v. 5, n. 4, 2025

Journal of Agricultural Sciences Research

Acceptance date: 25/04/2025

OCCURRENCE DATA OF *VOUACAPOUA AMERICANA* AUBL. (FABACEAE) IN THE STATE OF PARÁ

Iasmin Thalia Aranha da Silva
Agronomy - Federal Rural University of Amazonia

Sebastião Ribeiro Xavier Júnior
Education: Biologist
Master in Teaching Environmental Sciences
Embrapa Amazônia Oriental/SECTET/SEDUC

Cintia De Paula da Silva Rodrigues
Education: Systems Analysis and Development, Degree in Professional and Technological Education, Master in Professional and Technological Education

Marcelo Trindade Gomes
Degree In Sanitary and Environmental Engineering From UFPA - Postgraduate Degree in Occupational Safety Engineering.
Master's Student in Sanitary and Environmental Engineering at UFPA

Andrey Rabelo de Oliveira
Bachelor of Business Administration
Vocational Education Specialist
Master in Professional and Technological Education all with SECTET/SEDUC ties

Abstract: The acapu belongs to the Fabaceae - Caesalpinioideae family, is found in terra firme forests, is native to the Amazon and is known for its noble wood, as well as the diversity of uses it has. The advance of deforestation and other predatory exploitation activities that involve the suppression of forests, especially in the state of Pará, has affected and put its survival at risk. This, together with the low level of knowledge about the distribution and occurrence of the species, has led to it being included in official lists of endangered flora species at national and international level, in categories of greater restriction. Given this context, this research aimed to contribute to knowledge of the occurrence of *Vouacapoua americana* Aubl. based on data from botanical collections in the state of Pará, as well as to discuss the criteria that led to its inclusion on the Official List of Threatened Species. The data was obtained from a survey of herbarium collections available on the SpeciesLink and Reflora websites. Using the geographical coordinates collected, a map representing all the collection points indicating the occurrence of the species in the state of Pará was created using QGIS software version 3.22. The results showed a total of 339 collection points for botanical samples of the species. This result indicated that there is insufficient information on the data that was used to justify the inclusion of *V. americana on* the List of Threatened Species, since there are many gaps in collection when considering data from timber marketing sites, available in licensing agency databases and on the websites of companies that sell timber products from the species. It is necessary to gather more data and encourage more botanical collections to enable a consistent analysis of the species' real status as an endangered species.
Keywords: *Vouacapoua americana* Aubl; deforestation; occurrence; georeferencing map.

INTRODUCTION

The Amazon is widely recognized as one of the most biodiverse regions on the planet. Its vast tropical forests are home to an impressive variety of plants, many of which are unique and still unknown to science. The Amazon Rainforest is the largest tropical rainforest in the world and currently occupies 40% of South America's territory, with an area of 6.7 million km² that makes up the following countries: Bolivia, Brazil, Colombia, Ecuador, Guyana, French Guiana, Peru, Suriname and Venezuela (Porto-Gonçalves, 2015; Borges, 2023; National Geographic Brasil, 2023).

Brazil is home to more than half of this biome, with approximately 4.9 million km², and a third of all the tropical timber in the world, as well as 30,000 species of plants, of the 100,000 already cataloged in all of South America. With its riches, such as timber, rubber, nuts, fish and minerals, the region is also home to great cultural wealth, with traditional knowledge about the uses and conscious exploitation of these resources (Porto-Gonçalves, 2015; Porto, 2001).

The Amazon's plant biodiversity has significant economic potential. Products such as essential oils, exotic fruits, sustainable timber, among others, can generate income for local communities and contribute to the sustainable development of the region. However, it is crucial to find a balance between economic exploitation and the conservation of natural resources to ensure that these benefits are sustainable in the long term.

After all, the Amazon plays a crucial role in the global carbon cycle, storing large amounts of carbon in its biomass, "with 120-150 billion tons of carbon, which corresponds to about twelve years of global fossil fuel burning" (Artaxo, 2020, p. 58), contributing to mitigating the effects of the climate crisis. In addition, it acts as an important reservoir of atmospheric carbon, but "today it is neutral in

terms of emissions and could become a global source of CO2 in a few years. This is due to the increase in tree mortality, associated with the increase in droughts in recent years, such as the droughts of 2005, 2010 and 2015" (Artaxo, 2020, p. 59).

Furthermore, it is important to note that predatory exploitation and deforestation have an effect on rising temperatures and influence rainfall production, since forests play a fundamental role in recycling precipitation through evapotranspiration and in extracting water from the soil through their roots, contributing to the maintenance of atmospheric currents that generate essential precipitation for the continent (Gatti *et al., 2023*), 2023). This highlights the importance of understanding Amazonian plant biodiversity, with a view to mitigating environmental changes that affect the carbon cycle and conserving this ecosystem.

It is well known that anthropogenic actions in relation to the natural resources of the Amazon's flora have become excessively accentuated, while data from the Institute of Man and the Environment of the Amazon (IMAZON) confirm the increase in the rate of deforestation over the years. These rates increase or decrease according to specific periods that are related to institutional policy. In this way, we see an increase in this rate, in order to meet the logic of infinite production with finite natural resources.

For example, from January to September 2023, the lowest rate of deforestation since 2018 was recorded. When comparing this period in 2023 with the same period in 2022, it can be seen that the rate of deforestation fell almost threefold, from 9,069 km² to 3,516 km². However, when comparing the data for 2023 with that for 2013, the latter showed an accumulated total from January to September of 1,008 km², i.e. a rate three times lower than that of the present day (IMAZON, 2023).

With emphasis on the states that make up the Legal Amazon, the leader in the deforestation ranking is Pará, which, between January and September 2023, reached 1,000 km² of devastated Amazon forest, with a deforestation rate of 29% in relation to the other states (IMAZON, 2023), which highlights the need to discuss the reality of the state, based on deforestation and predatory exploitation of the native species of its biome.

It is a fact that Amazonian flora, especially timber species, are subject to predatory exploitation, causing environmental impacts (Silva, 1998), such as *Vouacapoua americana* Aubl., which is one of the noblest native Amazonian species, however, due to anthropic actions, it has been determined that it is at risk of extinction (CNCFlora, 2012).

The Ministry of the Environment (MMA) instituted Ordinance No. 443/2014, which included the acapu in the List of Threatened Species. Ordinance 148/2022 updated the Official National List of Endangered Flora Species, maintaining the presence of *V. americana* and adding other species. There was a need to analyze under what conditions the acapu was categorized as an Endangered Species (EN), given that it is currently under constant illegal exploitation and also hostage to deforestation.

With this in mind, the research aims to investigate the occurrence of the species based on an analysis of data from virtual herbaria in the state of Pará today, as well as to discuss the information on which the National Center for Flora Conservation (CNCFlora) based its justification for this inclusion.

LITERATURE REVIEW

Vouacapoua americana AUBL

Belonging to the Fabaceae family and the Caesalpinioideae subfamily, *Vouacapoua americana* Aubl. is represented by large trees, averaging 30 to 40 meters in height, with a diameter of approximately 60 centimeters. It has a complex aggregate distribution, with aggregates aligned at various scales, forming super--plates, extending east of the Guiana Plateau downstream of the Amazon Basin, found in French Guiana, Guyana, Suriname and Brazil. It is most common in the Brazilian Amazon, in the states of Maranhão, Amazonas, Amapá and Pará. The species' phytogeographic domain is areas of terra firme and Amazonian ombrophilous forest, in places that are or have been anthropized (Alves, *et al*. 2015; Collinet, 1997; Lorenzi, 2009; Santos *et al*., 2011; Roosmalen, 1985; Silva; Jardim, 2012).

