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Hancornia speciosa Gomes colonization in restinga environments in tropical climate areas

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Abstract

The presence of *Hancornia speciosa* Gomes (mangabeira) in tropical climate areas is linked to the edaphoclimatic conditions demanded by this specie that is found in Brazil, spread from the state of Amapá to Espírito Santo. The general objective of this study was to discuss the colonization of *Hancornia speciosa* Gomes in restinga environments in tropical climate areas. It is an research is applied type research, with a qualitative-quantitative approach, emphasizing procedures as bibliographical and documentary research, besides 49 technical visits in the spatial between the years of 2013 and 2019, that it was included Master's and Doctoral studies, funded by CAPES and CNPq. The adoption of a geographic concept of restinga allowed a better visualization and analysis of this environment, which presents the ideal soil and climate conditions for mangrove development, even though it has been threatened to the detriment, mainly, of urban sprawl. It is worth mentioning the proposal of classification of the restinga environments, once it allows a better biogeographic analysis of these transition environments in the Dunas - Restinga - Mata Atlântica trinomial. These three formations are considered as the ecological niche of mangabeira. Now days, restingas, despite the intense environmental vulnerability process that has transformed the natural environment into an anthropic and fragmented landscape, climatic and soil conditions still produce significant environmental conditions for the development of this specie. It is concluded that the colonization of populations of *Hancornia speciosa* Gomes in restingas is possible due to the abiotic, biotic factors and the evolutionary capacity of the species, represented by the dispersion.
Keywords: transition environments; soil and climatic conditions; mangabeira; ecological niche.

Resumo

A presença da *Hancornia speciosa* Gomes (mangabeira) em áreas de clima tropical está ligada às condições edafoclimáticas exigidas por essa espécie, as quais são encontradas no Brasil, desde o Amapá ao Espírito Santo. O objetivo geral desse estudo foi discutir a colonização de população de *Hancornia speciosa* Gomes em ambientes de restinga em áreas de clima tropical. A pesquisa é do tipo aplicada, com uma abordagem quali-quantitativa, com destaque para alguns procedimentos que foram desde pesquisa bibliográfica e documental, além de 49 visitas técnicas no recorte espacial entre os anos de 2013 e 2019, que englobaram estudos de Mestrado e Doutorado, financiados pela CAPES e pelo CNPq. A adoção de um conceito geográfico de restinga permitiu uma melhor visualização e análise desse ambiente, que apresenta as condições de solo e clima ideais para o desenvolvimento da mangaba, mas que tem sido ameaçado em detrimento, principalmente, da expansão urbana. Merece destaque a proposta de classificação dos ambientes de restinga, que permitem uma melhor análise biogeográfica desses ambientes de transição no trinômio Dunas – Restinga – Mata Atlântica. Considera-se esses três ambientes como o nicho ecológico da

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mangabeira. Atualmente, as restingas, apesar da intensa vulnerabilidade ambiental, que tem transformado o ambiente natural numa paisagem antropizada e fragmentada, as condições climáticas e de solo ainda produzem condições ambientais significativas para o desenvolvimento dessa espécie. Conclui-se que a colonização de populações de *Hancornia speciosa* Gomes nas restingas é possível devido aos fatores abióticos, bióticos e pela capacidade evolutiva da espécie, representada pela dispersão.
Palavras-chave: ambientes de transição; condições edafoclimáticas; mangabeira; nicho ecológico.

I. INTRODUCTION

The word restinga is extremely controversial, both in its origin (whether it is Portuguese, Spanish or even English), and its meaning, mainly in Brazil, where it has been used without any criterion since at least 1936. On the other hand, the meaning comes from a natural process using the designation of compartments, not yet perfectly understood, one must take precedence over language precision. However, especially in Brazil, the term has been applied referring, in fact, to sedimentary deposits of several origins, although they are most related to coastal or coastal processes. In addition, a similar procedure has been adopted, when the term refers to phyto-physiognomic concepts related to botany and plant ecology (SOUZA et al., 2008).

