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Biology-Botany

Biodiversity in urban centers: survey on palm trees in Antônio Danubio Park

Biodiversidade nos centros urbanos: levantamento das palmeiras no Parque Antônio Danúbio

Karina de Nazaré Lima Alves[I], **Flávia Cristina Araújo Lucas**[II], **Maria Antonia Ferreira Gois**[II]

[I] Museu Paraense Emílio Goeldi/Universidade Federal Rural da Amazônia, Belém, PA, Brasil
[II] Universidade do Estado do Pará, Belém, PA, Brasil

ABSTRACT

The green areas conservation in urban perimeters is an effective way to maintain native plant species, in addition to the important socio-environmental role they play in cities. Parque Antônio Danúbio is a conserved forest fragment in the metropolitan area of Belém, Pará, which presents a great diversity of native flora species, especially palm trees. The present study objective was to carry out a survey of the palm trees in Parque Antônio Danúbio aiming to know the vegetation structure through the distribution and frequency of the registered species. The study was made using a qualitative approach, frequency and structure analyzes (height classes) were also carried out. Nine palm species were identified, being açaí (*Euterpe oleracea* Mart.), mumbaca (*Astrocaryum gynacanthum* Mart.) and bacaba (*Oenocarpus bacaba* Mart.) the most frequent. Individuals distribution in the height classes indicated that there is regeneration in the environment. Such results show that Parque Antônio Danúbio presents a representative diversity of native palm trees, and the populations of these species enjoy good conditions for their development.

Keywords: Green areas; Conservation; *Arecaceae*

RESUMO

A conservação de áreas verdes em perímetros urbanos é um caminho eficaz para a manutenção de espécies vegetais nativas, além da importante função socioambiental que elas desempenham nas cidades. O Parque Danúbio constitui um fragmento conservado de floresta na área metropolitana de Belém, Pará, que apresenta grande diversidade de espécies da flora nativa, especialmente de palmeiras. O objetivo do presente estudo foi realizar um levantamento das palmeiras do Parque Antônio Danúbio visando o conhecimento da estrutura vegetacional em relação a distribuição e frequência das espécies

encontradas. O levantamento foi realizado utilizando abordagem qualitativa, também foram realizadas análises de frequência e de estrutura (classes de altura). Nove espécies de palmeiras foram identificadas, sendo o açaí (*Euterpe oleracea* Mart.), mumbaca (*Astrocaryum gynacanthum* Mart.) e bacaba (*Oenocarpus bacaba* Mart.) as mais frequentes. A distribuição dos indivíduos nas classes de altura indicou que há regeneração no ambiente. Tais resultados mostram que o Parque Antônio Danúbio abriga uma diversidade representativa de palmeiras nativas, e que as populações destas espécies desfrutam de boas condições para o seu desenvolvimento.

Palavras-chave: Áreas verdes; Conservação; *Arecaceae*

1 INTRODUCTION

Palm trees (Arecaceae) are outstanding Flora specimens, their extraction and cultivation have been essential for traditional populations for thousands of years. They are part of a wide network of society-nature associations involving ecological and socio-cultural variables. Açaí (*Euterpe oleracea* Mart.), for example, is an essential plant resource given the benefits it brings to Amazonian communities. The palm species are broadly used in this region due to their fruits and palm heart – both quite appreciated in human and animal diets -, their leaves are used to coat ceiling tops, for handcrafting and to produce household items, as well as stipe dare useful in construction support and the roots are used in popular medicine (MOURÃO, 2011). Açaí planting and management are promising and sustainable land-use alternatives also successfully applicable to reforestation, agroforest systems (AFS) and to the recovery of degraded sites (CONDÉ *et al*., 2020). Moreover, these trees are permanent landscape elements in the composition of parks and city squares. Therefore, this group of plants plays a key role in preserving and recovering Brazilian biomes (BRANCALION *et al*., 2011).

Brazilian flora belonging to family Arecaceae is rich. Representatives of this family are known by native peoples such as “Pindorama” – which means, “land of tall trees” or “land of palm trees”, in Tupy language (SILVA *et al*., 2007; ULHÔA, 2016). The number of studies on this group of plants has been growing worldwide since the 19th century when Von Martius (1817-1850) carried out investigations in different Brazilian phytophysiognomies along with Spix. They crossed the current

states of Maranhão, Pará and Amazonas while in the Amazonian Biome (OLIVEIRA *et al*., 2014). English naturalist Alfred Russel Wallace travelled through the Amazon from 1848 to 1851 and published the book "*Palmeiras da Amazônia e seus usos*", which is one of the greatest contributions to studies conducted in the region, mainly to the 44 palm tree species he had investigated. His study is not only important from the botanical viewpoint, but because it also describes their use by indigenous peoples and by the Brazilian population (WALLACE, 2014). Wallace stated: "*Gracious palm trees are distributed everywhere, they are the real inhabitants of the tropics, whose profile is the most impressive and featuring element*". Overall, plant species play relevant roles in urban zones, they embellish landscapes, improve air quality and provide thermal comfort, among other environmental benefits (LOBATO *et al*., 2017).

The socioeconomic and ecological importance of this family was proven by its great representativeness in parks and Botanical Gardens all over the world. It is also highly valuable because of its species diversity, occurrence in a wide range of habitats, status as integral part of the local culture and importance for the family-based economy of many traditional and non-traditional communities. It is quite essential highlighting the importance of this ethnobotanical information (MARTINS *et al.,* 2014).

Despite their relevance, little is known about the ecology of species in this family, mainly in urban zones, although such knowledge would make their management and sustainable use in the region easier. These plants provide fruits and seeds for the diet of vertebrates and invertebrates, including birds (toucans, parrots and passerines), mammals (marsupials, primates, rodents), insects (fruit fly), among other groups. Some of these groups are palm tree seed dispersers (RIBEIRO *et al*., 2013; ALIAGA-ROSSEL & MORAES, 2014), a fact that optimizes ecosystem services accountable for generating dynamic processes to help maintaining natural environments.

Antônio Danúbio Park is a conserved forest fragment located in Belém Metropolitan Region, Pará State. It presents great native flora species diversity, mainly palm trees (BASTOS, 2014). The park covers territorial space of 3,544 hectares and perimeter of 806.83 m (ANANINDEUA, 2011). Areas surrounding the park and overall areas around the city, are quite anthropic, but they still conserve vegetal formations (spots of dry land and lowland forests) mainly separated by urban constructions (ANANINDEUA, 2013). For two decades now, the park has been seen as a place for public leisure, since it is often visited by local residents. Among all aims of having the park in the region, one finds the maintenance of the local and regional ecosystem. It is important noticing that the park is available for community cultural, educational and leisure activities that do not pose risk to the environment (BASTOS, 2014). According to Alcântara & Vazquez (2016), a county that provides its population with high-quality public spaces allows it to have a healthy environment to live in.