V. americana is also known as acapu, acapuzeiro, wákapu or angelim-da-fleha-larga (Souza *et al*., 2000), and is characterized by:

> dominant or co-dominant with other forest species, and occur naturally in the primary terra firme forests of the eastern Amazon, in clay, sandy-clay or silty-clay soils [...] The species can be easily identified not only by its well-defined size, but also by its dark foliage and showy flowering, with terminal, erect, golden-yellow inflorescences, which attract attention wherever the crown can be glimpsed (Souza *et al*., 2000, p. 5).

"The wood is dark brown, often black, with multiple lighter streaks, smooth or a little rough, compact, heavy, hard, imputrescible, does not absorb moisture and is resistant to pests and diseases" (Maués *et al*., 1999, p. 15). "The grooves in the trunk of the acapu are deep and elongated" (Souza *et al*., 2000, p. 6) . Thus, the species has:

> erect paniculate inflorescences, hermaphrodite, golden-yellow, cup-shaped flowers; pubescent pentalobular calyx; pubescent pentamerous corolla; androecium with ten free stamens, rhymed dorsifixed anthers, arranged in two circles with five anthers each; gynoecium with unicarpellar ovary, stigma with apical depression, surrounded by papillae. [...] The flowers remain in the panicle for up to three days, gradually changing from yellow to brown, and abscission occurs on the third or fourth day when they are not fertilized. The floral resources and attractants are scent, pollen and nectar. The osmophores have been found to be located mainly on the petals and stipe (Maués *et al*., 1999, p. 17).

The reproductive system is allogamous and fruit is not formed by self-pollination, as the natural pollination rate is less than 0.1%, which is common in tree species. The acapu becomes dependent on native insects for pollination and fruit production, so the most common are the flies *Ornidia obesa*, *Eristalis* sp. and the bees *Apis mellifera*, *Aparatrigona impunctata* and *Frieseomelitta* sp. When tropical forests undergo any modification, the frequency of these insects is also affected by this, impairing their pollination (Maués *et al*., 1999). Seed dispersal is autochoric and zoochoric. The latter is carried out by small rodents, such as *Myoprocta acouchy* known as cutiara, and *Dasyprocta leporina* with the vernacular name of agouti, which disperse over short distances from the parent plant (Forget, 1990; Pereira, 2017).

The acapu flowers during the rainy season, from January to March, and bears fruit from April to June. The fruits are simple, dry, dehiscent, unilocular, monospermic, uniseriate, marginal, stenospermic, obovoid vegetables, approximately 5.53mm long. When the ripe fruit is detached from the tree, it is light brown in color and becomes darker over time. The pericarp is dry, leathery, internally and externally opaque, ligneous, irregular, with rough

depressions. The funicle is short, dry, subwoody, rigid, triangular in shape, dark and almost imperceptible (Campos *et al*., 2019; Pereira, 2017; Santos; Freitas; Santos, 2018).

The outer part of the seed is "stenospermic, oval in shape, with a tapered apex, rounded base, reddish brown forehead with small dark brown spots that are almost black, ligneous, glabrous, shiny, with small depressions" (Pereira, 2017, p. 22). On the inside, the "embryo is axial, milky white, the cotyledons are large, fleshy, crass, with a pale yellow epidermis and milky white inner region, oval in shape, rounded to slightly acuminate apex and rounded base" (Pereira, 2017, p. 23). "The embryonic axis, located between the cotyledonary lobes, is straight, conical, thick, milky white, with a radicle hidden inside the cotyledons. The plumule is moderately developed and milky white" (Pereira, 2017, p. 23).

DIVERSITY OF USES

This species is used as a medicinal plant, using tea from the bark to treat stomach problems, liver problems, diarrhea, back pain, hemorrhoids and as an anti-abortifacient (Corrêa; Bastos, 1997; Pinto, 2008). It has top quality wood, good workability, resistance to rot, pests and diseases. It is used in civil and naval construction, cooperage, beams, joinery, carpentry, among others. It can also be used as a tutor in black pepper plantations (Campos *et al*., 2002; Gonzaga, 2006; Silva, 2023).

Inclusion of *Vouacapoua americana* Aubl. on the List of Threatened Species

In order to warn of the loss of a significant number of the species, which is currently found in areas of secondary vegetation due to deforestation (Aragão; Almeida, 1997), CNCFlora, together with the International Union for Conservation of Nature - IUCN, drew up lists subdivided into two annexes, both of which contain *V. americana*.

In 2008, *V. americana* was included in Appendix II in the list of species based on the criterion of lack of information, produced by the Ministry of the Environment - MMA in partnership with the Chico Mendes Institute - ICMBio, which corresponds to the category of Insufficient Data, defined by the IUCN, demonstrating that there is a lack of data on a given taxon to the point where it is not possible to make a direct or indirect assessment based on its occurrence or population status.

In 2012, CNCFlora updated the List of Threatened Species, reclassifying *Vouacapoua americana* Aubl. to Appendix I, which refers to threatened species, on the grounds that, according to data collected by the State Secretariat for the Environment - SEMA/PA (2011) - currently known as the State Secretariat for the Environment and Sustainability - SEMAS/PA - the estimates made by CNCFlora indicated a reduction of 37.826 large-sized individuals or 282,747 medium-sized individuals between 2006 and 2011 (CNCFlora, 2012).

It is known that even when a species is classified in the "Insufficient Data" category, after a certain period, when there is information that its occurrence is compromised, it can be included on the List of Threatened Species (Appendix I). This list, also known as the "Red List", uses categories and criteria to classify a particular species as being at some level of risk of extinction (IUCN, 2000).

Given this scenario, *Vouacapoua americana* Aubl. was placed in the "Endangered (EN)" category by CNCFlora in 2012 on the List of Threatened Species, considering that the species is at risk of extinction. Thus, the criterion assigned to the plant was A2cd, established by the IUCN (2000), which summarizes some characteristics that can classify the condition of a taxon, in order to categorize the reality in which it finds itself regarding the pattern of occurrence. To this end, it was necessary to understand what each letter-number refers to in order to assess the conditions of this classification:

A. A reduction in population based on one of the factors listed below:

1. An observed, estimated, inferred or suspected reduction of ≥70% of its population, over the last 10 years or three generations (period is longer), with clearly reversible AND understood AND already ended causes, based on (specified) one of the following:

(a) direct observation

(b) a suitable abundance index for the taxon

(c) a decline in the area of occupation, the extent of occurrence and/or the quality of the habitat

(d) actual or potential levels of exploitation

(e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected decline of ≥50% of its population, over the last ten years or three generations (whichever period is longer), where this decline or its causes may not have ended OR may not be understood OR may not be reversible, based on (and specifying) any of the elements from a) to e) in A1.