The etymological origin of the word "Restinga" is doubtful (BUENO, 1974). According to Pinto (1899), "Restinga" is referred to as a Portuguese word. However, according to Schwartz (1982), the word "Restinga" is of Spanish origin, and its use has been recorded since the 15th century. For J. Corominas (BUENO, 1974) and also Schwartz (1982), the word can be derived from the English term "rocky string" (rocky: string, string, string), which could be translated as " cord, rocky point; series of cliffs ". In Spanish, there is the "Restringa" variant, which is very close to that term (Souza et al., 2008).

Specialists from various areas of knowledge, including geographers, present a wide range of concepts for the restinga environmental system, generating conflicts that involve the use of the term here in Brazil. Therefore, the concept of restinga can vary depending on the aspect considered, for analysis purposes, such concepts will be classified into two forms: those linked to the sandy terrain and those linked to the vegetation cover. Such a variety points controversies in the various means, causing problems in the application of the current environmental legislation to coastal areas where the term is adopted.

It is not always perceived in its value, extension and importance, the restinga is, among others, the most affected environments of the Brazilian coastal strip. From a geological-geomorphological point of view, this ecosystem consists of strips of sand deposited parallel to the coast, thanks to dynamic processes of destruction and construction of the oceanic waters. They are composed of successive deposits of sand, bars at

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the mouths of rivers, small lagoons dammed between the different strips of sand. These quaternary deposits are associated, in their formation, with supply of sediments, action of marine currents along the coast, sea level variation, exposing previously submerged sandbanks, and the presence of natural obstacles such as offshore reefs, which block sediment flows and form sand banks. Therefore, the species of flora and fauna that live there are adapted to conditions such as sandy and unstable soil, strong and direct insolation, salinity, influence of oceanic winds and relative water scarcity (FURLAN; NUCCI, 1999).

The lack of clarity in the application of the forest law has an inverse effect from what is desired, mainly with the increase of the anthropic pressure by the occupation of natural environments. Add to this clandestine occupation that, despite the restrictions of environmental legislation, licensing and environmental studies, goes through protected areas. Nevertheless, there is still doubt in the characterization of this situation of permanent preservation, due to the lack of technical precision in its regulation.

The absence of the application of legislation or a better definition of what will become the environmental system of restinga, has caused several interpretations that have taken this system to a high level of pressure being often greater than the capacity of resilience of it.

For the purposes of this study, it endorses Costa and Melo e Souza (2016) statement,

> taking into account: the polysemy existing in the word; the frequent use of the term restinga to represent coastal plain and vice versa; similar genesis; that the location of the restinga vegetation (botanical meaning) lies on the coastal plain; and despite all the criticism constructed to justify different environments; for the purposes of this analysis, in the geographic sense, it is considered as restinga the part of the coastal plain, except for the beach, dunes, tombstones, among other sub-environments, covered or not by vegetation and mainly, occupied or not by man, having as internal limit the coastal trays.

Therefore, Araújo and Lacerda's (1987) statement is endorsed, due to the difficulty of distinguishing between different geomorphological features.

The substrate on which the different vegetation types are developed is usually the coastal plain, whose genesis depends on a varied set of factors, as can be seen in Suguio and Tessler (1984) and Villwock (1994). To be clear that the vegetation covering any area of the planet is conditioned by three primary factors: climate, soil and history of disturbances (BROWN; LOMOLINO, 2006).

Lopes (2007), the diversity of uses for the word Restinga has generated problems of understanding, even among biologists and ecologists, since identical plant formations have been called different ways.

Among the plant formations present in the restinga environment, it is worth mentioning *Hancornia speciosa Gomes*. According to Koch (et al., 2014),

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the mangabeira is found in all regions of Brazil: North (Amazonas, Amapá, Pará, Rondônia, Tocantins), Northeast (Alagoas, Bahia, Ceará, Maranhão, Paraíba, Pernambuco, Piauí, Rio Grande do Norte, Sergipe) (Southeastern Brazil), Southeast (Espírito Santo, Minas Gerais, Rio de Janeiro, São Paulo) and South (Paraná).