The aim of the present study was to carry out a survey of palm trees at Antônio Danúbio Park to know its vegetation structure based on the distribution and occurrence of the observed species.

2 MATERIAL AND METHODS

2.1 Study site

Antônio Danúbio Park is located in Ananindeua City, Belém Metropolitan Region (01°23’02” S and 48°24’22” W), BR 316 Road, km 5. Climate in this region classified as equatorial humid of the Afi type (Köppen’s classification) (SIQUEIRA & APRILE, 2013). Mean annual temperature is 27°C, mean annual rainfall is 2,692.7 mm. The rainy season is observed between January and June, and the dry season from July to December (ANANINDEUA, 2013). According to the classification by IBGE

(2012), the original phytophysiognomy of the park presented Alluvial Dense Rainforest features of Open Ombrophilous Forest with palm trees (Figure 1).

Figure 1 – A. Overview of one of the trails. B. Overview of the park showing the prevailing phytophysiognomy

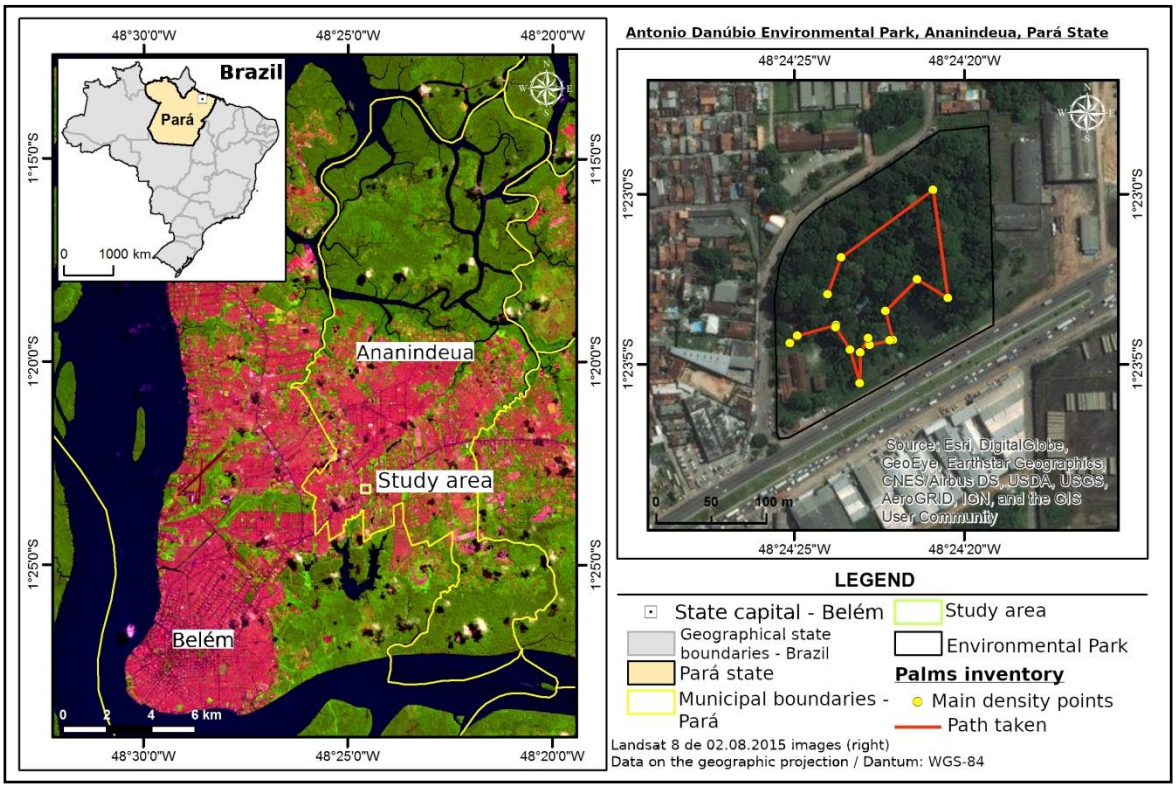
Source: Authors (2020)

2.2 Study design

Visitations to the park were carried out in order to get to know the whole site, to ask for authorizations and to have the first conversations about the education-activities program comprising the elaborated Environmental Education agenda. Park employees and managers were interviewed based on semi-structured forms (BELEI *et al*., 2008) and on participatory observation (MINAYO, 2011). The interviews helped identifying the demands for possible socio-education activities, mainly for activities involving native palm trees. These activities would be focused on experiencing nature and on encouraging research planning, as suggested by Thiollent (2011). Actions concerning palm trees would be part of a permanent program aimed at encouraging visitors to get to know the importance of nature components for urban landscapes used for outdoor activities, as well as to sensitize the population about local environmental issues. The inventory of native palm tree species was encouraged by the occurrence of this taxon throughout the whole park and by its prevalence in the woods and understory sites.

The qualitative approach adapted from Castilho (2004) was applied to the palm trees inventory. Approximately 600 m of the park were crossed in two hours. The route followed the existing trails, which lead to dense forest and palm tree densification areas in open vegetation sites that account for great circulation of people, namely: convenience area and areas close to the main gate (Figure 2).

Figure 2 – Map of the study site highlighting the route taken to make the inventory of palm tree species



Source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USCS, AeroGRID, ICN, and the CIS User Community (2020)

All individuals located at least 2 m from the trails (to the right and left) were inventoried (CASTILHO, 2004). Only individuals 1.30 m tall (minimum) were inventoried for frequency analyses. Flowering and fruiting data were collected in September 2016 - plant height estimates were also used in the analyses. Individuals were divided into classes as described by Resende *et al.* (2012), with adaptations: I (1.3 to < 3.5 m), II (3.5 to < 7.0 m), III (7.0 to < 10.5 m), IV (10.5 to < 14.0 m), V (14.0 to < 17.5 m), VI (17.5 to < 21.0 m), VII (21.0 to < 24.5 m) and VIII (24.5 to < 28.0 m).

