

CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA



Nineteenth meeting of the Conference of the Parties
Panama City (Panama), 14 – 25 November 2022

CONSIDERATION OF PROPOSALS FOR AMENDMENT OF APPENDICES I AND II

A. Proposal

Transfer from Appendix II to Appendix I of *Paubrasilia echinata* in accordance with Resolution Conf. 9.24 (Rev. CoP17), Annex I, Paragraph A) i) habitat where the species occurs is reducing and v) the species is suffering selective logging and Paragraph B) iii) the species is suffering selective logging and iv) a decrease in the area and quality of habitat and in the number of individuals, and with the following annotation.

Annotation

All parts, derivatives and finished products, including bows of musical instruments, except musical instruments and their parts, composing travelling orchestras, and solo musicians carrying musical passports in accordance with Res. 16.8.

B. Proponent

Brazil*

C. Supporting statement

1. Taxonomy

1.1 Class: Magnoliopsida

1.2 Order: Fabales

1.3 Family: Fabaceae

1.4 Genus, species or subspecies, including author and year: *Paubrasilia echinata* (Lam.) Gagnon, H.C.Lima & G.P.Lewis, 2016.

1.5 Scientific synonyms: *Caesalpinia echinata* Lam., *Guilandina echinata* (Lam) Spreng, *Caesalpinia obliqua* Vog., *Caesalpinia vesicaria* Vell.

1.6 Common names: English: Brazilwood, Pernambuco, Pernambuco wood.
Spanish: Palo brasil, Brasil, Palo pernambuco, Pernambuco, Palo rosado
French: Bois de pernambouc.
German: Pernambuckholz.
Portuguese: Arabutá, Arabutã, Árvore-do-brasil, Brasilete, Brasileto, Ibirapiranga, Ibirapita, Ibirapitã, Ibirapitanga, Ibirapitinga,

* The geographical designations employed in this document do not imply the expression of any opinion whatsoever on the part of the CITES Secretariat (or the United Nations Environment Programme) concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries. The responsibility for the contents of the document rests exclusively with its author.

Ibirapuíta, Ibiripitanga, Imirapiranga, Imirapitã, Imirapitanga, Muirapiranga, Orabutã, **Pau-brasil**, Pau-de-pernambuco, Pau-pernambuco, Pau-rosado, Pau-vermelho, Sapão (Camargos et al, 2001)

1.7 Code numbers: /

2. Overview

Brazilwood - *Paubrasilia echinata* - is a medium-sized tree of the Fabaceae family, with yellow flowers, an endemic species of the Atlantic Forest of Brazil. It produces excellent quality wood that is appreciated around the world for making bows for musical instruments. It is a national symbol tree (Brazil, 1978), which was overexploited as one of the main commercial products during the colonial period for the extraction of dyes (brazilein) during the Portuguese occupation. Estimated exploitation data of Brazilwood point to the removal of 527,182 mature trees over five centuries of economic exploitation (Rocha, 2008).

The use of Brazilwood in the music industry began in the mid-eighteenth century, due to its physical-mechanical characteristics that provide it with excellent sound. It is currently considered the best species for making stringed musical instrument bows. 520 years of intense exploitation of the tree to obtain dyes and later for the music industry, combined with great deforestation pressure on the coastal biome led to the fragmentation of natural populations, drastic reduction of populations, to the complete elimination of the species in several places where historically they were abundant and the inclusion of the species on the list of Brazilian flora threatened with extinction since 1992 in the category "Endangered".

In the last five years, investigations by the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) and the Federal Police have shown that the Brazilian industry has been using prohibited native wood to supply the growing international market for bows for musical instruments in the USA, Europe, and Asia. It is necessary to repress these criminal activities by rigorously increasing control of international trade of these woods. The inclusion of Brazilwood in Appendix I of CITES aims to increase these restrictions on international trade, with the objective of reducing pressures on the remaining native populations of this species on the Brazilian coast.

3. Species characteristics

3.1 Distribution

Brazilwood occurs spontaneously exclusively in Brazilian territory, in the coastal strip between the states of Rio de Janeiro and Rio Grande do Norte, between latitudes 5° 30' (RN) and 23° (RJ), only in the Atlantic Forest biome. Data on the distribution of the species can be found in Rocha & Simabukuro (2008) and Rocha (2010). There are no reliable estimates about the size of native populations.

Isolated trees are widely cultivated in the country as ornamental plants in streets and parks, and sometimes in commercial plantations (Gagnon et al, 2016).