In other words, according to the above, A2 shows a reduction of approximately 50% of the acapu population over the last 10 years or three generations - knowing that generation means the rate of renewal of reproductive individuals in a given population, in this case multiplied by three - considering the longest period, with a maximum of one hundred years, and that this decrease is due to causes that have not been terminated (ceased; interrupted), or which are incomprehensible or irreversible, based on the elements that demonstrate (c) a decline in occupation, the extent of occurrence and/or the quality of the habitat, or which show (d) actual or potential levels of exploitation.

Furthermore, ordinance no. 443 of December 17, 2014, issued by the MMA, restricts the "collection, cutting, transportation, storage, handling, processing and sale" of the species mentioned on the List of Threatened Species, to which the acapu belongs, except for those individuals grown in plantations licensed by the responsible environmental agency. Non-timber forest products (seeds, leaves and fruit) are also not included, as long as the techniques employed do not jeopardize the survival of the individual or its conservation.

The recommendations of the National Action Plans for the Conservation of Threatened Species (PAN), where they exist, must be applied with the restrictions and recommendations laid down in specific regulations, including international acts. In addition, the collection, transport, processing, storage and management of species on the List of Threatened Species for scientific or conservation research is permitted, as is the botanical collection and transport of species for floristic inventories for environmental licensing, which in turn must be authorized by ICMBio and take into account the existing PANs (MMA, 2014).

Years later, Ordinance No. 148 of July 7, 2022 was issued to amend the Threatened Species Lists, adding other species to the list, as well as ratifying the presence of other species that had already been included on the list, such as the acapu (MMA, 2022). That said, there is a debate about the validity of the methodology used to put the species on the List of Threatened Species, which is justified by estimates that show that the acapu occurs in small subpopulations.

DEFORESTATION AND PREDATORY EXPLOITATION AS CAUSES OF THE CONTINUING LOSS OF ACAPU IN PARÁ

The Amazon biome is rich in natural resources, as well as comprising an immense amount of land that corresponds to 58.93% of Brazil's territory (IBGE, 2022). However, despite it being common sense that the riches of the Amazon's flora and fauna are important in a context of climate crisis, and also in the conscious exploitation of these resources for the benefit of society in general, the logic of infinite exploitation of finite resources persists, as the following data points out:

> Deforestation in the Legal Amazon is a historical problem, it has never stopped, and by 2021 around 20% of the forest will have been reduced. In addition, from 2012 to 2021, deforestation grew by the equivalent of 35% and some states such as Tocantins, Maranhão and Rondônia have already deforested practically all of their forests. This should serve as a warning for government authorities to have strategic plans and measures in place to ensure that in other states, as well as in Pará, forests are preserved [....] However, deforestation, in addition to resulting in habitat loss, biodiversity reduction and species extinction, favors the incidence of prolonged droughts and extreme rainfall volumes due to the loss of the forest's environmental functions, as well as economic losses and impasses for the country's sustainable development (Silva *et al.*, 2023, p. 147), 2023, p. 147)

In this continuous process of loss of this biome, *V. americana has* become an endangered species, especially in the state of Pará, which is notable for deforestation in areas close to the species' occurrence to form pastures for extensive cattle breeding, so that the agricultural frontier is increasingly advancing over the arc of deforestation, in places such as the Marajó archipelago and the lower reaches of the Xingu and Anapu rivers (Becker, 2005; Spanner *et al.*, 2021).

In addition, Roberto Porro (2022) discusses the existing clandestine trade chain, detailing its links, which are described as "the felling of trees in the field, the transformation of the logs into stakes on site by hired workers or even by farmers who practice the activity on their land, followed by the removal, usually unpunished, of the stakes in trucks" (p. 2). Stakes are made from the wood of the tree, driven by manual force to the access points for external transport, placed in smaller vehicles to be transferred to trucks or dump trucks, in order to circumvent inspection and be sold to farms in the region, in the south and southeast of Pará, as well as in neighboring states (Porro, 2022).

On the other hand, the director of inspection Branscher (unpublished data), in the Scientific Technical Seminar "Perspective of forest management as an instrument for the conservation of the acapu species (*Vouacapoua americana* Aubl.)", reports that the environmental inspection carried out by SEMAS does not work specifically with species that are, for example, in a condition of predatory exploitation, but it does carry out its work in territories where deforestation and selective exploitation occur more frequently.

There are two fixed operations: Amazônia Viva, with teams traveling around Pará, and Operation Curupira, with three fixed bases: São Felix do Xingu, Novo Progresso/Castelo dos Sonhos and Uruará. Branscher says that the problem of deforestation of the acapu and the Amazon biome will not be solved, and is in favour of discussing criteria to legalize commercialization, as well as the entire production chain of the species.

METHODOLOGICAL RESEARCH TOOLS

In order to capture data on the occurrence of the acapu, we decided to check the SpeciesLink and Reflora websites. The Center for Reference in Environmental Information (CRIA) developed SpeciesLink, which is an

information system for biological collections that gives the curator the ability to manage and select data, with tools that allow information to be visualized, such as maps and graphs (Marinoni; Peixoto, 2010).

The Brazilian government set up the REFLORA Program - Plantas do Brasil: Resgate Histórico e Herbário Virtual para o Conhecimento e Conservação da Flora Brasileira (Plants of Brazil: Historical Rescue and Virtual Herbarium for the Knowledge and Conservation of the Brazilian Flora) in order to repatriate historical specimens of the Brazilian flora, presenting high-resolution images with textual information of the exsiccates, constituting the Reflora Virtual Herbarium (Forzza *et al*., 2015).

It was also necessary to use the Continuous Cartographic Base version 2023 - BC250v2023, from the Brazilian Institute of Geography and Statistics - IBGE, at a scale of 1:250,000 (BC250), as it offers a set of geospatial data to support planning, monitoring and territorial management actions, enabling thematic mapping of the country's population, geology, vegetation, soils, natural and environmental resources, among others, structured in digital databases, enabling an integrated view of the national territory (IBGE, 2023).

Finally, QGIS software, an official project of the Open Source Geospatial Foundation (OSGeo), can be run on various operating systems and supports numerous file formats, such as vectors, rasters, databases and features, making it possible to view, manage, edit, analyze data and create printable maps (QGIS, 2022).

When considering the theoretical bases that guide this work, it is reiterated that even though there is insufficient information on the data used by CNCFlora to include the acapu in the List of Threatened Species, or that contradictions can be observed in its conservation process, there is no doubt that this taxon, as well as others that are exposed to predatory exploitation and deforestation, need research projects to preserve and conserve the Amazon rainforest and native species. In this way, this research aims to contribute data on the occurrence of *Vouacapoua americana* Aubl. from botanical collections, as well as discussing which data was used to include it on the List of Threatened Species.

OBJECTIVES

GENERAL

Contribute data on the occurrence of *Vouacapoua americana* Aubl. (acapu) in the state of Pará, discussing its inclusion on the List of Threatened Species.

SPECIFICS

- Conduct a survey in virtual herbaria on the occurrence of botanical collections of the species in Pará;
- Evidence of this occurrence can be found on a map, which condenses the information obtained from the species' collections;
- Discuss the inclusion of *Vouacapoua americana* Aubl. (acapu) on the List of Threatened Species .

