Allochthonous.

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Conflict of interests:

The authors declare not to have any interest conflicts.

Authors' contribution:

The authors have participated in the writing of the work and analysis of the documents.