According to recent studies by Oliveira (et al., 2017), who analyzed the bibliographic collection of researches related to *Hancornia speciosa* Gomes, it was noticed that "there are few studies that seek to understand the support capacity of the extractive system, the threats that the species has been suffering from the advancement of other land uses, the current dynamics between the different social actors involved in the production chain, the socioeconomic benefits and difficulties generated by the implementation of commercial plantations, among others. "

Therefore, the main objective of this study was to discuss the colonization of *Hancornia speciosa* Gomes population in restinga environments in areas of tropical climate. In order to achieve this objective, we started with some questions, among them: What are the causes of the dominance of mangaba (*Hancornia speciosa* Gomes) in this environment? What is the role of climate and geomorphological processes for the current configuration of the environmental system to be studied?

II. MATERIAIS AND METHODS

In order to reach the proposed objective and conclude the study, the methodological procedures applied followed the method of approach, in this case, the structuralist approach. As for its nature, research is considered applied. Regarding their approach, the study starts from a qualitative-quantitative approach. As to its objectives, the research is characterized as explanatory.

Three methodological steps were adopted: bibliographic and documentary, field work and synthesis.

The bibliographical and documentary stage was constructed from the collection of preliminary (analogical, digital and bibliographical, cartographic and imagery) data, in diverse sources made available in organs of the direct and indirect public administration. Key words of the study were used to search for theses, dissertations, books, chapters of books, scientific articles published in journals in the CAPES database, mainly focused on Environmental, Geography and Interdisciplinary Sciences. As an elimination criterion, articles with inferior qualities to extract B2 were used. Articles in English and Spanish were also selected for the study. The objective of this stage was to construct the theoretical-methodological review of the present study.

The field work phase comprised 49 visits to the study area, being carried out between 2010 and 2013 (28 visits), in 2016 (8 visits) and between 2017 and 2018 (13 visits) for information gathering and mapping of

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areas, and more recently to update the study, mainly regarding the spatial distribution of the mangaba and its main vulnerabilities. In this step, the following techniques were used: empirical observation; photographic register; landscape sketches; guidelines and localization and registration in field notebooks.

In the synthesis step, the results were analyzed and tabulated, in addition to the writing of the article.

III. Results and Discussion

Restingas as transition environments

Formed from the most recent geological modifications on the Brazilian coast, from tertiary and quaternary sediments, Costa (2013) and Scarano (2002) agree that "restinga formation is physically fragile because they are composed of sandy soil, with high salinity levels, extremes of temperature, strong presence of winds, water scarcity and sunshine ", where climate and soil are essential variants for understanding the vegetation of this environment.

According to Sampaio et al. (2005), the restinga formation is recent from a geological point of view. Dunes close to the sea, where there is great action of the waves and the winds, are found recently formed places and that already present colonization by pioneers species typical of the herbaceous restinga. At sites of older sediment deposition, the soil may be rich in organic matter, with well-structured tree vegetation.

The relative variations of the sea level during the Quaternary (1,806.00 years ago) occurred at least three times exposing and submerging coastal areas that now form the restingas (SUGUIO; MARTIN, 1987). The restingas stand out for the large areas they occupy and for the formation of an ecosystem that has an intimate relationship with the sea. According to Cordeiro (2005), sandy plains constitute the substrate for several plant communities that are associated with geomorphology and present adaptation to physical and environmental conditions (BARCELOS, et al., 2012).

The physiognomy of the restinga environment is directly related to the constitution of the soil where it is found. Therefore, several authors affirm that it depends more on the soil than on the climate, being considered edaphic communities occurring in areas of great ecological diversity.

The vegetation of restinga formations is specifically contemplated by Brazilian legislation (these are specially protected territorial areas), in part because they are considered Permanent Preservation Areas (Law 4771/65, CONAMA Resolution 303/02), partly because they belong to the biome of the Atlantic Forest, which is protected by various legal instruments.