The municipalities with areas where natural populations have been confirmed to occur over the last few years are indicated in Table 1 (Carvalho, 2003; Lima, 2004; Lobão, 2007; Rocha & Simabukuro, 2008; Rocha, 2010; Zani et al, 2012; Sarnaglia Junior et al, 2014).

Table 1: Municipalities with botanical records of natural occurrence of Brazilwood.

State	Occurrence area
Rio Grande do Norte -RN	Baía Formosa, Extremoz, Natal, Nísia Floresta, Parnamirim and Tibau do Sul
Paraíba - PB	Camaratuba, Mamanguape and Rio Tinto.
Pernambuco - PE	São Lourenço da Mata until Vitória de Santo Antão, Nazaré da Mata, Tracunhaém, Pau d'Alho, Timbaúba and Goiana
Alagoas - AL	Junqueira and Coruripe
Sergipe - SE	There are no known native populations in the state.

Bahia - BA	Barrolândia, Camacan, Caraíva, Eunápolis, Guaratinga, Ibirapitanga, Ipiaú, Itamaraju, Itapé, Jussari, Mascote, Pau-Brasil, Pirai do Norte, Porto Seguro Santa Luzia, Tapera, Ubaitaba, Una and Vitória da Conquista
Espírito Santo - ES	Aracruz and Vila Velha*
Rio de Janeiro - RJ	Araruama, Arraial do Cabo, Búzios, Cabo Frio, Duque de Caxias, Iguaba Grande, Itaipuaçu, Japeri, Miguel Pereira, Niterói, Nova Iguaçu, Rio de Janeiro, São Pedro da Aldeia and Saquarema

* New data that has not yet been published

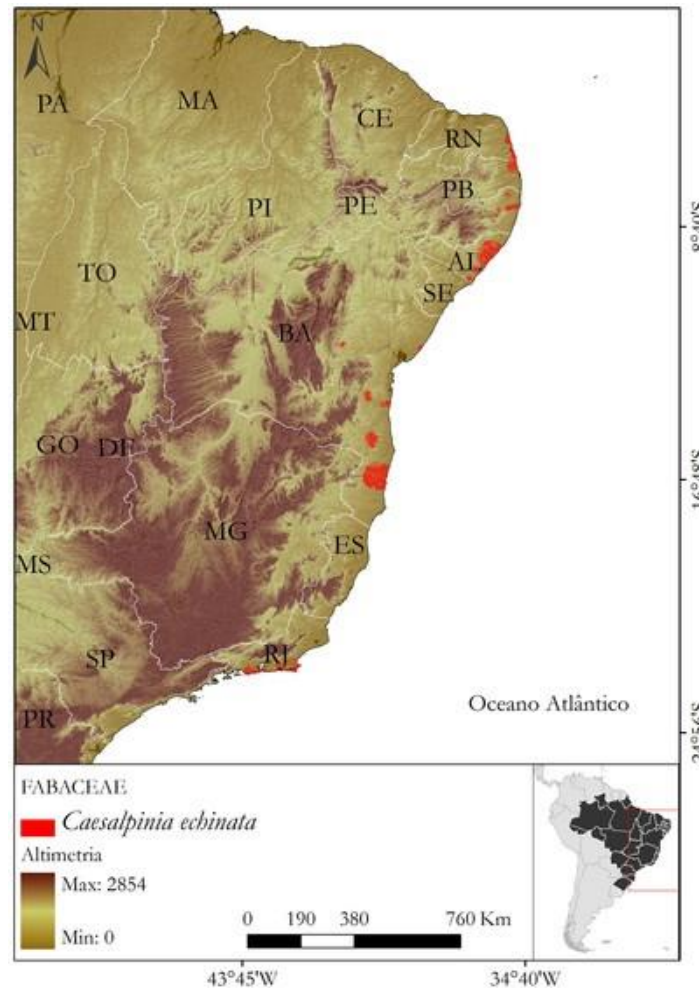


Figure 1 - Current geographical distribution of *Paubrasilia echinata*. (Source: CNCFlora, 2012).

3.2 Habitat

It occurs in the lowland semideciduous seasonal forest, dense rainforest, dune forests and in sandbanks in the coastal strip of the Atlantic Forest biome (Carvalho, 2003).

3.3 Biological characteristics

It is a perennial tree, a climax species, slow-growing, long-lived, occupying the middle stratum of the forest, usually 5 to 15 meters high and 15 to 50 cm DBH, but can reach up to 30 meters high and 100 cm DBH at adulthood. The trunk is short, twisted and sharp, with a short stem, exceptionally reaching 15m in primary forest, with small buttress at the base. Open, broad crown, with shiny dark green foliage and sharp branches. The bark is grayish-brown or pinkish-brown in places where it peels off in the form of plates. Heartwood red, with the trunk exuding a red sap when injured. Hermaphrodite plant, with fragrant golden yellow flowers, pollinated mainly by bees. Blooms from September to November in the state of Rio de Janeiro and from December to May in the state of Pernambuco. It produces orange or orange-red colored wood, with high densities (1.0 to 1.10 g/cm³), glossy, irregular grain, medium texture, very resistant to fungi (Carvalho, 2003).