MATERIALS AND METHODS

BOTANICAL COLLECTIONS TO RECOGNIZE THE SPECIES IN THE WILD

As part of the training in recognizing the species in natural conditions and understanding and characterizing its habitat, botanical collections were made on 23/01/2024 from two *V. americana* trees in Belém/PA (Figure 1), near the Ceasa road, in the Mocambo Area - Embrapa Amazônia Oriental, at the following coordinates: -1.4409013, -48.4132472; -1.4410128, -48.4155062.

a)

Source: The author (2024).

b)

Source: The author (2024).

c)

Source: The author (2024).

Figure 1 - Photographic records of the two trees visited in the Mocambo area - Embrapa Amazônia Oriental, Belém/PA. a) base of the trunk of tree 1; b) base of the trunk of tree 2; c) cut showing the live bark

MAKING EXSICCATES

The botanical samples collected were taken to the Botany Laboratory at Embrapa Amazônia Oriental and dehydrated in an oven. Subsequently, the samples were sent for confirmation of the species in a herbarium and, finally, they were mounted in an exsiccate (Figure 2) for inclusion in the IAN Herbarium collection. The exsiccate (Figure 3a) is 16 m high and 35 cm in diameter, and the exsiccate (Figure 3b) is 18 m high and 40 cm in diameter. The collection was carried out initially to make contact with the species and, in addition, to confirm the presence of the acapu in this area.

Figure 2 - Process of assembling the exsiccates of the botanical samples collected in the Mocambo area Embrapa Amazônia Oriental

Source: The author (2024).

a)

b)

Figure 3 - Exsiccates of the botanical samples collected in the Mocambo area - Embrapa Amazônia Oriental. a) Exsiccate 1; b) Exsiccate 2

Source: The author (2024).

PROCEDURES FOR MAKING THE MAP OF AREAS WHERE THE SPECIES OCCURS

In order to provide current data on the occurrence of acapu, we used the information available on the SpeciesLink and Reflora websites to obtain the necessary information from a survey of collection sites in the state of Pará. The data was then organized in an Excel spreadsheet, removing duplicate collections in order to create a georeferenced map of the acapu in Pará, making it possible to visualize the occurrence of the species. The data obtained from SpeciesLink and Reflora was evaluated by herbarium, including the identification and number of botanical collections of the species .

The information from the botanical collections was classified into: 1) collections with available geographical coordinates; 2) collections that only had data on the name of the municipality, rivers, roads, among others; and 3) collections that did not have any of this information. For this reason, the latter were not used to make the map. The data was entered into an Excel spreadsheet, and those with only location data were searched on Google Earth Pro to add the geographical coordinates.

The coordinates, which were in degrees, minutes and seconds (DDDº MM' SS"), were converted into decimal degrees (GD) using INPE's Geographic Calculator (Instituto Nacional de Pesquisas Espaciais). Next, a cartographic survey was carried out, where the cartographic base was BC250v2023 - IBGE's continuous cartographic base version 2023. After obtaining all the necessary data, QGIS software version 3.22 was used to draw up a map of the occurrence of *Vouacapoua americana* Aubl.

RESULTS AND DISCUSSIONS

COLLECTION AND OCCURRENCE DATA

The survey of occurrence records resulted in 377 botanical collection points, of which 339 had geographical coordinates and 38 had no geographical coordinates. The points without coordinates were only used to count the number of collections recorded for the species.

Municipality	No. of collections
Abaetetuba	2
Acará	14
Almeirim	9
Altamira	18
Anajás	10
Ananindeua	4
Anapu	1
Barcarena	2
Bethlehem	69
White Pitch	3
Brief	2
Cametá	1
Castanhal	1
Inhangapi	2
Melgaço	1
Moju	106
Novo Repartimento	10
Óbidos	1
Oriximiná	9
Paragominas	6
Plates	4
Portel	1
Santa Izabel do Pará	4
Santarém	4
São Félix do Xingu	3
Thailand	4
Tomé-Açu	3
Tucuruí	11
Xingu Victory	34
No information	38
Grand Total	339

Table 1 - Number of points per municipality recorded with *Vouacapoua americana* Aubl. samples, in the state of Pará, based on herbarium surveys

Source: The author (2024).

The data analyzed are from samples collected in 29 municipalities, with the highest occurrence records in Moju with 106; Belém with 69; Vitoria do Xingu with 34; and Altamira with 18: Moju with 106; Belém with 69; Vitoria do Xingu with 34; and Altamira with 18. These municipalities that stand out the most represent 67% of the total number of collections recorded for the species (Table 1). It was also noted that 69 samples deposited in the herbaria do not have location information, although some do have geographical coordinates. In 10 samples there is information on the location of the plant, but it is not enough to define the exact location of its municipality. In another 40 exsiccates, the municipality is not defined, but there are geographical coordinates that allowed the collection points to be allocated.

The samples are deposited in 30 national and international herbariums (Table 2), made by 83 botanical collectors and collaborators, with Ribeiro B.G.S. standing out with 57 samples, Pires J.M. with 43, Ducke W.A. 16, Nascimento M. P. do with 13 and the other 79 collectors add up to 174 samples (with 1 to 7 collections), while 36 samples have no indication of the collector (Graph 1).

Of the 38 botanical samples analyzed that didn't have enough location information to make up the map, it was found that they are from different centuries and decades: 25 are from the 20th century (decades 1916-1987), 2 from the 21st century (decades 2001-2021), and another 12 didn't provide information on the year of collection (Graph 2).

After plotting the location information obtained from the botanical samples of *V. americana* analyzed, the map generated showed collection records concentrated near the capital of the state of Para, mainly in the metropolitan mesoregions of Belém, the Northeast of Para and the Southwest of Para (Figure 4).

Roosmalen (1985) reported that the species' distribution area extends to the east of the Guiana plateau downstream of the Amazon basin, and Collinet (1997) pointed out that the abundance of acapu is significantly lower in lowlands and hydromorphic soils than in other soil types, however, Souza *et al*., (2000) state that the species can be found close to river banks, which highlights a contradiction regarding knowledge of the phytogeographic domain.

As it is a shade-tolerant species (Favrichon, 1995) there is a stagnation or regression in the growth of propagules after 25% light (Barigah *et al*. 1998), making the survival of the species sensitive in open areas. Rijkers *et al*. (2000) found that 95% of individuals less than 20 meters tall are located in areas with less than 25% canopy openness.

Data observed by Ferreira (unpublished data) presented during the Scientific Technical Seminar "Perspective of forest management as an instrument for the conservation of the acapu species (*Vouacapoua americana* Aubl.)" on the licensing of the species for the commercialization of wood, available on the Forest Products Commercialization and Transport System (SISFLORA) in the state of Pará, indicated that between 2006 and 2011 there was a movement of wood in 31 municipalities, of which the largest amount (72.6%) was in the municipalities of Anapu, Portel, Pacajá, Tailândia, Moju, Tomé-açu, in the state's integration regions of Marajó, Tocantins, Rio Capim and Xingu, but with records in all regions of the state.