Palm trees presenting underground stem growth and visible stipe, such as *Attalea maripa* (Aubl.) Mart., were inventoried based on the method by Salm *et al*. (2011). Species were categorized into classes of frequency based on Filgueiras *et al.* (1994) in order to measure their ecological importance to the environment: frequent (≥ 10% of the total of sampled individuals), common (between 5% and 9% of the total), occasional (between 1% and 4.9% of the total) or locally rare (<1% of the total).

Species identification took place *in loco* and was performed by the parataxonomist of the MG herbarium of Emílio Goeldi Paraense Museum, Belém City, Pará State. Notes about morphology and phenology were taken and plant images were recorded. Species nomenclature was updated in the databases of the List of Flora Species in Brazil (FLORA DO BRASIL 2020) and of the Missouri Botanical Garden (www.tropicos.org). Species conservation status was assessed in the International Union for Nature Conservation and Natural Resources (IUCN, 2016) headquarters and in the National Center of Flora Conservation (CNCFLORA, 2012). Materials deposited in herbaria and registered in the *species Link* network (www.splink.cria.org.br) were also assessed.

3 RESULTS AND DISCUSSION

Nine native palm tree (Arecaceae) species were identified (Table 1). This is a significant number of species to be identified in a short urban forest fragment. Silva *et al*. (2007) surveyed tree, shrub and palm tree richness and density in seven urban parks in Recife. They mentioned the small number of registered native palm tree species in the assessed parks, namely: only two native species among the total of fourteen species registered in Brazil. These species are not “assessed for endangerment” based on the conservation status offset to these species by CNCFLORA (2012) and IUCN (2016).

Table 1 shows the native species identified in the inventory and their respective popular names, number of individuals and classification based on

frequency. In total, 490 individuals were identified in the park and 3 species presented frequent distributions: açaí (*Euterpe oleracea* Mart.) - which recorded the largest number of individuals (229) -, mumbaca (*Astrocaryum gynacanthum* Mart.) (130) and bacaba (*Oenocarpus bacaba* Mart.) (101). Salm *et al*. (2011) conducted a study in the Sustainable Forest District of BR-163, Western Pará State and found high density values (individuals ha^{-1}) for *A. gynacanthum* and *E. oleracea*. Germano *et al*. (2014) highlighted the presence of açaí and miriti/buriti (Mauritia flexuosa L.f.) in the riversides of Abaetuba city, Pará State.

Table 1 – Palm tree species and their respective classification based on their frequency in the assessed site. Fr = frequent; Co = Common; Oc = Occasional; Lr = Locally rare

Scientific name	**Popular name**	**Sampled individuals**	**Classification**
Acrocomia aculeata (Jacq.) Lodd. ex Mart.	Mucajá	1	Lr
Attalea maripa (Aubl.) Mart.	Inajá	9	Oc
Astrocaryum gynacanthum Mart.	Mumbaca	130	Fr
Astrocaryum vulgare Mart.	Tucumã	1	Lr
Bactris gasipaes Kunth	Pupunha	1	Lr
Euterpe oleracea Mart.	Açaí	229	Fr
Mauritia flexuosa L.f.	Miriti/Buriti	17	Oc
Oenocarpus bacaba Mart.	Bacaba	101	Fr
Socratea exorrhiza (Mart.) H.Wendl.	Paxiúba	1	Lr
		Total = 490	

Source: Authors (2020)

Euterpe oleracea and *O. bacaba* were observed in the whole route taken in the Park, but the number of *E. oleracea* individuals identified in the most opened sites was larger than that of *O. bacaba*. This species was more frequent in the forest and *M. flexuosa* representatives were limited to locations by the lake.

The inventory by Pinheiro *et al*. (2010) was carried out in the open rainforest (hillside) and alluvial rainforest (shallow) environments of the urban park in

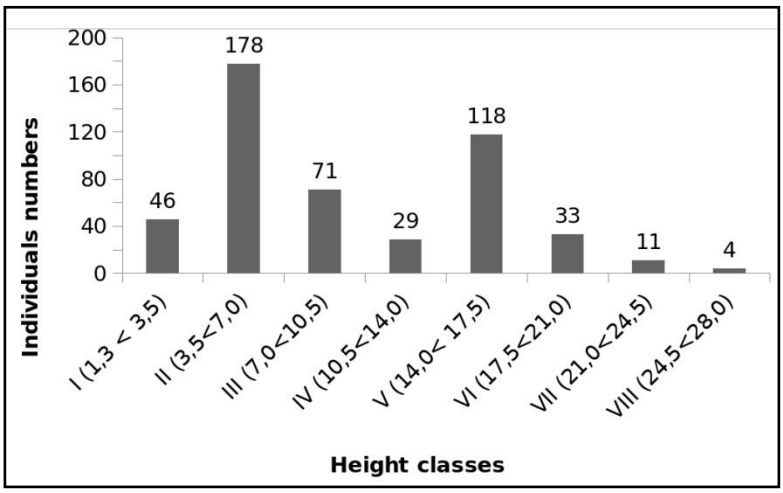
Manaus City, Amazon State. The same method led to six species at Antônio Danúbio Park. These authors also found *E. oleracea* and *O. bacaba* in two types of phytophysiognomy, as well as *M. flexuosa* in the alluvial environments. Pott & Pott (2004) justify the greatest occurrence of *M. flexuosa* in flooded ground as consequence of its pneumatophore roots, which allow its development in environments subjected to different soil types, climate and to specific humidity conditions - water makes fruit dispersion easier and favors species reproduction (CAVALCANTE, 1996).

Based on Gama *et al*. (2003), *E. oleracea* was the only species inventoried through the existing light climax (LC), which is a high floodplain forest in Afuá County, Northern Pará State. This finding shows the difficulty of this species in developing on closed forest, due to the low light conditions. According to Shanley *et al*. (2010), *O. bacaba* prefers open sites, however, it can grow in shady locations. Oliveira *et al*. (2008) carried out a study in a dense dry forest in Central Amazon, Amazonas State, where understory vegetation is dense. They found that *O. bacaba* juveniles prevailed in the assessed site and concluded that this species is highly tolerant to light shortage. There was a large number of *A. gynacanthum* individuals in sites presenting vegetation densification. This species is part of a common genus distributed in understory vegetation featured by high density of individuals (CLAUDINO *et al*., 2015). Rocha & Silva (2005) reported high density indices and frequency of *A. gynacanthum* species in a study carried out in a secondary forest environment in Bragança County, PA, Brazil. This outcome evidenced that this species presents great frequency in the Amazonian Domain. Such an information helps better understanding the distribution and colonization dynamics of this species in the environment, mainly in urban zones subjected to constant fragmentation.