3.4 Morphological characteristics

Medium sized to large trees, 5–15+ m tall, armed with small to large upturned prickles, these usually arising from woody protuberances, 1–20 mm long (the prickles often sparse or lacking on more mature specimens and larger, older branches); bark chestnut brown to almost black with greyish pustular lenticels, flaking in large woody plates; heartwood red, with the trunk exuding a red sap when injured. Stipules lanceolate, acute to acuminate, caducous. Leaves bipinnate, ending with a pair of pinnae; petiole and rachis finely tomentose; pinnae alternate, the terminal pair opposite to subopposite, with (2–) 3–20 pairs of pinnae per leaf; leaflets alternate, with (2–) 3–19 (–21) leaflets per pinna (generally the number of leaflets is inversely proportional to their size), 0.9–5 × 0.5–3.6 cm (although some specimens have leaflets up to 12 cm long), leaflet blades coriaceous, broadly oblong to subrhombic, apex rounded, obtuse or emarginate, base asymmetric, eglandular, glabrous, midvein excentric, secondary veins brochidodromous. Inflorescence a terminal, or occasionally axillary, finely tomentose raceme or panicle, with c. 15–40 flowers; bracts broadly ovate-triangular, apex acute to acuminate, less than 1 mm long, pubescent, caducous. Flowers bisexual, zygomorphic; calyx a tomentose hypanthium with 5 sepals, that are c. 5–9 mm long, the lowest sepal cucullate, covering the other 4 in bud, all sepals caducous but the hypanthium persisting as a free ring around the pedicel as the pod matures; petals 5, free, bright yellow, the median petal with a blood-red blotch on the inner face, c. 11–15 × 4–10 mm, all petals eglandular, broadly-obovate to slightly spathulate, the petal claws pubescent; stamens 10, free, 7–9 mm long, eglandular, densely pubescent on lower half; ovary pubescent with small spines intermixed, stigma a subterminal fringed-chamber. Fruit a spiny, finely pubescent, sub-lunate, woody, 5.5–7.3 × 1.9–2.6 cm, elastically dehiscent pod with twisting valves, 1–2-seeded. Seeds laterally compressed, ovate-obovate (Gagnon et al, 2016).

Despite being recognized as a single species in the recently dismembered genus *Caesalpinia*, Brazilwood shows considerable variation throughout its range. It is possible to recognize at least three morphological patterns, which show differences in leaves (leaf formula, leaflet shape, and size) and in the anatomical structure of the wood. These morphotypes are genetically separable (Juchum et al 2008), however, so far, no subspecies or varieties have been officially recognized.

3.5 Role of the species in its ecosystem

It is a climax, long-lived species that occupies the middle stratum of coastal forests on poorly fertile soils, with high dominance value and importance in the tree composition in the fragments where it was evaluated (Zani et al, 2012; Sarnaglia Junior et al, 2014). It plays a significant role in the cocoa-cabruca agroforestry system (Lobão, 2007). Little is known about the function of this species in the ecosystem or other relevant ecological aspects.

4. Status and trends

4.1 Habitat trends

The Atlantic Forest originally covered about 15% of the national territory, in 17 states, leaving only 12.4% of the forest that existed 500 years ago. The original geographical distribution of Brazilwood and the size of its native populations have been reduced by logging, caused by the exploitation of its wood, by the opening of areas for agriculture and forestry activities, and by the expansion of urban centers (Rocha, 2010). The largest populations are now found in forested areas in fully protected conservation units or in cocoa-cabruca agroforestry systems in southern Bahia and in rapid decline due to the accelerated transformation of cocoa plantations into pastures.

4.2 Population size

There is no concrete data on the size of natural populations in the remaining fragments of the species. In the construction of the National Floristic Inventory conducted by the Brazilian Forest Service, no specimens of Brazilwood were located in the sampled plots in the states of Espírito Santo (SFB, 2019), Sergipe (SFB, 2017), Paraíba (SFB, 2019), and Rio Grande do Norte (SFB, 2018), areas of historical occurrence of the species. In Rio de Janeiro (SFB, 2018) the species was found in natural populations, but no population size estimates were conducted.