DATA SUPPORTING CNCFLORA'S JUSTIFICATION FOR INCLUDING THE ACAPU ON THE LIST OF THREATENED SPECIES

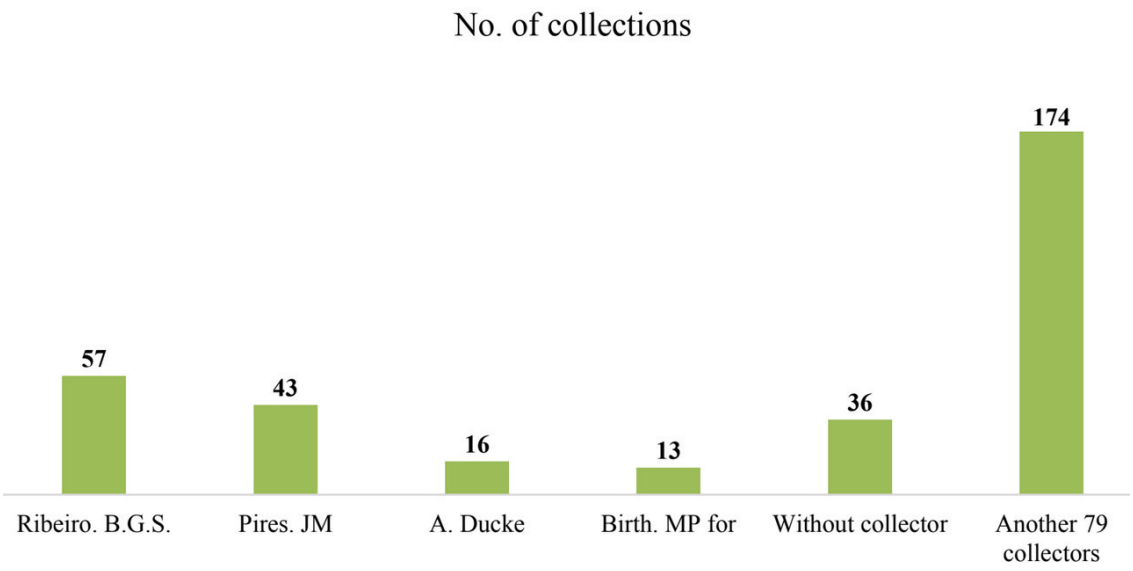
The inclusion of *V. americana* in the list of endangered species of Brazilian flora was based on the following justification:

Herbarium	Acronym	Institution	No. of samples
Alexandre Leal Costa Herbarium	ALCB	UFBA - Federal University of Bahia	3
Calvino Mainieri Library	BCTW	IPT - Institute of Technological Research	14
Embrapa Genetic Resources and Biotechnology Herbarium	CEN	Cenargen - Embrapa Genetic Resources and Biotechnology	5
Field Museum of Natural History	F-SEEDPLANTS	The Field Museum	3
Amapaense Herbarium	HAMAB	IEPA - Scientific and Technological Research Institute of the State of Amapá	1
Father José Maria de Albuquerque Herbarium	HATM	UFPA-Federal University of Pará, Altamira	11
Sérgio Tavares Herbarium	HST	UFRPE - Federal Rural University of Pernambuco	1
Herbarium of the Federal University of Western Pará	HSTM	UFOPA - Federal University of Western Pará	6
State University of Feira de Santana Herbarium	HUEFS	UEFS - State University of Feira de Santana	5
Agronomic Institute of the North	IAN	EAO - Embrapa Amazônia Oriental	169
Herbarium of the Institute of Natural Sciences	ICN	UFRGS - Federal University of Rio Grande do Sul	1
INPA Herbarium	INPA	INPA - National Institute for Amazonian Research	12
Wood Collection - Xiloteca INPA	INPAW	INPA - National Institute for Amazonian Research	4
Herbarium - IPA Dárdano de Andrade Lima	IPA	IPA - Pernambuco Agricultural Research Company	1
Herbarium Specimens at the Royal Botanic Gardens	K	KEW - Royal Botanic Gardens	5
Maranhão Herbarium	MAR	UFMA - Federal University of Maranhão	1
Herbarium Prof. Dr. Marlene Freitas da Silva	MFS	UEPA - Pará State University	24
João Murça Pires Herbarium	MG	Emílio Goeldi Museum of Pará	1
Missouri Botanical Garden	MO	MOBOT - Missouri Botanical Garden	7
The New York Botanical Garden - South America records	NY	NYBG - The New York Botanical Garden	8
	P*		1
National Museum Herbarium	R	MN - National Museum	1
Herbarium of the Botanical Garden of Rio de Janeiro	RB	Rio de Janeiro Botanical Garden Institute	31
Collection of South American vascular plants	RECOLNAT_ MNHN_P	MNHN - Muséum national d'Histoire naturelle	5
Herbarium of Rondonia	RON	UNIR - Federal University of Rondônia	1
State Herbarium Maria Eneyda P. Kaufmann Fidalgo	SP	IPA/SP - Environmental Research Institute	1
University of São Paulo Herbarium	SPF	USP-IB - Institute of Biosciences of the University of São Paulo	2
Federal University of Goiás Herbarium	UFG	UFG - Federal University of Goiás	1
Herbarium of the Federal University of Paraná	UPCB	UFPR - Federal University of Paraná	2
Smithsonian Department of Botany - South American records	US	SMITHSONIAN - Smithsonian Institution	12
Grand total			**339**

Table 2 - Number of records collected in each herbarium with data available on Reflora and SpeciesLink with collections of *Vouacapoua americana* Aubl.

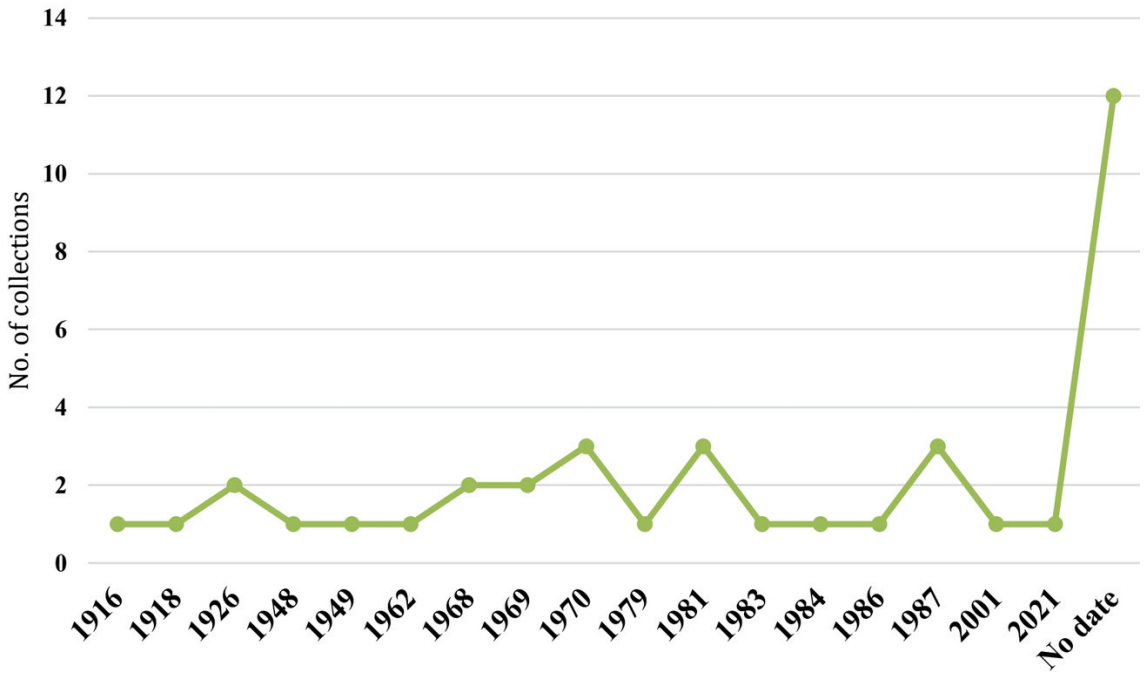
Source: The author (2024).