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The different types of vegetation cover, accompanied by their pedological conditions, occur in Brazilian restingas ranging from herbaceous formations, through open or closed shrub formations, reaching forests whose canopy varies in height, generally not exceeding 20m.

Based on the information collected and based on the classification used by Rizzini (1963), Hertel (1959), Hueck (1955), Seeliger (1992), Araujo (1992), among others, consensus found, a classification was the Sergipe restingas, which can also be taken as a parameter for other realities of the planet (Table 1).

Table 1 - Proposal of Classification of Restinga Environments.

Found Consensus	Study Proposal (Transitional Environments - Ecotones)
Herbaceous	Dune-Restinga Transitional Formation
Shrub	Shrub-arboreal Restinga Formation
Arboreal	Restinga-Atlantic Forest Transitional Formation

Organization: Authors, 2019.

Dune-Restinga Transitional Formation: Range out of reach of the sea, fueled by wind work. The vegetation presents / displays with some herbaceous species, with greater percentage of shrubs and rarely trees. This environment has free spaces, without vegetation cover. The soil is sandy of marine origin and dry, and it can accumulate rainwater at certain times of the year. It has a thin layer of litter, raised around bushes formed by shrubs and herbaceous plants. The coastal shallows and lagoons are seen as easy delimiters between the sand dunes and the restinga environment. After the coastal shallow, the feature is still of dune environment, but the stabilizing vegetation is typical of restinga. The anthropogenic effect in the landscape is observed with the introduction of restinga species, like *Cocos nucifera*, causing shade in typical species of light and coastal dunes such as *Ipomoea pescaprae*, classified as a species shade. The main factors that limit the establishment of plant species in this transitional area are the availability of moisture and burial. Humidity interferes with the germination and survival of the species and both the sea and the wind deposit and remove large amounts of sand on them, which can cause erosion and consequently the death of specimens.

Shrub-arboreal Restinga Formation: Composed by dry sandy substrate of predominantly marine origin, with better fertility and water conditions, this area forms a superficial network of roots that shelters a thin layer of litter, epiphytes and humus with many leaves not yet decomposed. The climate is milder for both vegetation cover and distance from the sea. Some areas are flooded by outcrops of groundwater. Vegetation

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predominantly shrub and arboreal, and the more it enters the interior of the continent, rare are the shrubs and the greater the size of the trees. Among the species found in this environment are: *Anacardium occidental* (cashew), *Cocos nucifera* (coconut-bay), *Psidium guajava* (guava), *Mangifera indica* (mango), *Cactus spp* and *Hancornia speciosa* Gomes.

Restinga-Atlantic Forest Transitional Formation: it is also located in the coastal plain, this area is composed of a sandy soil, although it already presents a composition with clay and organic matter, due to the proximity with the Barreiras Group (Coastal sedimentary deposit) with thick layer of humus and litter. Rare shrubs can be found, being an environment composed of few typical restinga trees such as *Hancornia speciosa* Gomes and *Cocus nucifera* and, more abundantly, typical Atlantic forest trees such as *Birsonimia spp*. (murici), *Lonchocarpus sericeus* (ingazeiro) and aromatic *Xylopia* (pindaíba).

The forest formations of restinga are in transitional portions for the environments of ombrophilous forest and have vegetation that mix forest components of both formations (MELO JR.; BOEGER, 2015; MELO JÚNIOR; BOEGER, 2016). Still according to the same authors, "from the structural point of view of restinga communities, some species are, due to characteristics such as degree of cover, abundance, density and/or dominance, considered as indicators of phytophysiognomies".

The remains of restinga should become a source of scientific research that produces information applicable to the monitoring, management and restoration of biodiversity (MELO JÚNIOR; BOEGER, 2017a; MELO JÚNIOR; BOEGER, 2017b).

These three transitional environments, analyzed from the study of Costa (2013) to present studies (2019), although generally do not occupy large tracts, they have fundamental importance in terms of environmental conservation, since they are vital spaces for traditional communities (fishermen, shellfish, quilombolas, pickers of mangaba, among others) and the locus of the reproduction of *Hancornia speciosa* Gomes.