The 490 individuals were distributed into eight height classes (Figure 3), most of them were in classes lower than VI, mainly in class II (178 individuals). Classes VII and VIII recorded the smallest number of individuals. These results are similar

to those recorded by Almeida & Jardim (2011), who found greater concentration of individuals in class II (from 5.1 to 10 m) and few individuals in classes V (from 15.1 to 20 m) and VI (more than 25 m). According to Resende *et al.* (2012), such concentration in the first height classes are indicative of individuals addition to the assessed classes. This pattern points towards the regeneration of stable tropical forests. Data highlights reproductive self-sufficiency and, consequent, natural maintenance of this repository. Different height classes express different regeneration and colonization levels. According to Miranda *et al.* (2003), such a profile deeply contributes to the floristic, structural and dynamic interpretation of these plants composition.

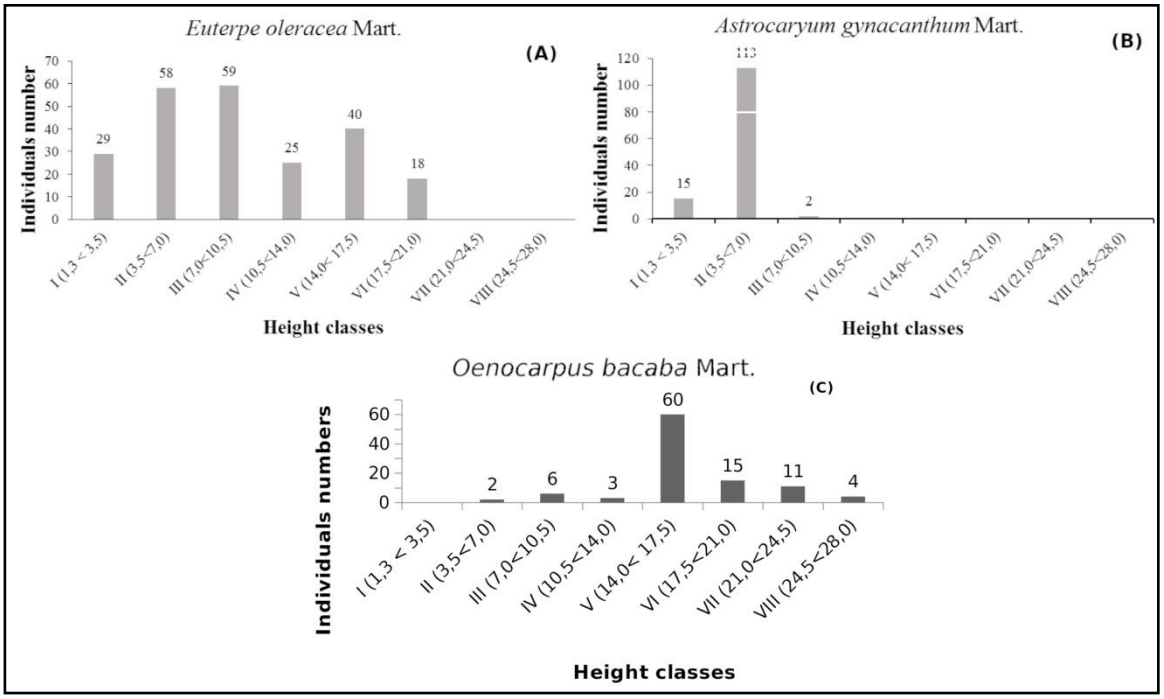
Figure 3 – Total number of individuals belonging to the recorded palm tree species based on height class (m)



Source: Authors (2020)

E. oleracea distribution (Figure 4 – A) was similar to that found by Almeida & Jardim (2011) in low land forest in Sororoca Island, Ananindeua County. There was greater concentration of individuals in lower strata (up to 10 m tall). They observed a pattern for tropical forests that point towards intense regeneration.

Figure 4 – Number of individuals per height class recorded for the most representative palm tree species: A- Açaí (*Euterpe oleracea*); B- Mumbaca (*Astrocaryum gynacanthum*); C- Bacaba (*Oenocarpus bacaba*)



Source: Authors (2020)

Euterpe. oleracea and *O. bacaba* (Figures 4-A and 4-C, respectively) occurred in different forest strata, at different height patterns, and this finding highlights constant phytophysiognomy. Finol (1971) and Mendes *et al*. (2013) discussed the establishment profile and composition of all classes. According to them, they were the consequence of genetic features of species adapted to understory conditions when their growth is constant. *Mauritia flexuosa* did not have representatives in Height Class I, only in classes II and V. The largest number of individuals in intermediate classes was similar to that found by Jardim *et al*. (2007) in an Amazonian lowland forest in Combu Island, Belém, Pará State. Accordingly, 80% of individuals belonging to the assessed species were in classes presenting individuals between 5.1 and 20.0 m tall. Height distribution did not meet the J-inverted pattern, which is characteristic of self-regenerative populations.

