SCIENTIFIC PUBLICATIONS DEPARTAMENT

Cuban Journal of Forest Sciences

CFORES

Volume 9, Issue 1; 2021

University of Pinar del Río "Hermanos Saíz Montes de Oca"

Director: DrC. Marta Bonilla Vichot
Email: mbon@upr.edu.cu

ISSN: 2310–3469 RNPS: 2347
CFORES Journal, January-April 2021; 9(1):87-102

Translated from the original in spanish

Original article

Current status of *Conocarpus erectus* L., in the coastal sector of Cacongo, Cabinda province, Angola

Estado actual de *Conocarpus erectus* L., en el sector costero Cacongo, provincia de Cabinda, Angola

Situação atual do *Conocarpus erectus* L., no setor costeiro Cacongo, província de Cabinda, Angola

Yuris Rodríguez Matos[1*] https://orcid.org/0000-0002-5032-6362

Surima Orta Pozo[1] https://orcid.org/0000-0001-5159-2227

Modesto González Menéndez[2] https://orcid.org/0000-0003-2265-1894

Orfelina Rodríguez Leyva[1] https://orcid.org/0000-0002-1575-1515

Emir Falcón Oconor[1] https://orcid.org/0000-0001-8833-4942

[1]Guantanamo University. Cuba.
[2]University of Pinar del Río "Hermanos Saíz Montes de Oca", Forestry and Agronomy Faculty, Forestry Department. Pinar del Río, Cuba.

[*]Correspondence author: yurisrodriguezm@gmail.com

Received:09/10/2020.
Approved:24/01/2021.

ABSTRACT

The research was conducted in the period from November 2018 to November 2019, in the coastal sector Cacongo, Cabinda province, in a coastal protection area of 14 ha, with the objective of characterizing the status of the species *Conocarpus erectus*. Different dasometric parameters were evaluated: height (m), diameter (cm); basal area (m2) and

volume (m3); as well as natural regeneration (incipient, established) and mortality (cut trees, dead trees and cut branches). With community participation, the main environmental problems affecting the species were determined by interviewing 65 people individually for 100 % and an observation guide was applied. The species was planted in the first line of the sea, where it does not adapt, it does not have an adequate development, the dynamics of natural regeneration is incipient with few established plants, with a state of the species in each plot that shows the following behavior: 44 dead trees, 134 cut trees and 110 cut branches. The main problems identified in the mangrove ecosystem were inadequate development (92 %), indiscriminate logging (85 %), diseases (74 %), coastal erosion (52 %), road and threshing construction (41 %), sea penetration (32 %) and water pollution (oil) (23 %).

Keywords: Dasometric parameters; Natural regeneration; Main problems and coastal sector.

RESUMEN

La investigación se realizó en el periodo comprendido entre noviembre de 2018 a noviembre de 2019, en el sector costero Cacongo, provincia de Cabinda, en un área protectora del litoral de 14 ha, con el objetivo de caracterizar el estado actual de la especie *Conocarpus erectus*. Se evaluaron diferentes parámetros dasométricos: altura (m), diámetro (cm); área basal (m^2) y volumen (m^3); además, la regeneración natural (incipiente, establecida) y mortalidad (árboles cortados, muertos y ramas cortadas). Con participación comunitaria se realizó la determinación de los principales problemas ambientales que inciden en la especie, para ello se entrevistaron de forma individual a 65 personas para un 100 % y se aplicó una guía de observación. La especie al ser plantada en la primera línea de mar, donde ella no se adapta, no tiene un desarrollo adecuado, la dinámica de regeneración natural es incipiente con pocas plantas establecidas, con un estado de la especie de cada parcela que muestra el siguiente comportamiento: 44 árboles muertos, 134 árboles cortados y 110 ramas cortadas. Los principales problemas que se identificaron en el ecosistema de manglar fueron: inadecuado desarrollo (92 %), tala indiscriminada (85 %), enfermedades (74 %), erosión costera (52 %), construcción de camino y trillo (41 %), penetración del mar (32%) y contaminación del agua (petróleo) (23 %).

Palabras clave: Parámetros dasométricos; Regeneración natural; Principales problemas y sector costero.