Thus, the conservation of restinga relict areas do not depend exclusively on a single segment of society, but on participatory and multisectoral actions that give restinga the character of a collective patrimony and that can preserve biodiversity and the cultural and aesthetic aspects associated with it (MELO JÚNIOR, et al., 2018).

According to the studies of Sobéron e Peterson (2005), *Hancornia speciosa* Gomes was considered to be the ecological niche of *Hancornia speciosa* Gomes,

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Three important factors that can determine the area in which a species can be found and, consequently, reflect in the niche of the species: 1. Abiotic factors, that impose the physiological limits on the survival capacity of a species; 2. Biotic factors, the set of interactions with other species that modify the ability of species to maintain their populations; 3. The regions that are accessible to the dispersal by the species. It should also be considered that a species will only be present in a given place, where the first three factors are gathered, although other factors also contribute, such as the evolutionary capacity of the species.

According to the above statement, the analyzed environments present at least three environmental factors, in addition to an environmental vulnerability, characterized by deforestation, caused by urban expansion, with the construction of residential condominiums and resorts, according to recent studies by Costa, Melo and Souza and Mendonça (2018).

Hancornia speciosa Colonization Gomes in restinga environments

The mangabeira is a fruiter native to several regions of Brazil stretching along the Atlantic Coast from Amapá and Pará, in the coastal plains and coastal slopes of the Northeast, to the Espírito Santo, throughout the region of Cerrado of Central Brazil until the Pantanal, occurring also in neighboring countries such as Paraguay, Bolivia, Peru and Venezuela (LEDERMAN et al., 2000).

According to Ferreira and Marinho (2007), it is vegetating spontaneously in areas of sandy, deep and nutrient-poor soils.

According to the studies (PERFECT, 2014, LEDERMAN et al., 2000, LIME, 2010, PEREIRA et al., 2006), there are three mango varieties: Gomes, Gardneri and Pubescens. According to Perfect (2014), "it belongs to the class *Dicotyledoneae*, order *Gentianales*, family *Apocynaceae*, genus *Hancornia* and species *speciosa*".

According to the study by Soares (2016), Monachino (1945), Chaves (2006) and Ganga, Chaves and Naves (2009), *Hancornia speciosa* comprises six botanical varieties: *speciosa* Gomes, *maximiliani* (A. DC.), *cuyabensis* (Malme), *lundii (*A. DC.), *gardneri* (A. DC.) *Muell*. Arg. and *pubescens* (Nees et et al.) *Muell*. Arg. This classification, still widely used by taxonomists, is based on the morphological differences presented by plants, related to leaves, fruits and growth rate of seedlings in the field, for example.

However, a recent reclassification (KOCH et al., 2014) suggested that many of them are synonyms and that the mangabeira can be classified in only two varieties (*speciosa* and *pubescens*).

The mangabeira is a tree that is between 2 and 10 meters in height, produces white flowers and very tasty fruits. The plant has a latex known as "mango milk". It occurs in places of open vegetation, mainly in the Cerrado and Caatinga biomes and in the restingas, and there are records of occurrence also in the Amazon

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region. The mangabeira develops well in acidic and nutrient-poor soils and can tolerate dry periods (LIMA, 2010).

The trunk is tortuous, quite branched and rough, smooth and reddish branches. The entire plant exudes latex, which is used in the region as a home remedy for treatment of tuberculosis and ulcers. It has opposite, simple, petiolate, glabrous, shiny and coriaceous leaves. Its inflorescence has 1 to 7 perfumed flowers and white color (SOARES et al., 2000).

Still according to Lima (2010) "generally, the flowers of the mangabeira appear mainly from August to November, but there are many early flowers, that is, they bloom ahead of time. For this reason, there are fruits in the trees practically all the year, depending on the region. However, most fruit production occurs between October and April. "

The variation in fruit production per plant is enormous, and there are mangabeiras that can produce more than 800 fruits in a year. Likewise, fruit size and weight also vary widely, with each fruit having more or less 5 seeds and weighing about 20 grams (LIMA, 2010).