* Acronym found on the exsiccata, but no data found on the herbarium.



Graph 1 - Main botanical collectors with collection records in the herbarium collections consulted for the *Vouacapoua americana* Aubl. collection.

Source: The author (2024).



Graph 2 - Number of collections per year of collections without geographic location information, deposited in the herbarium collections consulted for the *Vouacapoua americana* Aubl collection.

Source: The author (2024).

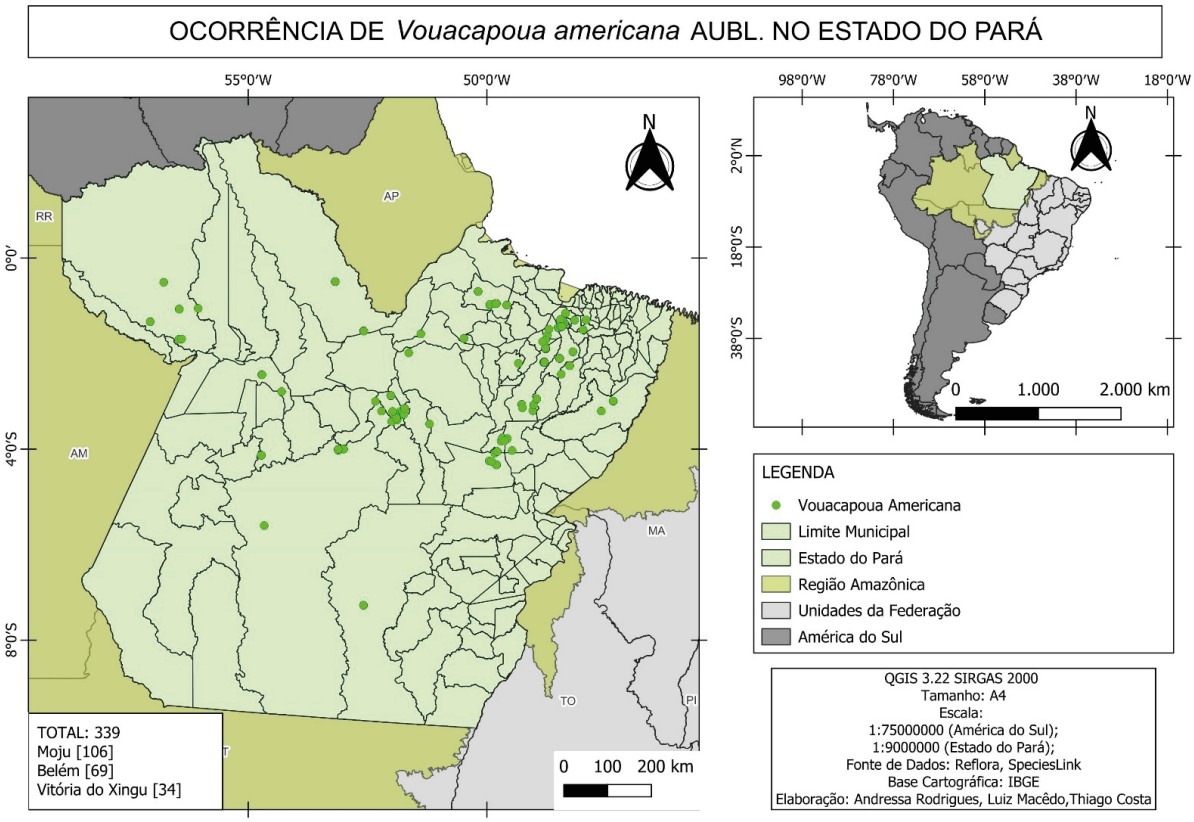


Figure 4 - Map generated for *Vouacapoua americana* Aubl. collection points in the state of Pará based on data obtained from herbaria

Source: Costa, T. D. A.; Macêdo, L. E. C.; Rodrigues, A. D. (2024).

Vouacapoua americana is **slow-growing**, has potential **economic value** and occurs in **small subpopulations** in the states of Amapá, Pará, Amazonas and Maranhão. Its wood is widely used in construction and shipbuilding. Despite the legalization of extraction, considering size data, it is estimated that 37,826 large individuals or 282,747 medium-sized ind. were suppressed between 2006 and 2011. In addition, the species **occurs in areas that are heavily anthropized**, where there is a constant decline in habitat quality. The generation time is estimated to be at least 90 years. Therefore, it is possible to **suspect** that **there has been** a **population reduction of at least 50% in the last 90 years**. Population and genetic studies and greater monitoring of the species' removal from the wild are recommended. (Martinelli; Moraes, 2013) - emphasis added.

With regard to population criteria, Collinet (1997) pointed out that the species has a complex aggregate distribution with nested aggregates at various scales forming what he called "superplates" or "topographic plates" of acapu. While Demay (1998) reported that trees with a DBH of more than 60 cm have a heterogeneous distribution, being found in areas of several tens of kilometers devoid of the species.

When assessing the population distribution of the species on a smaller scale, Descheres (1991) recorded groups of acapu 4 to 9 km in diameter, while Schulz (1960) in Suriname recorded groups of acapus occupying areas 1 to 5 km in diameter, and reported that the distribution of the species depends on the topography and confirmed the edaphic preferences of the acapu.

These studies indicate that aggregate distribution may be a relevant factor in population maintenance due to the issues involved in establishing and maintaining structure (soil factor, dispersal, interspecific competition) (Hubbell, 1979; Goreaud; Pélissier, 2000).

In view of the above and the data obtained from the botanical collections, it is clear that there is a need to increase the collection effort for the species in its different areas of occurrence, so that those with preferential environments for the species' occurrence are covered and provide subsidies for a more complete analysis of its conservation.

However, this justification brings contradictions that expose the great gap in knowledge about the occurrence of the species, since there is data on illegal exploitation not captured by environmental agencies that can also contribute to the categorization of the species. Data available on the Burning Map superimposed on the areas of natural occurrence *of Vouacapoua americana* in 2019, allowed us to infer illegal exploitation or population reduction of this species within a radius of 3km from registered collection points (Spanner *et al*., 2021).

Finally, another point that deserves attention is that the criteria used to include the species in the current threat category are based on just one source, even though the IUCN (2000) states that there needs to be a robust amount of information to assess the status of the species, where the "best available data" is selected

CONCLUSION

The research into the collections resulted in the recording of 377 botanical samples that are deposited in national and international herbaria. Of this data, 339 botanical collection points were included in the georeferencing map, as they provided information on the location of the plants. The number of botanical collections that had neither geographical coordinates nor location (among municipalities, river names, highways) was 38 samples.