RESUMO

A investigação foi realizada no período de Novembro de 2018 a Novembro de 2019, no setor costeiro de Cacongo, província de Cabinda, numa área de proteção costeira de 14 ha, com o objectivo de caracterizar o estado atual da espécie *Conocarpus erectus*. Foram avaliados diferentes parâmetros dasométricos: altura (m), diâmetro (cm); área basal (m2) e volume (m3); além disso, regeneração natural (incipiente, estabelecida) e mortalidade (árvores cortadas, árvores mortas e ramos cortados). Com a participação da comunidade, os principais problemas ambientais que afetam as espécies foram determinados através de entrevistas individuais a 65 pessoas (100 %) e da aplicação de um guia de observação. A espécie, sendo plantada na primeira linha do mar, onde não se adapta, não tem um desenvolvimento adequado, a dinâmica da regeneração natural é incipiente com poucas plantas estabelecidas, com um estado da espécie em cada

parcela que mostra o seguinte comportamento: 44 árvores mortas, 134 árvores cortadas e 110 ramos cortados. Os principais problemas identificados no ecossistema dos manguezais foram: desenvolvimento inadequado (92 %), exploração indiscriminada (85 %), doenças (74 %), erosão costeira (52 %), construção de estradas e debulha (41 %), penetração marítima (32 %) e poluição das águas (petróleo) (23 %).

Palavras chave: parâmetros dasométricos; regeneração natural; principais problemas e sector costeiro, estrada e debulha.

INTRODUCTION

Mangrove ecosystems are one of the most threatened ecosystems in the world; their existence is even more endangered than that of tropical forests and coral reefs, with a 60 % loss of biodiversity (Marcelo *et al*., 2018).

Mangrove forests provide different services to humankind, among which are the protection they provide to the coastline against storms and hurricanes, they also stabilize sediments and function as biological filters, they are areas of high landscape value, because they are home to a great biodiversity and function as places for the breeding of fish and invertebrates of commercial importance (FAO 2018).

In spite of the ecological and economic importance of mangroves, their distribution is subject to the balance or development of human communities settled on the coasts, where there is destruction mainly due to urban development, indiscriminate logging, firewood, aquaculture and overexploitation for human consumption of the species found in this ecosystem (Marcelo *et al*., 2018).

The continuous degradation of natural resources endangers not only terrestrial and aquatic production, but also the penetration of saline water into adjacent agricultural soils, the compaction and desertification of these, causing the deterioration of different ecosystems, in addition to the fact that the salinity curve covers a much larger area compared to previous periods (Graziano 2018).

The Cabinda province, Cacongo coastal sector, does not escape from the problems mentioned above, where there is a transformation of socioeconomic activities and increased pollution of the waters that enter the seas, affecting the species *C. erectus*, in its dasometric development, and ecological consequences for the conservation of biodiversity in this ecosystem.

Therefore, the objective of this study was to characterize the status of *C. erectus* in the coastal sector of Cacongo, Cabinda province, Angola.

MATERIALS AND METHODS

Characterization of the study area

The study was conducted in the period between November 2018 to November 2019, in the mangrove ecosystem of the coastal sector Cacongo, Cabinda province (Figure 1), in an area of 14 ha, where its function is protective of the coastline.

Figure 1. - Location of the study area

Edaphic characterization of the study area

These soils are classified as oxixois, with deep horizon characteristics, red-yellow, with excellent structure and low fertility, they were also described with an A, B, C profile, when they present transition horizons, deep, with a moderately deep brown to yellowish brown A horizon, with color 10 YR 5/8 to 7.6 YR 6/8. The clay can be less than 50 % and the sand fraction acquires high values, which can vary from 30 to 60 %, where fine sand predominates and the apparent density acquires relatively high values, varying between 1.25-1.45 g cm-^{3}, which translates into total porosity values between 60-45 % (FAO, 2006).

The same author explains that the characteristics of the chemical properties show that in the upper horizons the organic content ranges between 2.26-3.86 % and a pronounced decrease with depth, slightly acidic pH between 5.5 - 6.6 and its degree of saturation ranges between 45 to 60 %.

Climatic characterization of the study area

Figure 2 represents the climatic characteristics of the Cabinda municipality, according to the meteorological station, from 2008 to 2019. The average annual temperatures are 34, 58 ºC and the average annual rainfall is 909 mm. The driest months are from April to the second half of October and in the month of December, while from January to the first half of April are rainy and the month of November is the rainiest, above 100 mm. In general, it is characterized by a dry climate.