The fruit of the mangabeira is of the berry type with ellipsoid and / or rounded format (PEREIRA et al., 2006). According to Perfeito (et al., 2015), it presents yellow-green pulp, aromatic, sweet and characteristic flavor. Mangaba fruits have a high pulp yield (around 77%) and, therefore, have interesting characteristics for agroindustrial processing.

The ideal harvest point of the mangaba is difficult to determine and represents one of the factors that limit the exploitation of the crop. The fruit when mature has better flavor and lower content of latex. However, there are no signs of very marked and visible changes in the fruits, as occurs in most fruit species. In the Caatinga mangoes, where the speciosa botanical variety predominates, the signs are more evident in relation to those of the Cerrado, because when ripe or semi-mature (fruit of time) they have reddish spots, a slightly soft or soft consistency and a more yellowish coloration. In general, Cerrado mangabas are much larger than those in the Northeast and do not show reddish spots when ripe, characteristic of fruits of the pubescens and gardneri varieties (PEREIRA et al., 2006).

According to information from Souza et al., (2007), they evaluated fruits of six different mango tree clones located in João Pessoa (PB) and reported that the fruits presented on average 25.74 g of total mass, 3.83 cm of length, 3.47 cm in diameter and yield of the edible portion (peel and pulp) of 85%.

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The propagation of the species is done predominantly through the seeds. The success of seedling formation, on the other hand, depends on seed quality, which is determined by a combination of physical, genetic, physiological and health factors (ANJOS et al., 2009).

Rosa, Naves and Oliveira Júnior (2005, p. 67) who studied the production and growth of mangabeira (*Hancornia speciosa Gomes*) seedlings on different substrates, "there was greater response when using chemical fertilization, which demonstrates the superiority of the treatment 010 in comparison to the others ". Therefore, the least favorable results were from treatments that did not receive fertilization, "regardless of the presence and proportion of the sugar cane bagasse, and whether or not they received liming. This may be interpreted as a differential mechanism of nutrient uptake by the mangabeira seedlings compared to other cultivated species, which reinforces the importance of studies on the ecophysiology of native cerrado plants. The pollination of the flowers is carried out by insects of eleven species of bees (*Hymenoptera*) and 23 of Lepdoptera in the diurnal and nocturnal periods. Of these, 50% refer to *Sphingidae*, 39% to *Hesperiidae* and 9% to *Nymphalidae*. During the day, floral visitors are *Euglossini* bees and *Nymphalidae* butterflies, with the most frequent hesperides in the morning twilight periods and the night sphynxes (DARRAULT; SCHULINDWEIN, 2005).

According to the conclusions of Felix's study (et al., 2015), "the mangabeira (*Hancornia speciosa* Gomes) has developed better in the Regolítico Neossolo. Low-developed soils, such as the Regolítico Neossolo and the Planosol Haplic, favor the initial growth of mangabeira (*Hancornia speciosa)* seedlings.

The mangabeira vegetates well in regions with average temperature of 25ºC, rainfall of 750 to 1,600 mm annually and, in altitude up to 1,500 m. It has good tolerance to periods of water deficit and, in times of high temperature, presents a better vegetative development. The spontaneous development of the mangabeira is common in Latosols and Quartzeneous Neosols (Quartz Sands), which are soils characterized by low organic matter content, high acidity and low availability of nutrients and exchangeable bases (FERREIRA; MARINHO, 2007).

The native mangrove areas in the State of Sergipe occupy 34,033ha, equivalent to 1.55% of the total area of the State of Sergipe. Due to the prohibitions on access, members of the localities of identified mangaba collectors practice the extractivism of the fruit in 31,302 ha, according to the following forms of access: i) free (areas of private, of the Union, of the State and of the Municipalities, the areas of environmental preservation of settlements, where anyone can collect the fruits); ii) own sites (only the owners

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of the land can collect the fruits); iii) granted for collection in third-party areas (mangaba collectors with consent of the landowner can collect, at no cost to the collector); iv) purchase in third-party areas (mangaba pickers with landlord's consent may collect, but have to pay for the fruits, in cash); v) daily sale of the labor force in third-party areas (landowners pay the mangaba pickers on the day of harvesting of fruits, in which case all fruits are left with the owner of the land); vi) lease (the land owner gives the area, by negotiated term and value) (RODRIGUES et al., 2017).