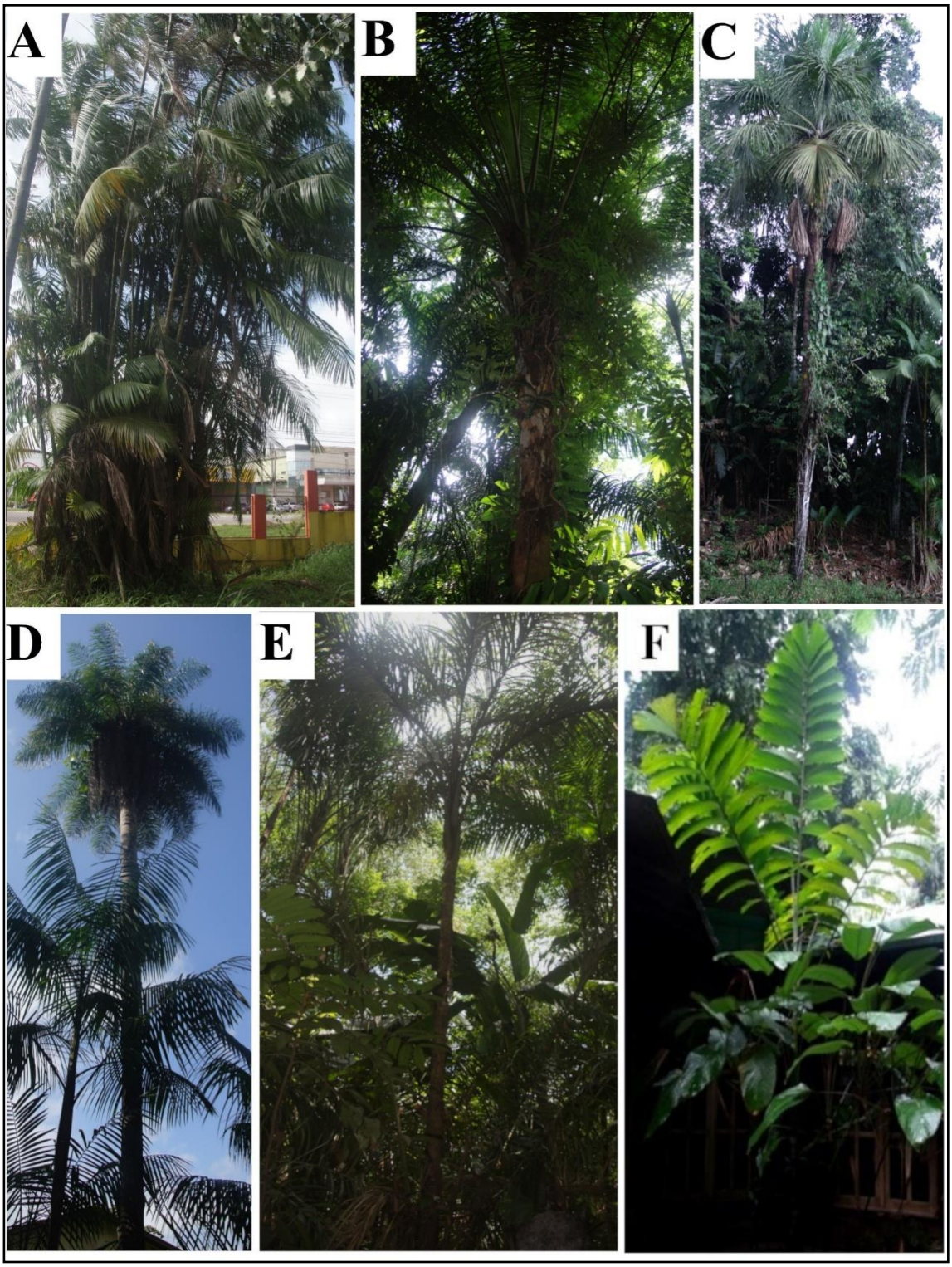
Attalea maripa did not have representatives in the first height classes (I and II) or in other ones (VI, VII and VIII), as well. Jardim *et al*. (2007) identified the continuous distribution (J-inverted) of this species in a lowland forest in Combu Island, Belém, Pará State. All classes had their representatives and the number of individuals tended to decrease from the first classes to the last ones.

Four species only counted on one individual in the inventory, namely: *A. aculeata* (approximately 15 m tall) (Figure 5 – E), *A. vulgare* (approximately 8 m tall), *B. gasipaes* (approximately 3 m tall) and *S. exorrhiza* (approximately 3 m tall) (Figure 5 - F). In total, from 1/3 to 1/4 of the species recorded low density and this amount was expected for tropical forests (MIGUEL *et al.*, 2011). However, it was not expected for anthropized sites, such as *capoeira*, pastures and open fields (MENEZES *et al*., 2012), where such species often have significant growth, are more resistant to fire and abundant. Svenning (2001) considered that palm tree aggregations result from specific conditions such as environmental reproduction and/or heterogeneity deriving from soil type, climate, topographic and altitude conditions associated with biotic factors such as predation, dispersion, germination and recruiting - even if there is a set of intrinsic factors that favor the permanence and colonization of a given species. The pattern observed in the herein assessed park points towards much interference either from physical structures (constructions, grounding, garbage, vegetation pruning, among others) or from external factors such as transit flow, pollutants, noise and other aspects influencing the formation of denser populations.

Only *A. vulgare*, *S. exorrhiza* and *A. gynacanthum* did not present reproduction structure (fruits or flowers) within the assessed period (September). According to Shanley *et al*. (2010), *A. vulgare* fruiting starts when individuals measure from 1.5 m to 5 m tall. However, in Pará State, the species' mean flowering time was observed between March and July, and fruiting took place from December to April. Souza (2007) considered that approximately 10 m is the minimum height for adult *S. exorrhiza* individuals at reproduction time. The only specimens measuring approximately 3 m