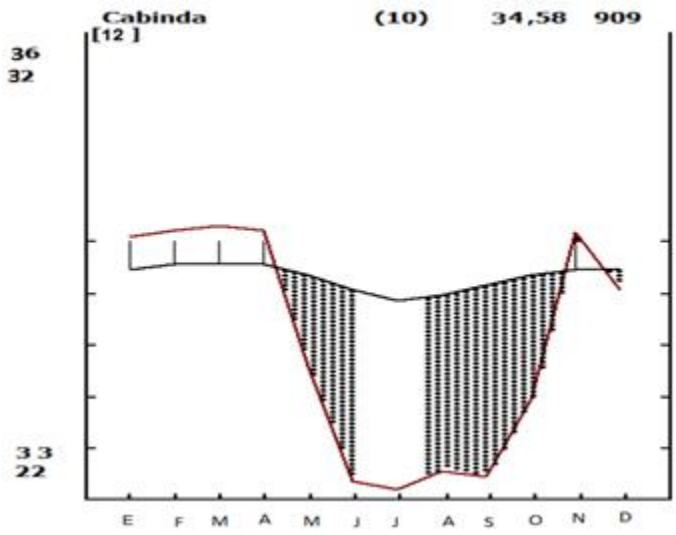

Figure 2. - Climogram of the Cabinda Meteorological Station (2008-2019)

Data collection

There were 21 plots of 10 m X 10 m (100 m^2), separated by 10 m, according to Guzmán and Menéndez. (2013). The method used in the sampling was systematic with plots aligned perpendicularly to the coast, recommended by FAO (1994), cited by Rodríguez (2016), using as variable of interest the volume (V ha^{-1}).

In order to calculate the sample size, it was first necessary to determine the sampling intensity (f) (Equation 1).

$$f = \frac{n}{N} \quad (1)$$

f = sampling intensity.

Where:
f= fraction or sampling intensity;
n= number of units or area sampled;
N = number of population units or total area.

As (1-f) > 0.98; the population is infinite and the following formula is used (Equation 2).

$$n = \frac{t^2 s_x^2}{E^2} \quad (2)$$

Based on the variance (Equation 3).

$$n = \frac{t^2 (cv\,\%)^2}{(LE\,\%)^2} \quad (3)$$

As a function of the coefficient of variation (Equation 4).

$$n = \frac{t^2 (cv\,\%)^2}{(LE\,\%)^2} \quad (4)$$

Where:
t= Student's t-distribution for a significance level of 0.05;
s^2= variance;
E= error;
cv= coefficient of variation;
LE= error limit.

The following formulas were used to determine the sampling errors (Equation 5).

$$\text{Absolute error:} \quad E_a = \pm t * s_{\bar{x}}$$

$$\text{Relative error:} \quad E_r = \pm \frac{t * s_{\bar{x}}}{\bar{x}} * 100 \quad (5)$$

Determination of dasometric parameters, natural regeneration and mortality.

Measurement variables

All trees in the plots were evaluated by measuring the dasometric variables: height (m), diameter (cm), basal area (m^2) and volume (m^3) (Equation 6).

$$G = F\sum_{i=1}^{m} g \; = F\sum_{i=1}^{m} \frac{\pi}{4} d^2 \quad (6)$$

Basal area (m^2).

Average volume (m^3) (Equation 7).

$$\overline{V} = \frac{\pi}{4} d_i^2 * (h + 3) * f_e \quad (7)$$

Basal area per hectare (m^2 ha^{-1}) (Equation 8).

$$Gha^{-1} = F\sum_{i=1}^{m} g_i = F\sum_{i=1}^{m} \frac{\pi}{4} d_i^2 \quad (8)$$

Volume per hectare ($m^3\ ha^{-1}$) (Equation 9).

$$Vha^{-1} = F\left(\sum_{i=1}^{m} \frac{\pi}{4} d_i^2 * h_i * f_i\right) = F\left(\sum_{i=1}^{m} g_i * h_i * f_i\right) \text{ o } \quad Vha^{-1} = F\left(\sum_{i=1}^{m} v_i\right) \quad (9)$$

Regeneration

For the determination of this parameter, the subplot method was used (Guzmán and Menéndez 2013), which consists of erecting 1 m^2 (1 x 1 m) plots at the corners and in the center of each 100 m^2 plot where the height of all plants present in the plots is measured. The evaluation criteria are as follows:

Incipient: from 0 to 0.50 m.

Established: from 0.50 to 1 m.

Status of the species

To determine this parameter, the status of the species was quantified for each 100 m^2 plot (Guzmán and Menéndez, 2013). The evaluation took into account the dead trees, cut trees and cut branches.

Identification of the main environmental problems

The identification of the main problems was developed based on the methodological basis of the Participatory Rural Appraisal (PRA) (Schorhuth and Kievelitz 1994).