4.3 Population structure

The population structure for one of the last fragments of native forest with Brazilwood in Espírito Santo was evaluated by Zani et al (2012). Phytosociological data indicate that Brazilwood had the highest importance value in that fragment of Ombrophylous Dense Lowland Forest (Tableland Forest), among the 181 tree species sampled in the area. They also point out that the species had a large number of regenerants in the understory, which was associated with the high availability of light in some sections with clearings. No other studies on the population structure of Brazilwood in other fragments where the species occurs are known.

4.4 Population trends

The Atlantic Forest is one of the most threatened biomes in the world, and Brazilwood occurs in environments that have been severely degraded since colonization until today, which caused an intense decline in habitat quality and the extinction of subpopulations. These local extinctions were responsible for the fragmentation of the species, which began to present an aggregate distribution, causing a reduction in genetic variability, with increasingly lower gene flow between subpopulations (CNCFLORA, 2012). Natural populations are no longer found in Sergipe. In Espírito Santo, there is a single forest fragment with a native population of Brazilwood in Aracruz. Recently a new population was discovered in another municipality in Espírito Santo. There is strong urban sprawl in the fragments with the occurrence of Brazilwood in Rio de Janeiro. In southern Bahia, the threat is also aggravated by the decline of cocoa production areas, where the species was kept to shade *Theobroma cacao* in the cocoa-cabruca agroforestry system (Lobão, 2007). Even with all legal protection applied to the species, there are current and recent records of selective logging of centennial trees, inside and outside protected areas, in Paraíba, Rio Grande do Norte (Rocha, 2008) and especially in southern Bahia, to supply the market for bows for musical instruments. Although the last two decades have been marked by investments in environmental awareness regarding the need for conservation of this particular species, including abundant studies on phenology, genetics, germination, wood anatomy, among others, the negative pressures on the natural populations of the species in the remaining forest fragments are evident. There are no formal experiments that evaluate the population trend of the species in the fragments where it occurs. Nevertheless, due to the advance of deforestation, the dismantling of the cocoa-cabruca agroforestry system and the increase in cases of selective extraction, the trend is obviously a strong decline in population.

4.5 Geographic trends

The Atlantic Forest has only 12.4% of its original cover. As *P. echinata* occurs in environments of Semideciduous Seasonal Forest, Dense Ombrophylous Forest and Sandbanks, its survival becomes increasingly limited. There are dozens of experimental plantings, inside and outside the natural range of *P. echinata*, especially in the state of São Paulo, that can act in ex-situ conservation of the species (Rocha & Simabukuro, 2008).

5. Threats

5.1 Deforestation

Deforestation of the Atlantic Forest has been intensifying in recent years. In total, 21,642ha were deforested between 2020/2021, 13,053ha between 2019/2020, and 14,375ha between 2018/2019. The increase in the last biennium was worrying from the coastal states where the last natural fragments of Brazilwood are located. According to the SOS Mata Atlântica Foundation (2022), there was a significant increase in forest loss in the states of Pernambuco (569%), Alagoas (302%), Rio de Janeiro (95%), Bahia (54%). The maintenance of the high level of loss of native vegetation is a real threat to *Paubrasilia echinata*.

5.2 Illegal logging and export of *Paubrasilia echinata*

By Federal Law No. 11,428 of 2006 and Federal Decree No. 6,660 of 2008, the exploitation of native species included in the Official List of Threatened Species of Brazilian Flora in the Atlantic Forest is prohibited. Therefore, the national legislation does not allow the extraction of Brazilwood in its natural habitat.

Legal protection has not stopped criminals from illegally logging mature trees in Bahia, Rio Grande do Norte and Paraíba (Rocha, 2008). In 2019 IBAMA caught 102 of recently cut logs Brazilwood logs hidden in a rural property linked to a famous *archetier* from Aracruz (ES), who was legally exporting bows to Europe and the USA. Illegal transportation of Brazilwood lumber on the BR 101 highway in São Mateus (ES) and the selective logging of centuries-old trees inside Pau-brasil National Park in Porto Seguro (BA) were also caught. Selective extraction of Brazilwood is still active, both inside and outside conservation units. In all cases recently detected, the destination of these woods is the bow making industry for musical instruments.

6. Utilization and trade

6.1 National utilization

The current use of *Paubrasilia echinata* is the manufacture of bows for musical instruments. Pernambuco wood is extensively sought after abroad, being internationally considered the only one that gathers ideal characteristics of resonance, density, durability, beauty, besides the extension of curvature, weight, thickness and precious tonal qualities, for the making of the best stringed instrument bows. It is traded almost exclusively abroad (>92%) as violin, viola, cello and double bass bows, under the denomination "Pernambuco" or "Brazilwood".