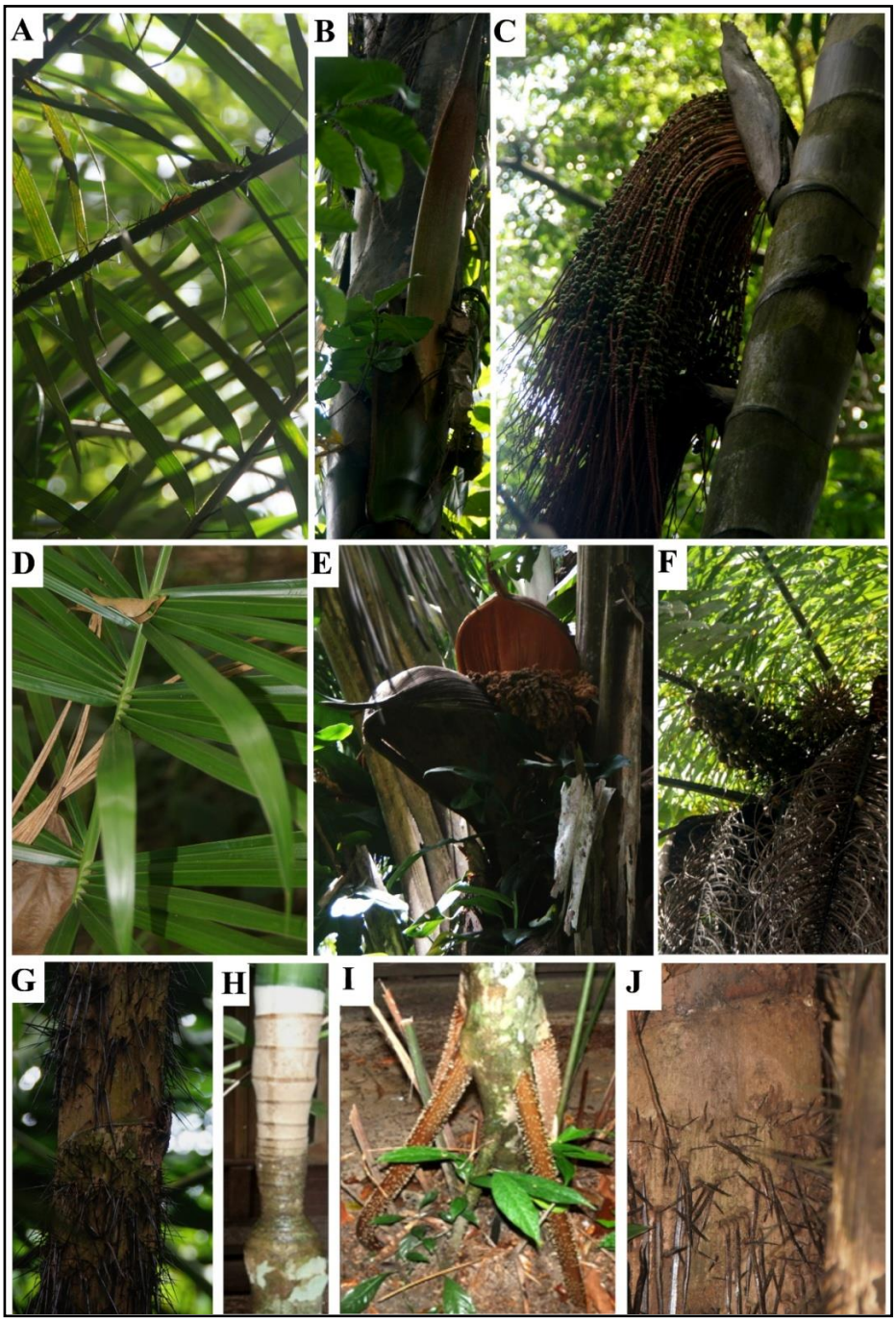
tall at Antonio Danúbio Park did not present reproductive structures. The aforementioned author highlighted that 2 m is the appropriate initial height for *A. gynacanthum*. Individuals inventoried at Antônio Danúbio Park exceeded such a height. Pimentel (2015) observed phenological records of palm tree species herbaria in Tapajós National Forest, Pará State and found that *A. gynacanthum* flowered and fruited in November. They also stated that rainfall and rainy-period variations can change the phenological behavior of palm trees, a fact that justifies the pattern observed for this species at Antonio Danúbio Park.

Figure 5 - Overall aspect of palm trees in the park. A – Açaí bush (*E. oleracea*); B- Inajá (*A. maripa*) C- Miriti (*M. flexuosa*); D. Mucajá (*A. aculeata*) E. Mumbaca (*A. gynacanthum*), isolated individuals and F- Paxiúba (*S. exorrhiza*)



Source: Authors (2020)

Figure 6 - Detail of the morphological structure observed for palm tree featuring. A – Bacaba (*O. bacaba*), pines grouped and placed in different angles; B - Bacaba green-purple sheath; C - Bacaba, pendulum inflorescence; D – Inaja (*A. maripa*), irregular pines grouped and placed in different angles; E - Inaja, interfoliar inflorescence; F - Mucaja (*A. aculeata*), yellowish fine epicarp fruits; G – Mumbaca stipe (*A. gynacanthum*) with black, flat and long thorns; H – Paxiúba (*S. exorrhiza*), stipe; I - Paxiúba, cone with adventitious thorn roots; J – Tucumã stipe (*A. vulgare*) with thorns grouped in node



Source: Authors (2020)

4 CONCLUSIONS

The floristic composition of native palm trees was similar to that observed in other studies conducted in Amazonian environments. Nine species were found, some of them were forming dense population inside the forest. The study on the occurrence of these species has shown that açaí (*E. oleracea*), mumbaca (*A. gynacanthum)* and bacaba (*O. bacaba*), were the most frequent ones. With respect to vegetation structure, most species presented height class pattern indicative of tropical forests, which are stable - as expected for natural environments presenting lower anthropization. This outcome suggests that the dynamics of natural resources in the park's environment is favorable to the maintenance of species' life cycle, as well as points towards its resistance to impacts from human intervention.

The park is an urban forest fragment presenting native palm tree species diversity. These species were culturally absorbed by Amazonian populations, which acknowledge the socio-environmental diversity observed in Belém Metropolitan Region. Several tools have been adopted to outspread scientific information and environmental awareness in the region.

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REFERENCES

ALCANTARA, M.A.R.; VAZQUEZ, G.H. Caracterização paisagística e da frequência de usuários de duas praças centrais de Caraguatatuba/SP. **Revista da Sociedade Brasileira de Arborização Urbana**, Piracicaba, v. 10, n. 3, p. 38-59, 2016.

ALIAGA-ROSSEL, E.; MORAES, R. Mamíferos consumidores de frutas y semillas de lachonta (*Astrocaryumgratum*, Arecaceae) en bosques submontanos y aluviales de Bolivia. **Ecología en Bolivia**, v. 49, n. 2, p. 98-103, 2014.

ALMEIDA, A. F.; JARDIM, M. A. G. Florística e estrutura da comunidade arbórea de uma floresta de várzea na Ilha de Sororoca, Ananindeua, Pará, Brasil. **Scientia Forestalis**, v. 39, n. 90, p. 191-198, 2011.

ANANINDEUA, **Lei Nº. 2.472, de 05 de Janeiro de 2011**, Cria a Área de Relevante Interesse Ecológico (ARIE) denominada "Parque Ambiental Antonio Danúbio Lourenço da Silva" e dá outras providências. Publicado no Diário Oficial [do Município de Ananindeua] de 17/01/2011.

ANANINDEUA. **Decreto nº 15.183**, de 12 de Dezembro de 2012. Homologa o Plano Municipal de Desenvolvimento Rural Sustentável – PMDRS para o biênio 2013/2015, e dá outras providências. Publicado no Diário Oficial [do Município de Ananindeua] de 30/12/2013.

BASTOS, R. Z.; FARIAS, A. L. A.; CANTO, O.; OEIRAS, E. V. L. Realidade e Desafios da Institucionalização de Unidades de Conservação Municipais do Estado do Pará, Brasil. **Revista Geoamazônia**, v. 2, p. 206-220, 2014.

BELEI, R. A.; GIMENIZ-PASCHOAL, S. R.; NASCIMENTO, E. N.; MATSUMOTO, P. H. V. R. O uso de entrevista, observação e videogravação em pesquisa qualitativa. **Cadernos de Educação**, v. 30, 187-199, 2008.