In order to obtain the necessary information, various tools were used, such as: interviews with 65 people, for 100 % of the community, exploratory tours and direct observation of the field Geilfus (1997), to identify the effects on the species *C. erectus.*

The interviews were conducted with open-ended questions (Annex 1).

Direct field observation and exploratory tours were carried out in order to determine the irregularities of the problems caused by the activities carried out by the inhabitants and their impact on the deterioration of the mangrove forest, the coastal zone, the environment in general, and the community's surroundings (Annex 2).

Statistical processing

For data processing, the statistical program Stadistical Package for Social Science (SPSS) ver. 15.0 for Windows was used to perform a descriptive analysis.

RESULTS AND DISCUSSION

Sampling intensity

Table 1 shows the sample size calculation that was performed for an error of ±10 % and a probability of 95 %. The variable of interest was the volume per hectare (V ha^{-1}).

(V ha^{-1}), and when the 21 plots of 100 m^2 gathered in the pilot sampling were statistically processed, it was determined that they were sufficient, which infers that the sampling carried out is representative.

It can be stated that when determining the relative error, it indicates that the sample size is reliable, with a relative error of 8.13 %, below that proposed, which indicates that the sample is representative for the volume per hectare in the research area.

Table 1. - Sample size in the ecosystem of the mangrove species

Variable	Value	U/M
Sample number	21	-
Average	30,380	m^3 ha^{-1}
Variance (S_x^2)	0,004	m^3 0,01 ha
Standard deviation(S_x**)**	0,066	m^3 0,01 ha
Relative error (E_r)	8,13	%

Behavior of dasometric parameters, natural regeneration and mortality of the species

The dasometric parameters of the species show a height (H) of 4.49 m, diameter ($D_{1.30}$) 16 cm, basal area (G) 26.83 m^2 ha^{-1} and volume (V) 6.38 m^3 ha^{-1}.

It is of great importance to highlight that this species is located in the first coastal strip, in direct contact with seawater, so there is abundant salt circulation, which does not allow the different dasometric parameters to develop adequately.

Similar results were reached by Pinheiro and Talamoni (2018) when explaining that this species generally inhabits the highest parts and on sandy and less salty soils. In addition, it often develops as shrubs and in favorable places, as trees, with a height of 4 to 7 meters. They also agree with these values Núñez and Ugas (2018) who clarify that the species *C. erectus*, presents salt-secreting glands, which makes it resistant to these ecosystems, but farther from the sea, and recorded values between 2.56 and 6.97 m in height, in a study conducted in the Unare Lagoon, Venezuela.

These results coincide with Orjuela *et al*., (2011) when they state that in order for the species *C. erectus* to give good values in terms of basal area, it is important for it to develop under favorable soil and climatic conditions, so that it can adapt to salinity conditions and nutrient absorption.

Natural regeneration

In the case of natural regeneration (Table 2), it is observed that there is not an adequate recovery of the species *C. erectus*, because it does not manage to establish itself in its totality, due to the edaphoclimatic conditions that affect its germinative development and because it is in the first strip of the sea, with high salinization.

Table 2. - Natural regeneration of the species

Species	Incipient	Established
C. erectus	87	95

This number of individuals of small diameters and low height, characterize the structure of the ecosystem in this area, with a dynamic of little regeneration and growth, with few plants due to the adaptability and the edaphic conditions and salty water.

Similar results were reached by Moreno and Infante (2016), explaining that this species of mangrove, C. erectus, lives further inland, in the highest and sandiest part of the mangrove. Therefore, it is the one that is most felled, to extend the cattle lands and is always associated with the other species, but where there is low tidal influence.

In order to reach an ecological balance in these ecosystems, it is important to take into account the aspects of adaptability, with the objective of a future recovery of the mangrove species. In this regard, Reyes and Tovilla (2002) explain that where the flood level is permanent, the survival of *Rhiphozora mangle* L. plants is assured, while *C. erectus* does not have an adequate development.

The rehabilitation of mangroves through natural regeneration is relatively inexpensive and its management requires little work. Walters *et al.,* (2008), who make it clear that it leads to better root development in the early stages and causes less disturbance to the soil, report similar results. Vargas (2015) and Rodríguez *et al*., (2018) also recognize the importance of natural regeneration, which allows plant species to remain over time.

Similar results were reported by Rodríguez *et al*., (2014), in a mangrove forest of the coastal sector Cortés, in Pinar de Rio. They affirm that the behavior of natural regeneration is good and the quality of plants is evidenced when conditions are favorable for their morphological and physiological development.