Considering the geographical distribution area of the species, as indicated in the various literature available on this subject, the data collected in herbaria does not represent the actual distribution of the species, making this information insufficient to support decision-making on the criteria for including the species in official lists of flora species threatened with extinction. Thus, the inclusion of the acapu in the endangered (EN) category may not be the most appropriate, since CNCFlora's justification uses only one source of data that deals only with legalized commercialization, preventing a concrete assessment of the condition of this species, in accordance with IUCN criteria.

The data obtained contributes to a framework of knowledge about the occurrence of the species and alerts us to the need to carry out more botanical collections of acapu, in order to provide robust information that results in a more complete analysis, with the aim of expanding its conservation.

It is also suggested that the species' areas of occurrence be analyzed in overlap with deforestation data, in order to carry out new investigations into the real level of threat to the species' populations and, in this way, assess the most appropriate category to classify the species, demystifying the controversies caused by the use of only one documentary source to justify the inclusion of the species as endangered (EN) on the List of Threatened Species.

REFERENCES

ALVES, J. C. C. *et al*. *Vouacapoua americana* Aubl. (Leguminosae-Caesalpinoideae), no herbário IAN (Embrapa Amazônia Oriental). IV Simpósio de estudos e pesquisas em ciências ambientais na amazônia. Belém (PA), nov. 2015.

Amazônia Legal. IBGE, 2022. Disponível em: https://www.ibge.gov.br/geociencias/informacoes-ambientais/geologia/15819-amazonia-legal.html?=&t=o-que-e Acesso em: 08. abr. 2024.

ARAGÃO, I. L. G.; ALMEIDA, S. S. de. Estrutura ecológica comparada de populações de acapu (*Vouacapoua americana* Aubl., Caesalpiniaceae) em duas florestas de terra firme da Amazônia oriental *In*: **A vegetação e a flora**, cap. IV, 1997, p. 273-286.

ARTAXO, P. As três emergências que nossa sociedade enfrenta: saúde, biodiversidade e mudanças climáticas. **Estudos avançados**, v. 34, n. 100, 2020.

BARIGAH, T.S., P. Imbert and R. Huc. 1998. Croissance et assimilation nette foliaire de jeunes plants de dix arbres de la forêt guyanaise cultivés à cinq niveaux d'éclairement. Ann. For. Sci. 55:681–706.

Bases cartográficas contínuas – Brasil. IBGE, 2023. Disponível em: https://www.ibge.gov.br/geociencias/cartas-e-mapas/bases-cartograficas-continuas/15759-brasil.html?=&t=sobre Acesso em: 05. abr. 2024.

BECKER, B. 2005. Geopolítica da Amazônia. **Estudos Avançados**, 19, 71-86. Disponível em: https://www.scielo.br/pdf/ea/v19n53/24081.pd f/ Acesso em: 08 abr. 2024

BORGES, G. P. R. dos. **Desmatamento na Amazônia:** um estudo bibliográfico. TCC — UNIPAMPA (RS), 2023, 36 f.

BRANSCHER, T. Acapu no contexto de fiscalização ambiental: uma discussão sobre a eficácia da proibição do corte de espécie no estado *In*: Perspectivas do Manejo Florestal como Instrumento para a conservação da espécie acapu (*Vouacapoua americana* Aublet), **Seminário técnico científico**: Embrapa Amazônia Oriental. Não publicado.

CAMPOS, J. S. *et al*. **Distribuição espacial de *Vouacapoua americana* Aubl. (acapú), em um fragmento de floresta urbana, Jardim botânico Bosque Rodrigues Alves.** FCAP/Embrapa, 2002.

CAMPOS, K. M. de. *et al*. OCORRÊNCIA DE Vouacapoua americana Aubl. e Virola surinamensis Warb. EM ÁREAS IMPACTADAS PELA UHE BELO MONTE. **InterEspaço**, Grajaú (MA), v. 5, n. 18, 2019, p.01-11.

CATEGORIAS E CRITÉRIOS PARA LISTAS VERMELHAS. **UICN**, 2000. Disponível em: https://nc.iucnredlist.org/redlist/content/attachment_files/Portuguese__Categories_Criteria_v3.1_2ndEd.pdf Acesso em: 05. abr. 2024.

CNCFlora. *Vouacapoua americana* Aubl. Em Lista Vermelha da Flora Brasileira Versão 2012.2 Centro Nacional de Conservação da Flora. Disponível em: http://cncflora.jbrj.gov.br/portal/pt-br/profile/*Vouacapoua americana*. Acesso em: 14. out. 2023.

CORRÊA, M. M.; BASTOS, T. X., Aspectos bioclimáticos do acapu (*Vouacapoua americana* Aubl.), **Pibic Embrapa**, 1997.

COLLINET, F. (1997). "Essai de regroupements des principales espèces structutantes d'une forêt dense humide d'après l'analyse de leur répartition spatiale (forêt de Paracou - Guyane)".

DEMAY (L.). — Étude de la qualité des bois sur pied et suivi de leur transformation en scierie. Annexe 5. *In*: Cellule conseil pour l'aménagement forestier et l'utilisation des bois (CCAUB-ONF): rapport final/N. Perthuisot. — Kourou: Silvolab Guyane, 1998.

DESCHERES, P. (1991). "Etude quantitative de la répartition spatiale de quelques espèce forestières commercialisables en Guyane française: cas particulier: Dicorynia Guianensis.". Mémoire ENGREF. 44 f.

DESMATAMENTO NA AMAZÔNIA É O MENOR DOS ÚLTIMOS CINCO ANOS, MAS EQUIVALE A 1.300 CAMPOS DE FUTEBOL POR DIA. **IMAZON**, 2023. Disponível em: https://imazon.org.br/imprensa/desmatamento-na-amazonia-e-o-menor-dos-ultimos-cinco-anos-mas-equivale-a-1300-campos-de-futebol-por-dia/#:~:text=De%20janeiro%20a%20setembro%2C%20foram,2023%20em%20Santar%C3%A9m%20(Par%C3%A1). Acesso em: 01. mar. 2024.

EM QUE PAÍSES ESTÁ A FLORESTA AMAZÔNICA? **National Geographic Brasil**, 2023. Disponível em: https://www.nationalgeographicbrasil.com/meio-ambiente/2023/12/em-que-paises-esta-a-floresta-amazonica. Acesso em: 07. jan. 2024.

FAVRICHON, V. 1995. Mode`le matriciel de´terministe en temps discret. Application a` l'e´tude de la dynamique d'un peuplement forestier tropical humide (Guyane franc¸aise). The`se de Doctorat de l'Universite´ Claude Bernard, Lyon I, Lyon.

FORGET, P. M. Reeruitment palteni of *Vouacapoua americana* (Caesalpiniaceae) a rodent dispersed tree species ia French Guiana. **Biotropica**, v.26, n. 4, p. 408-419, 1990.

FERREIRA, G. C. Ocorrência e distribuição do acapu *In*: Perspectivas do Manejo Florestal como Instrumento para a conservação da espécie acapu (*Vouacapoua americana* Aublet), **Seminário técnico científico**: Embrapa Amazônia Oriental. Não publicado.

FORZZA, R. C. *et al*. HERBÁRIO VIRTUAL REFLORA. Rede de Herbários e Herbários Virtuais do Brasil – 66º Congresso Nacional de Botânica, **UNISANTA Bioscience**, ed. esp., v. 4, n. 7, 2015.