Still according to Rodrigues (et al., 2017), "Mangrove natural areas occur in 7.8% of the state of Sergipe, most of them in the municipalities of Itaporanga d'Ajuda (23%), Pirambu (17%) and Japoatã (14%). Pirambu is the municipality that has the largest area occupied by natural mangrove areas (29% of its territory), followed by Barra dos Coqueiros (20%) and Japoatã (11%)". The municipalities that suffered most from the reduction of the size of natural mangrove areas were Estância (47,60%), Barra dos Coqueiros (41,47%), Japoatã (36,34%), Indiaroba (32,18%), Pirambu (23.25%), Japaratuba (22.31%), Pacatuba (13.61%) and Itaporanga d'Ajuda (11.75%).

Analyzing the Production of Plant Extraction and Silviculture - PEVS of the Brazilian Institute of Geography and Statistics in the time cut from 2010 to 2017 (last available data), it is verified that the state of Sergipe ceased to be the world's largest producer of mangaba, according to the data in Table 2.

In addition to the seven producing states that appear in the table, we have the state of Ceará that had production registered from 2014 with 38 tons, being 7 tons in 2015, 1 ton in 2016 and 2 tons in 2017. The state of Tocantins only registered in 2017 with 4 tons.

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Table 2 - Production data of mangaba, in tons, of producing states between 2010 and 2017.

States of Brazil	2010	2011	2012	2013	2014	2015	2016	2017
Maranhão	1	1	1	1	2	2	2	5
Rio Grande do Norte	44	85	79	81	71	176	162	167
Paraíba	99	79	89	95	93	136	246	304
Alagoas	33	34	33	33	34	34	51	141
Sergipe	401	351	367	327	353	219	190	206
Bahia	142	128	105	100	89	83	106	108
Minas Gerais	1	1	1	1	1	1	-	84

Source: Production of Plant Extraction and Forestry - PEVS, IBGE (2010-2017).
Organization: authors, 2019.

Analyzing the data available since the year 2000, it is noticed that Sergipe maintained the leadership of the largest producer, losing this placement in 2016 to the state of Paraíba, which in turn, has increased the production of this fruit.

According to the field survey that took place between 2013 and 2019, the main fragilities about the management and beneficiation of mangaba in Sergipe are related to real estate speculation (land fencing, construction of residential condominiums, hotels and resorts), violence on the part of owners of land and new residents, not own land, deforestation for planting other crops and lack of state support. These are the main causes for the decline of mango production.

From the confrontation between the edaphoclimatic conditions demanded by this species (mainly the EMBRAPA studies) and the conditions found in the study area, it is perceived that such requirements are found satisfactorily in the sergipana restingas, being these the locus for the cultivation of this species.

The phytogeographic distribution proves this conclusion, so far as it moves away from the restinga environment, the smaller the occurrence of this species until no trace of it is found.

The regularity of the precipitation is a preponderant factor for the production of the mango, since it is perceived that this increases in the driest years, that is, when the precipitation is lower. Along with precipitation, management techniques must be inserted in the producing areas (COSTA, 2013).

The presence of *Hancornia speciosa Gomes* in Sergipe may also be linked to AB'SÁBER Refuges Theory, which according to the same author, is presented as one of the most important bodies of ideas referring to the standard distribution mechanisms of floras and faunas in the Tropical America. In essence, the refuges and refuges theory takes care of the repercussions of the quaternary climate changes on the distribution of floras

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and faunas, in determined times, along physiographic, landscape and ecologically mutant spaces (AB'SÁBER, 2006).

The perspective of the Refuge Theory, based on studies of paleoclimate, paleosols, and geomorphological forms and allied to palynological and carbon 14 analyzes, constitutes an important mechanism to explain the phytogeographic dynamics, mainly in Brazil, from the Period Quaternary.