These results are also agreed with by Sánchez (2017) and Ravelo and Pérez (2018) in explaining that *C. erectus* seeds are recalcitrant. Therefore they cannot be stored at low temperatures; they can lose viability quickly, which is why they must be sown immediately, also making it clear that regeneration can have many causes: lack of seed trees, irregular seed production, high rates of seed predation, low germination rates and also, insufficient light.

Status of the species

Table 3 shows the status of the species by plot, with a total of 541 trees, including 64 dead trees, 134 cut trees and 110 cut branches due to human action.

Table 3. - Status of the species

plot	No. of trees per plot	Species status			plot	No. of trees per plot	Species status		
		Dead trees	Cut trees	Cut branches			Dead trees	Cut trees	Cut branches
1	35	6	11	9	12	24	2	6	5
2	31	4	8	7	13	26	3	6	2
3	36	5	6	6	14	36	3	5	3
4	16	4	7	4	15	19	1	4	5
5	31	4	8	7	16	16	3	7	4
6	30	3	6	8	17	23	1	5	3
7	17	5	9	6	18	28	2	6	4
8	24	3	9	8	19	22	1	5	3
9	31	4	7	7	20	26	2	6	3
10	19	3	2	5	21	29	2	5	4
11	22	3	6	7	**Total**	**541**	**64**	**134**	**110**

These results show that the number of dead trees is because this species does not adapt to the edaphoclimatic conditions, since it develops adequately in areas of low salinization, a condition that was not taken into account at the time of planting.

Regarding the amount of dead trees, cut trees and cut branches, Chargoy and Hernández (2002) and González *et al.,* (2016) agree, reporting that there are also other problems that affect the mangrove forest, such as the inappropriate use of forest and fishery resources, in addition to that, there are illegal exploitation of forest resources and soil extraction.

Main problems identified

Figure 3 shows the main problems identified in the mangrove forest and in the *C. erectus* species: inadequate development (92 %), indiscriminate logging (85 %), diseases (74 %), coastal erosion (52 %), road construction (41 %), sea penetration (32 %) and water pollution (oil) (23 %).

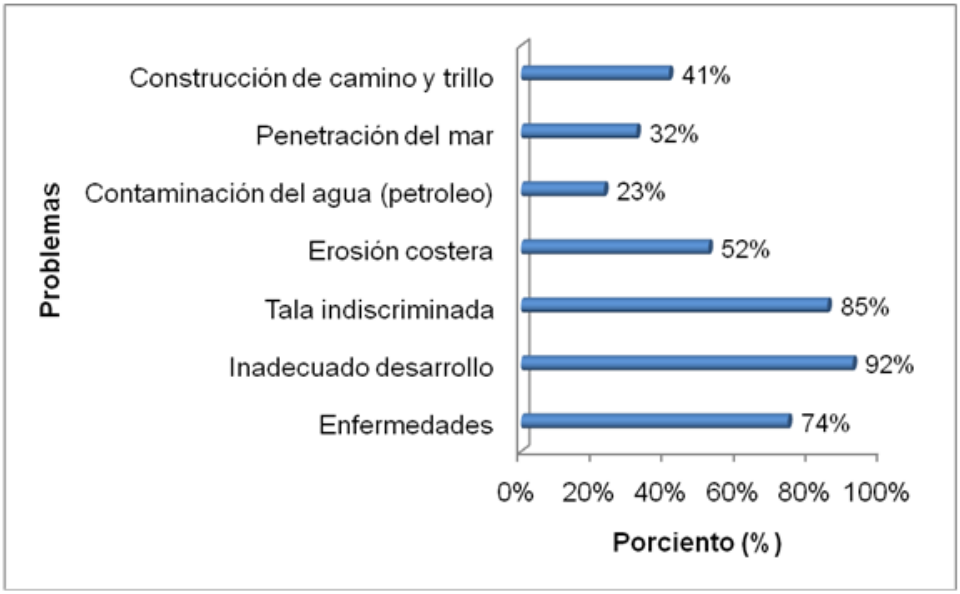

Figure 3. - Main problems identified in the ecosystem of the *C. erectus* species

Rodríguez *et al.,* (2014) when performing a comprehensive analysis of all the problems obtain similar results. They explain that the reported problems that damage the mangrove forest are soil deterioration and indiscriminate logging, in addition to coastal erosion and desertification.