GATTI, L. V. *et al*. Impactos humanos nas emissões de carbono & perdas nos serviços ecosistêmicos: a necessidade de restauração e financiamento climático inovador para a Amazônia. **Policy brief**, 2023. Disponível em: https://www.aamazoniaquequeremos.org/wp-content/uploads/2024/02/PB-Carbon-Emissions-and-Finance_GA_por.pdf Acesso em: 18. Mar. 2024.

GONZAGA A. L. Madeira: uso e conservação. Instituto do Patrimônio Histórico e Artístico Natural. **Caderno Técnico**. Brasília – DF, 2006, 246 f.

GOREAUD, F. & PÉLISSIER, R. 2000. in press. On explicit formulas of edge effect correction for Ripley's K-function. Journal of Vegetation Science.

HUBBELL, S. P. 1979. Tree dispersion, abundance, and diversity in a tropical dry forest. Science 203, p. 1299–1309.

LORENZI, H. Árvores brasileiras. v. 2, Ed.3. **Nova Odessa**: Instituto Plantarum. 2009. 384 f.

MAUÉS, M. M. *et al*. biologia da polinização do acapu (*vouacapoua americana* Aubl. leguminosae), uma essência florestal amazônica. **Simpósio silvicultura na amazônia oriental**: **IDFID**/Embrapa Belém, PA, fev. 1999.

MARINONI, L.; PEIXOTO, A. L. **AS COLEÇÕES BIOLÓGICAS COMO FONTE DINÂMICA E PERMANENTE DE CONHECIMENTO SOBRE A BIODIVERSIDADE**. As coleções biológicas como fonte dinâmica e permanente de conhecimento sobre a biodiversidade. **Cienc. Cult.**, São Paulo, v. 62, n. 3, p. 54-57, 2010. Disponível em: http://cienciaecultura.bvs.br/scielo.php?script=sci_arttext&pid=S0009-67252010000300021&lng=en&nrm=iso Acesso em: 06. abr. 2024.

MARTINELLI, G.; MORAES, M. A. Livro Vermelho da Flora do Brasil. 1.Ed. Instituto de Pesquisas Jardim Botânico do Rio de Janeiro, 2013, 1100 f.

MMA. PORTARIA MMA Nº 443, de 17 de dezembro de 2014. Disponível em: http://cncflora.jbrj.gov.br/portal/static/pdf/portaria_mma_443_2014.pdf Acesso em: 06. abr. 2024.

MMA. PORTARIA MMA Nº 148, de 7 de junho de 2022. Disponível em: https://www.icmbio.gov.br/cepsul/images/stories/legislacao/Portaria/2020/P_mma_148_2022_altera_anexos_P_mma_443_444_445_2014_atualiza_especies_ameacadas_extincao.pdf Acesso em: 06. abr. 2024.

PEREIRA, A. G. **Morfometria de frutos, sementes, desenvolvimento pós-seminal e de plântulas e fisiologia de sementes de *Vouacapoua americana* AUBL. (Leguminosae)**. Dissertação UFRA/Emílio Goeldi, 2017, 56 f.

PINTO, L. N. do. **Plantas medicinais utilizadas em comunidades do município de Igarapé-Miri, Pará**: Etnofarmácia do Município de Igarapé-Miri, Pará. PPGCF/UFPA, 2008, 98 f.

PORRO, R. O que as cercas de acapu ensinam sobre o desmatamento na Amazônia**? O ECO**, 2022. Disponível em: https://oeco.org.br/analises/o-que-as-cercas-de-acapu-ensinam-sobre-o-desmatamento-na-amazonia/ Acesso em: 08. abr. 2024.

PORTO-GONÇALVES, C. W. Amazônia enquanto acumulação desigual de tempos: uma contribuição para a ecologia política da região. **Ver. Crítica de Ciên. Soc.**, v. 107, p. 63-90, 2015.

PORTO, C. Macrocenários da Amazônia 2000 – 2020. **Parcerias estratégicas**, n. 12, 2001.

RIJKERS T.; JandeVries P.J.; Pons T.L. & Bongers F. 2000. Photosynthetic induction in

saplings of three shade-tolerant tree species: comparing understorey and gap habitats in a

French Guiana rain forest. Oecologia 125(3): 331-340.

ROOSMALEN, M. G. M. van. Fruits of the Guianan flora. Utrecht Institute of Systematic Botany, 1985, 483 f.

SANTOS, A. C.; FREITAS, J. L.; SANTOS, S. S. Comportamento Fenológico de Espécies Florestais com Potencial Madeireiro em Ecossistema de Terra Firme, Amazônia Oriental. **Ver. Bras. de Geo. Fís.**, v. 11, n. 03, 2018.

SANTOS, C. A. N. dos; JARDIM, F. C. S. da. Dinâmica da regeneração natural de *Vouacapoua americana* com diâmetro. **Floresta**, Curitiba (PR), v. 42, n. 3, 2012, p. 495 – 508.

SANTOS, E. S. dos *et al*. Relação da estrutura diamétrica das Espécies acapu (*Vouacapoua americana* Aublet) e Breu-branco (Protium pallidum Cuatrec) com diferentes alturas comerciais. *In*: **Simpósio latino-americano sobre manejo florestal**, Santa Maria: UFSM, Programa de Pós-Graduação em Engenharia Florestal, 2011, p. 826-836.

SCHULZ; J.P. Estudos ecológicos sobre florsestas tropicais no norte do Suriname**. Mededelingen van het Botanisch Museum en Herbarium van de Rijksuniversiteit te Utrecht**, 1.Ed. v. 163, 267, 1960.

SEMA – PA. Extração e Monitoramento de Toras de Madeira Nativa. Período de 1/1/2006 até 23/10/2011. Dados, Belém, PA, 2011.

SILVA, A. J. da *et al*. DESMATAMENTO DA FLORESTA AMAZÔNICA NO PARÁ: CAUSAS, IMPACTOS E MEDIDAS DE MANEJO DOS RECURSOS NATURAIS. **Rev. Augustus**, Rio de Janeiro, v.32, n. 59, 2023, p. 125-151.

SILVA, F. L. **Diagnóstico do sistema de produção da pimenteira-do-reino no município de Tomé-açú**. TCC/UFRA, 2023, 45 f.

SILVA, E. J. V. da. **Impactos da exploração madeireira predatória e planejada sobre o crescimento e diversidade de espécies arbóreas na Amazônia oriental.** ESALQ/USP — Piracicaba (SP), 1998.

SOBRE O QGIS. QGIS, [s/d]. Disponível em: https://www.qgis.org/pt_BR/site/about/index.html Acesso em: 05. abr. 2024.

SOUZA, L. A. G. de *et al*. PERÍODO DE FRUTIFICAÇÃO E VIABILIDADE DAS SEMENTES DO "ACAPU" (*Vouacapoua americana* AUBL. - LEG. CAESALP.) DA REGIÃO DO MÉDIO RIO TOCANTINS, PARÁ, BRASIL. **BoI. Mus. Para. Emilio Goeldi, sér. Bot.** v.16 n.1, 2000.

SPANNER, G. C. *et al.* Distribuição potencial de Vouacapoua americana Aubl. na Amazônia brasileira e o impacto da mudança no uso do solo. **Rev. Bras. de Geo. Fís.**, v.14, n.02, 2021.