BRANCALION, P. H. S.; NOVEMBRE, A. D. L. C.; RODRIGUES, R. R. Seed development, yield and quality of two palm species growing in different tropical forest types in Brazil: implications for ecological restoration, **Seed Science & Technology**, v. 39, p. 412-424, 2011.

CASTILHO, C. V. As palmeiras da região do Seringalzinho. In: BORGES, S. H.; IWANAGA, S.; DURIGAN, C. C.; PINHEIRO, M. R. (Eds.). **Janelas para a Biodiversidade no Parque Nacional do Jaú: Uma estratégia para o estudo da biodiversidade na Amazônia**. Manaus: Fundação Vitória Amazônica, 2004, p. 95-102.

CAVALCANTE, P. B. **Frutas comestíveis da Amazônia. 2. ed.** Belém: Museu Paraense Emílio Goeldi, 1996.

CLAUDINO, W. V; GARCIA, M. L.; LOPES, C. R. A. S.; RODRIGUES, L.; CABRAL, F. F.; PIVA, J. H.; SILVA, A. C. S. Análise fitossociológica da vegetação na região do arco do desmatamento. **Revista de Ciências Agroambientais**, v. 13, n. 1, p. 43-52, 2015.

CNCFLORA - Centro Nacional de Conservação da Flora. **Lista Vermelha da flora brasileira versão 2012.2., 2012**. Available at: cncflora.jbrj.gov.br/portal/pt-br/listavermelha. Acessed in: 15 sep. 2016.

CONDÉ, T.M; CONDÉ, J.D.; SOUZA, C.W.L. Açaí fruit production and carbon stock in managed plantations in Southeast of Roraima. **Revista Agroambiente on-line**, v.14, 2020.

FERREIRA, L. S. L.; SOUSA, J. A. L. de; JARDIM, M. A. G. Florística, ecologia e potencial paisagístico de palmeiras do Parque Zoobotânico do Museu Paraense Emílio Goeldi, Belém – PA, **Revista da Sociedade Brasileira de Arborização Urbana**, v. 9, n. 4, 2014.

FILGUEIRAS, T. S.; BROCHADO, A. L.; NOGUEIRA, P. E.; GUALA, G. F. Caminhamento: um método expedito para levantamentos florísticos qualitativos. **Cadernos de Geociências,** v. 12, p. 39-43, 1994.

FINOL, U. H. Nuevos parámetros a considerarse en el análisis estructural de las selvas vírgenes tropicales. **Revista Forestal Venezolana**, v. 14, n. 21, p. 29-42, 1971.

FLORA DO BRASIL 2020. Available at: http://floradobrasil.jbrj.gov.br/. Acessed in: 7 jun. 2016.

GAMA, J. R. V.; BOTELHO, S.A.; BENTES-GAMA, M.M.; SCOLFORO, J.R.S. Estrutura e potencial futuro de utilização da regeneração natural de floresta de várzea alta no município de Afuá, Estado do Pará. **Ciência Florestal**, v. 13, n. 2, p. 71-83, 2003.

GERMANO, C. M.; LUCAS, F. C. A.; MARTINS, A. C. C. T.; MOURA, P. H. B. DE; LOBATO, G. DE J. M. Comunidades ribeirinhas e palmeiras no município de Abaetetuba, Pará, Brasil. **Scientia Plena**, v. 10, n. 11, p. 1-10, 2014.

IBGE - Instituto Brasileiro de Geografia e Estatística. Manual Técnico da Vegetação Brasileira, 2012. Available at: http://www.biblioteca.ibge.gov.br/visualizacao/livros/liv63011.pdf. Acessed on: 13 nov. 2016.

IUCN - International Union for Conservation of Nature. **The IUCN Red List of Threatened Species, 2016**. Available at: http://www.iucnredlist.org. Acessed in: 26 oct. 2016.

JARDIM, M. A. G.; SANTOS, G. C. DOS; MEDEIROS, T. D. S.; FRANCEZ, D. da C. Diversidade e estrutura de palmeiras em floresta de várzea do estuário amazônico. **Amazônia: Ciência & Desenvolvimento**, v. 2, n. 4, p. 67-84, 2007.

LOBATO, G. de J. M.; LUCAS, F. C. A.; JUNIOR, M. R. de M. Estética, crenças e ambiência: as representatividades das plantas ornamentais em quintais urbanos de Abaetetuba-Pará. **Ambiência**, v. 13, n. 1, p. 135 – 149, 2017.

LOBATO, G. J. M.; MARTORANO, L. G.; LUCAS, F. C. A.; TAVARES-MARTINS, A. C. C.; JARDIM, M. A. G. Condições térmico-hídricas e percepções de conforto ambiental em quintais urbanos de Abaetetuba, Pará, Brasil. **R.Ra' e Ga-Curituba**, v. 38, p. 243-266, 2016.

MARTINS, R. C.; FILGUEIRAS, T. S.; ALBUQUERQUE, U. P. Use and diversity of palm (Arecaceae) resources in central western Brazil. **The Scientific World Journal**, 2014.

MENDES, F. D. S., JARDIM, F. C. D. S., CARVALHO, J. O. P. D., SOUZA, D. V., ARAÚJO, C. B., LEAL, E. D. S., & OLIVEIRA, M. G. D. Dinâmica da estrutura da vegetação do sub-bosque sob influência da exploração em uma floresta de terra firme no município de Moju – PA. **Ciência Florestal**, v. 23, n. 2, 377-389, 2013.

MENEZES A. J. E. A, HOMMA A. K. O.; OLIVEIRA, M. E. C.; MATOS, G. B. Exploração do óleo de tucumã do Pará (*Astrocaryum vulgare* Mart.) na mesorregião da Ilha do Marajó-município de Soure- Pará. In: **II Congresso Brasileiro de Recursos Genéticos**, Belém: 2012.

MIGUEL, A.; MARIMON, B. S.; MARACHIPES, L.; OLIVEIRA, E. A.; JUNIOR, B. H. M. Mudanças na estrutura da vegetação lenhosa em três porções da mata de galeria do córrego bacaba (1999-2006), Nova Xavantina - MT. **Árvore**, v. 35, n. 3, p. 725-735, 2011.

MINAYO, M. C. S. Trabalho de campo: contexto de observação, interação e descoberta. In: DESLANDES, S. F.; GOMES, R., MYNAYO, M. C. S. (Org.). **Pesquisa social: teoria, método e criatividade**. 26. ed. Rio de Janeiro: Vozes, 2011. p. 61-77.