In order to manage this ecosystem in a rational way, it is necessary to achieve a precise work in the area, with people in order to achieve an adequate development and to know how to conserve the different resources that exist. With these results, Marcelo *et al*., (2018) agree when they state that the mangrove ecosystem is one of the most subject to deterioration, due to the irrational use of its resources, beyond its recovery capacity; in addition, the polluting waste from industries also affects the feeding and reproduction of aquatic life, both plants, insects and fish.

CONCLUSIONS

The average dasometric parameters in the different variables show that there is not a good development of the species *Conocarpus erectus*. The species *Conocarpus erectus* has a dynamic of little natural regeneration and low increments, as it is located in the first strip of the sea. Anthropic actions that affect the development of the species *Conocarpus erectus* were identified in the ecosystem.

ANNEXES

Annex 1. Individual interview guide.

1. What type of fuel is used in your home for cooking?

2. In the case of using firewood from the Mangrove, it is through:

___Cuts healthy standing trees. _____Cuts dead or diseased standing trees ___Waste from fallen branches and trunks. _____Others.

3. Do you know the mangrove?

4. Do you attribute any importance to it?

5. If the above answer is affirmative, please answer:

_____Provides firewood and charcoal. _____To catch crabs. _____ To castrate honeys _____ To hunt hutias. _____ To harvest oysters. _____ Hunting _____Sowing rice.

6. The capture of fish and crustaceans is generally done in:

_____The platform _____Open sea_____ In the mangrove.

7. Of the capture species, which of them do you know that inhabit the coastline for some time?

8. Do you know if the mangrove influences fishing yields?

Yes _____ No_____

If the answer above is yes, please explain why.

9. Have you observed any changes in the presence of underwater weeds on the beaches or near the coast?

Yes _____ No _____

10. Do you know if any of the following are discharged into the sea?

_____ Oil from ships. _____ Solid or liquid waste from industry_____ Construction waste_____ Sewage_____ Other.

11. Have you noticed any significant changes in:

_____ tide levels? _____ coastal vegetation? _____ temperature?

_____ soil? ___ coastline? _____ the salinity of the coastal waters?

12. Do you attribute any importance to mangroves?

Yes _____ No _____

For being:

_____ Coastal protector _____ For catching crabs. _____ For fishing. _____ To cut firewood _____ To hunt. _____ To castrate honeys.

13. How do you consider their current condition?

_____ Bad _____ Fair _____ Good _____ Good

14. Is there any prohibition by the Institute of Forestry Development (IDF) and Environment to use mangrove firewood?

15. Have there been any environmental training activities in the community?

Annex 2. Observation guide.

The purpose of the observation is to verify in the field the regularities that occur in the management of coastal ecosystems by the inhabitants and the impact of these activities on the deterioration of the environment, in the mangrove forest and in general.

It is carried out in coordination with the community and the direct participation of the inhabitants, collecting the most relevant objective evidence that reflects the current state of the coastal zone.

Aspects to keep in mind during field observation

- Coordinate with the villagers the selection of sites to be visited, as well as the routes to travel to the area.
- Evaluate the percentage (%) of the area affected by anthropogenic action and the management techniques used.
- Determine the natural components that are affected by inappropriate use.
- Identify the environmental problems generated by mangrove overexploitation and describe them: erosion, deforestation, desertification, and others.
- The observations will be registered with digital photographs as real evidence of the observed objects.

REFERENCES

CHARGOY, M.A.R. y HERNÁNDEZ, C.T., 2002. Restauración de áreas alteradas de manglar con *Rhizophora mangle* en la Costa de Chiapas. *Madera y Bosques* [en línea], vol. 8, pp. 103-114. [Consulta: 14 octubre 2020]. ISSN 2448-7597. DOI 10.21829/myb.2002.801294. Disponible en: https://myb.ojs.inecol.mx/index.php/myb/article/view/1294.

FAO, 2006. World Reference Base: Mapa Mundial de Suelos, escala 1: 30 000 000. S.l.: FAO, EC, ISRIC.

FAO, 2018. El estado de los bosques del mundo - Las vías forestales hacia el desarrollo sostenible. Roma: FAO.

GEILFUS, F., 1997. *80 herramientas para el desarrollo participativo: diagnóstico, planificación, monitoreo, evaluación* [en línea]. S.l.: IICA. Disponible en: https://books.google.com.cu/books/about/80_herramientas_para_el_desarrollo_parti.html?hl=es&id=jVTUkFstuIIC&redir_esc=y.