The presence of cacti in the study area (littoral range) can also be explained by the performance of paleoclimates, because of the aridification processes that Brazil passed during the last glaciation in the northern hemisphere, there was the advance of the xerophytic species to the plains coastal areas. At the end of the ice age, the climate became more humid, but the caatinga vegetation remained in the coastal region.

The understanding of the geological structure constitutes an important aspect of control in the geomorphological evolution, however, it is only possible to analyze this evolution from a study of paleoclimates and current climatic conditions. During the Cenozoic, the paleogeographic evolution was marked by the successive paleoclimatic episodes characterized by alternation of drier or wetter conditions, such that the current environments are reflections of the climatic conditions at their moment of formation.

The restinga reveal a close relation between Geomorphology and the paleoclimatic aspects that acted in the area when it was formed, resulting in a landscape where relic forms are juxtaposed with current forms (wind reworking), subordinated to the present morphodynamic processes (COSTA, 2013).

The role of climate is undeniable in explaining aspects of the surface structure of the landscape and current dynamics, but many features suggest paleoclimatic Plio-Pleistocene mechanisms that have left their imprints on its shape, sediments accumulated along the coast, in types of weathering that gave rise to changes in color and varied colors, among others. Climatic changes at the end of the Tertiary and, especially, those of the Quaternary have played a significant role in the individualization of the present forms. The polycyclic character of the area is explained in part by the climatic oscillations associated with the glacial and interglacial periods that followed during the Quaternary.

The main factor for the formation of the coastal plain were variations in the relative sea level during a drier period than the current one. Thus, during the regressive events, large amounts of sand were exposed on the continental shelf, constituting, therefore, the main sediment source to feed the natural process of beach expansion. The progression was not only at the expense of the sediments exposed during the last regression. Important role can be attributed to wave-induced current systems in the coastal zone. These systems,

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responsible for the coastal drift, can introduce significant amounts of sediment into the coastal plains considered here.

Therefore, sea level decline over the last 5,000 years, exposing large amounts of sediment on the continental shelf, represented the sediment source mechanism to feed the coastal plain.

As already mentioned, the coastal processes are strongly influenced by the dynamic agents, so that their detailed knowledge is important for the understanding of the geological and geomorphological evolution of the coastal areas, in the short, medium and long term.

IV. CONCLUSIONS

The adoption of a geographic concept of restinga allowed a better visualization and analysis of this environment, which presents the ideal soil and climate conditions for mangaba development that has been threatened to the detriment, mainly, of real estate speculation with a view to urban expansion.

It is worth mentioning the proposal of restinga environment classification, which allowes a better biogeographic analysis of these transition environments in the Dunas - Restinga - Atlantic Forest trinomial. These three environments are considered as the ecological niche of mangabeira.

Now days, restingas, despite the intense environmental vulnerability that has transformed the natural environment into an anthropic and fragmented landscape, climatic and soil conditions still produce significant environmental conditions for the development of this species. It is concluded that the colonization of *Hancornia speciosa* Gomes in restingas is possible due to the abiotic, biotic factors and the evolutionary capacity of the species, represented by the dispersion.

It is necessary to create a protection zone, or an extractive reserve for this species, foreseeing the maintenance of this activity in Sergipe, as well as increasing production, since this state has lost the status of the world's largest producer since 2016.

Mangabeira is today, one of the most important producers of raw material for the juice and ice cream industry in the Northeast and Central West, as the State of Sergipe is the largest producer in Brazil, due to the increase in value added to mangaba in recent years (pulp, ice cream, among others), and by intensifying the practice of extractivism in several areas of the State of Sergipe, among others, it is necessary to generate knowledge that supports the cultivation and permanence *of Hancornia speciosa* Gomes in Sergipe .

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Considering the ecological importance of restinga areas and the main threats pointed out that reflect changes in the dynamics of environmental processes, complementary studies are needed to deepen the biogeographic relationships of this environmental system.

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