MIRANDA, I. P. DE A.; BARBOSA, E. M.; GUILLAUMET, J. L. B.; RODRIGUES, M. R. L.; SILVA, M. F. F. (Eds.). **Ecossistemas florestais em áreas manejadas na Amazônia**. Manaus: MCT/INPA/PPG-7, 2003.

MOURÃO, L. **Do açaí ao palmito**: uma história ecológica das permanências, tensões e rupturas no estuário amazônico. Editora Açaí, 2011.

OLIVEIRA, A. N.; AMARAL, I. L.; RAMOS, M. B. P.; NOBRE, A. D.; COUTO, L. B.; SAHDO, R. M. Composição e diversidade florístico-estrutural de um hectare de floresta densa de terra firme na Amazônia Central, Amazonas, Brasil. **Acta Amazonica**, v. 38, n. 4, p. 627-642, 2008.

OLIVEIRA, L. M. O.; FREITAS, R. C. de J.; MIRANDA, S. do C. de. Importância e a contribuição de Von Martius para o conhecimento da Flora Arborea do cerrado. **Revista Sapiência**, v. 3, n. 2, 2014.

PIMENTEL, M. S. **Registro em Herbários e Expressões Fenológicas de Palmeiras Associadas à Condições Pluviais na Floresta Nacional do Tapajós, Estado do Pará**. 2015. Dissertação (Mestrado em Ciências Ambientais) Centro de Ciências Naturais e Tecnologia – Universidade do Estado do Pará, Belém.

PINHEIRO, E. D. S.; MARTINOT, J. F.; CAVALCANTE, D. G.; MACEDO, M. A. D.; NASCIMENTO, A. Z. A.; & MARQUES, J. P. C. Paisagem, estrutura e composição florística de um parque urbano em Manaus, Amazonas, Brasil. **Rodriguésia**, v. 61, n. 3, p. 531-549, 2010.

POTT, V. J.; POTT, A. Buriti – *Mauritia flexuosa*: Fauna e Flora do Cerrado, 2004. Available at: http://cloud.cnpgc.embrapa.br/faunaeflora/plantas-uteis/buriti-mauritia-flexuosa. Acessed in: 3 dec. 2016.

RESENDE, I. L. M.; SANTOS, F. P.; CHAVES, L. J.; NASCIMENTO, J. L. Estrutura etária de populações de *Mauritia flexuos*a L.f. (Arecaceae) de veredas da região central de Goiás, Brasil. **Revista Árvore**, v. 36, n. 1, p. 103-112, 2012.

RIBEIRO, E. S.; SOUZA, R. S.; MOREIRA, E. L.; PASA, M. C. & SOUZA, R. A. T. M. Contribuição das plantas frutíferas do cerrado na dieta das aves e a importância das aves no processo de dispersão de sementes. **Biodiversidade**, v. 12, n. 1, p. 74-89, 2013.

ROCHA, A. E. S.; SILVA, M. F. F. Aspectos fitossociológicos, florísticos e etnobotânicos das palmeiras (Arecaceae) de floresta secundária no município de Bragança, PA, Brasil. **Acta bot. bras**., v. 19, n. 3, p. 657-667, 2005.

SALM, R.; SALLES, N. V. D., ALONSO, W. J., & SCHUCK-PAIM, C. Cross-scale determinants of palm species distribution. **Acta amazonica**, v. 37, n. 1, p. 17-25, 2007.

SALM, R. L., JARDIM, M. A. G. & ALBENAZ, A. L. K. M. Abundância e diversidade de palmeiras no Distrito Florestal Sustentável da rodovia BR-163, Pará, Brasil. **Biota Neotropica**, 11(3), 99-105, 2011.

SHANLEY, P; SERRA M; MEDINA, G. (Ed.) **Frutíferas e plantas úteis na vida amazônica**. Belém, PA: CIFOR: Embrapa Amazônia Oriental: IMAZON, 2010. 304 p.

SILVA, L. R.; MEUNIER, I. M. J.; FREITAS, A. M. M. Riqueza e densidade de árvores, arvoretas e palmeiras em parques urbanos de Recife, Pernambuco, Brasil. **Revista da Sociedade Brasileira de Arborização Urbana**, v. 2, n. 4, p. 34-4, 2007.

SIQUEIRA, G. W.; APRILE, F. Avaliação de risco ambiental por contaminação metálica e material orgânico em sedimentos da bacia do Aurá, Região Metropolitana de Belém - Pará. **Acta Amazonica**, 43(1), 51-62, 2013.

SOUZA, T. E. L. **Distribuição de palmeiras (Arecaceae) ao longo de gradientes ambientais no baixo interflúvio Purusmadeira, Brasil**. 2007. Dissertação (Mestrado em Ciências Biológicas) – Instituto Nacional de Pesquisas da Amazônia, Manaus.

SVENNING, J. C. Environmental heterogeneity, recruitment limitation and the mesoscale distribution of palms in a tropical montane rain forest (Maquipucuna, Ecuador). **Journal of Tropical Ecology** 17: 97-113. 2001.

THIOLLENT, M. **Metodologia da pesquisa-ação**. São Paulo: Cortez, 2011.

ULHÖA, M. T. A imagem como a última das histórias possíveis em Pindorama de Arnaldo Jabor. **Fuera de Campo**, v. 1, n. 1, p. 67-83, 2016.

WALLACE, A. R. **Palmeiras da Amazônia e seus usos**. Manaus: Edua, 2014.

Authorship contributions

1 – Karina de Nazaré Lima Alves (Corresponding author)
Museu Paraense Emílio Goeldi, Master in Biological Sciences - Tropical Botany.
https://orcid.org/0000-0002-1360-735X • karinalvesnl@gmail.com
Contribuition: Conceptualization|Data curation|Formal Analysis|Investigation|Methodology|Project Administration|Writing - original draft.

2 – Flávia Cristina Araújo Lucas
Universidade do Estado do Pará, PhD in Biological Sciences
https://orcid.org/0000-0002-0752-7206 • copaldoc@yahoo.com.br
Contribuition: Conceptualization|Data curation|Funding
Acquisition|Supervision|Validation|Writing - review & editing

3 – Maria Antonia Ferreira Gois
Museu Paraense Emílio Goeldi, Master in Biological Sciences - Tropical Botany.
https://orcid.org/0000-0002-5663-7188 • mariah.botanica@gmail.com
Contribuition: Writing – original draft

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