GONZÁLEZ-HERNÁNDEZ, L., SOL-SÁNCHEZ, Á., PÉREZ-VÁZQUEZ, A., OBRADOR-OLAN, J.J., GONZÁLEZ-HERNÁNDEZ, L., SOL-SÁNCHEZ, Á., PÉREZ-VÁZQUEZ, A. y OBRADOR-OLAN, J.J., 2016. Sobrevivencia y crecimiento de mangle negro (*Avicennia germinans* L.) en plantaciones reforestadas y regeneración natural. *Revista mexicana de ciencias agrícolas* [en línea], vol. 7, no. SPE14, pp. 2769-2782. [Consulta: 14 octubre 2020]. ISSN 2007-0934. Disponible en: http://www.scielo.org.mx/scielo.php?script=sci_abstract&pid=S2007-09342016001002769&lng=es&nrm=iso&tlng=es.

GRAZIANO, J., 2018. Las vías forestales hacia el desarrollo sostenible de los bosques del mundo. *FAO (Organización de las Naciones Unidas para la Alimentación y la Agricultura)*, ISSN 1020-5721.

GUZMÁN, J.M. y MENÉNDEZ, L., 2013. *Protocolo para el monitoreo del ecosistema de manglar* [en línea]. La Habana: Proyecto GEF/PNUD. ISBN 978-959-287-042-0. Disponible en: https://www.cifor.org/publications/pdf_files/WPapers/WP117Kauffman.pdf.

MARCELO, A., PINHEIRO, A. y CAROLINA, A. 2018. Educação Ambiental sobre Manguezais. 1ª Edição. Universidade Estadual Paulista "Júlio de Mesquita Filho" (UNESP) Instituto de Biociências (IB), Câmpus do Litoral Paulista (CLP). Brasil. ISBN: 978-85-61498-08-5, pp. 165. Disponible en: https://www.clp.unesp.br/Home/publicacoes/educacao-ambiental-sobre-manguezais.pdf

MORENO, P. y INFANTE, D., 2016. *Conociendo los Manglares, las Selvas Inundables y los Humedales Herbáceos* [en línea]. Primera edición. Disponible en: http://www.inecol.mx/inecol/libros/Conociendo_los_manglares,_ as_selvas_ pdf.

NÚÑEZ, F. y UGAS, M. 2018. Caracterización ûsionómica del manglar de *Avicennia germinans* y *Conocarpus erectus* emplazado en la Laguna de Unare, Venezuela Terra Nueva Etapa, vol. XXXIV, núm. 55, ISSN: 1012-7089, Universidad Central de Venezuela, Venezuela, pp. 21. Disponible en: http://www.redalyc.org/articulo.oa?id=72156172015.

ORJUELA-ROJAS, A.M., VILLAMIL, C.A. y SANJUAN-MUÑOZ, A., 2011. Extensión and structure of mangrove forests in the baja guajira, colombian caribbean. *Boletín de Investigaciones Marinas y Costeras - INVEMAR* [en línea], vol. 40, no. 2, pp. 381-399. [Consulta: 14 octubre 2020]. ISSN 0122-9761. Disponible en: http://www.scielo.org.co/scielo.php?script=sci_abstract&pid=S0122-97612011000200009&lng=en&nrm=iso&tlng=es.

PINHEIRO, M. y TALAMONI, A., 2018. *Educação ambiental sobre Manguezais. Ia Edição São Vicente* [en línea]. S.l.: Universidade Estadual Paulista "Júlio de Mesquita Filho" (UNESP) Instituto de Biociências (IB), Câmpus do Litoral Paulista (CLP). ISBN 978-85-61498-08-5. Disponible en: https://www.clp.unesp.br/Home/publicacoes/educacao-ambiental-sobre-manguezais.pdf.

RAVELO, F.N. y PÉREZ, M.U., 2018. Caracterización fisionómica del manglar de *Avicennia germinans* y *Conocarpus erectus* emplazado en la Laguna de Unare, Venezuela. *Terra. Nueva Etapa* [en línea], vol. XXXIV, no. 55, pp. 193-218. [Consulta: 14 octubre 2020]. ISSN 1012-7089, 2542-3266. Disponible en: https://www.redalyc.org/articulo.oa?id=72156172015.

REYES, M. A. y TOVILLA, C., 2002. Restauración de áreas alteradas de manglar con *Rhizophora mangle* en la Costa de Chiapas. Revista Madera y Bosques, Vol. 8 Número especial 1. ISSN: 1405-0471, pp.103-114. Disponible en: https://www.redalyc.org/pdf/617/61709806.pdf

RODRÍGUEZ, O.L., 2016. Estado actual del bosque de manglar en el lote 2 de la Reserva Ecológica Baitiquirí, Guantánamo. *Revista Cubana de Ciencias Forestales* [en línea], vol. 4, no. 2, pp. 207-219. [Consulta: 14 octubre 2020]. ISSN 2310-3469. Disponible en: http://cfores.upr.edu.cu/index.php/cfores/article/view/203.

RODRÍGUEZ, O., FALCÓN, E., FERNÁNDEZ, M.C., RODRÍGUEZ, E. y ROMERO, C.V., 2014. Estado actual del bosque de manglar en el sector costero Caimanera. *Revista electrónica «Hombre, Ciencia Tecnología»*, vol. 34, no. 71, pp. 10-25. ISSN 1028 08712014. Disponible en: https://dialnet.unirioja.es/descarga/articulo/5768628.pdf

RODRÍGUEZ, O.L., OCONOR, E.F., CASTILLO, C.V.R. y CRESPO, G. de la C.R., 2018. Propuesta de acciones para recuperar el bosque de manglar en la bahía de Guantánamo, Cuba. *Revista Cubana de Ciencias Forestales* [en línea], vol. 6, no. 2, pp. 224-239. [Consulta: 14 octubre 2020]. ISSN 2310-3469. Disponible en:http://cfores.upr.edu.cu/index.php/cfores/article/view/336.

SÁNCHEZ, J., 2017. *Conocarpus erectus L.* [en línea]. 2017. S.l.: PlanFor.es. Disponible en: http://www.arbolesornamentales.es.

SCHORHUTH, M. y KIEVELITZ, U., 1994. *Diagnóstico Rural Rápido Participativo. Métodos de Diagnóstico y Planificación en la Cooperación al Desarrollo*. S.l.: Gesellschaftfur Technische Zusammenarbeit. GTZ. GmbH.

VARGAS-FONSECA, E., 2015. Capacidad de regeneración natural del bosque de manglar del Estero Tortuga, Osa, Puntarenas, Costa Rica. *Rev. biol. trop* [en línea], pp. 209-218. [Consulta: 14 octubre 2020]. Disponible en: http://www.scielo.sa.cr/scielo.php?script=sci_arttext&pid=S0034-77442015000500209.

WALTERS, B.B., RÖNNBÄCK, P., KOVACS, J.M., CRONA, B., HUSSAIN, S.A., BADOLA, R., PRIMAVERA, J.H., BARBIER, E. y DAHDOUH-GUEBAS, F., 2008. Ethnobiology, socio-economics and management of mangrove forests: A review. *Aquatic Botany* [en línea], vol. 89, no. 2, pp. 220-236. [Consulta: 14 octubre 2020]. ISSN 0304-3770. DOI 10.1016/j.aquabot.2008.02.009. Disponible en: http://www.sciencedirect.com/science/article/pii/S0304377008000417.

Conflict of interests:
Los autores declaran no tener conflictos de intereses.

Authors' contribution:
Yuris Rodríguez Matos: Conception of the idea, literature search and review, instrument making, instrument application, compilation of information resulting from the instruments applied, statistic análisis, preparation of tables, graphs and images, general advice on the topic addressed, drafting of the original (first version), review and final version of the article, article correction, authorship coordinator, translation of terms or information obtained, review of the application of the applied bibliographic standard.

Surima Orta Pozo: Conception of the idea, literature search and review, instrument making, instrument application, compilation of information resulting from the instruments applied, statistic analisis, general advice on the topic addressed, drafting of the original (first version), review and final version of the article, article correction, authorship coordinator, translation of terms or information obtained, review of the application of the applied bibliographic standard.

Modesto González Menéndez: Lliterature search and review, instrument making, compilation of information resulting from the instruments applied, statistic análisis, general advice on the topic addressed, drafting of the original (first version), review and final version of the article, translation of terms or information obtained.

Orfelina Rodríguez Leyva: Instrument making, preparation of tables, graphs and images, database preparation, drafting of the original (first version), review and final version of the article, translation of terms or information obtained, review of the application of the applied bibliographic standard.

Emir Falcón Oconor: Instrument making, preparation of tables, graphs and images, database preparation, drafting of the original (first version), review and final version of the article, translation of terms or information obtained, review of the application of the applied bibliographic standard.

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International license.
Copyright (c) 2021 Yuris Rodríguez Matos, Surima Orta Pozo, Modesto González Menéndez, Orfelina Rodríguez Leyva, Emir Falcón Oconor