With Pau-brasil bows of high value and great quality can be made, even low cost bows used by amateurs and students (Angyalossy, 2005). We have observed that the international market search mainly professional bows, classified as gold, silver and nickel, extremely demanding in the quality of the wood used to make them. It is estimated that such requirements eliminate more than 90% of the cut wood, considered as waste in the production line, unsuitable for the manufacture of professional bows.

6.2 Legal trade

There is no formal control of the international commercialization of bows for musical instruments, due to annotation #10 for the species upon entry into Appendix II in September 2007. By Brazilian legislation, the activity in the Document of Forest Origin (DOF, acronym in Portuguese) is only controlled up to the level of bow blanks (sticks), and bows are also outside the controls and records of commercialization by environmental agencies.

Informally, the data collected during the inspection actions carried out in recent years by IBAMA in the companies producing bows - certainly underestimated, indicate that in the last 20 years 127,274 pieces of bow blanks and bows have been sold abroad. The main consumer countries of Brazilwood raw material are the USA, Japan, Belgium, Germany, Netherlands, Portugal, Italy and France.

6.3 Parts and derivatives in trade

The main commercialised products of the *Paubrasilia echinata* are bow blanks and bows for violin, viola, cello and double bass. Occasionally buttons, pegs, chinrests and tailpieces are also made of Pernambuco. For musical instrument bows, HS code (Harmonised System) 920992 and NCM (MERCOSUR Common Number) 92099200 are used for string musical instruments.

The main importing countries for bows and bow blanks are: USA, Belgium, Japan, Germany, Netherlands, Italy, Portugal, France, Taiwan Province of China, China, United Kingdom of Great Britain and Northern Ireland, Canada, Singapore, Slovenia, South Korea, Poland, Spain, Switzerland, Australia, Hong Kong SAR, Chile, Colombia, Argentina and Austria.

6.4 Illegal trade

IBAMA detected illegal transport of bows of Brazilwood musical instruments without any documents sent as parcels by the Post Office. Between 2017 and early 2018, 10 orders were retained at Guarulhos Airport sending Brazilwood bow blanks and bows without any proof of legal origin. In October 2018, the "Operation Dó-Ré-Mi", carried out by IBAMA, began to combat the illegal trade in timber of CITES species, especially *Paubrasilia echinata* and *Dalbergia nigra*. This Operation uncovered dozens of environmental crimes and administrative infractions involving the producers of bows for musical instruments that have their activities concentrated especially in the state of Espírito Santo, in the municipalities of Aracruz, João Neiva, Linhares, Santa Teresa, and Domingos Martins. In these locations, more than 30 bow makers and companies were fined for producing the instrument with wood of illegal origin, which has been extracted mainly from forest remnants in southern Bahia.

IBAMA agents seized more than 200,000 bow blanks and bows made with wood that had no legal origin. According to the inspection, the stock of Brazilwood existing in the companies is made up of scrap materials, already evaluated in the production line and abandoned due to physical defects, cracks, fissures, holes, misalignment of the fibers, bow blanks with sweep/irregularly shaped, cross grain, knots or other imperfections that prevent them for bow making with the quality required by the export market. It was noted that companies have been actively searching for new sources of raw material, attempting to find quality bow blanks that could meet the requirements of the export market. In this organization participate extractors that harvest trees inside and outside the conservation units, intermediaries that breakdown logs into bow blanks and sell directly to national and foreign bow makers, or to transporters that deliver these materials to companies in the Espírito Santo region. Illegal wood enters the companies' stocks and are covered by the official documents that these companies already possess, giving the trade of bows carried out thereafter an air of legality. With the data forwarded by IBAMA, in November 2021 the Federal Police launched an operation against smuggling of Brazilwood, carrying out search and seizure warrants in 20 targets. Investigators believe that most of the wood was taken from Pau-Brasil National Park in southern Bahia, which is home to the largest amount of remnants of the national symbol tree, and which has reported selective logging of these trees several times in the past decade, all cut to standard log sizes used in the bows industry. Police estimate that the suspects have profited more than USD 46 million from smuggling on the international market.



Figure 2 - 400 bow blanks of illegal origin forwarded by the Post Office to France, seized at Guarulhos (SP) airport in 2017.



Figure 3 - 102 logs of illegally sourced Brazilwood hidden in world-famous archetier's rural property, seized in Aracruz (ES) during Operation Dó-Ré-Mi in 2019.



Figure 4 - 20,747 illegally sourced bow blanks hidden at rural properties in João Neiva (ES), seized during Operation Dó-Ré-Mi in 2018.

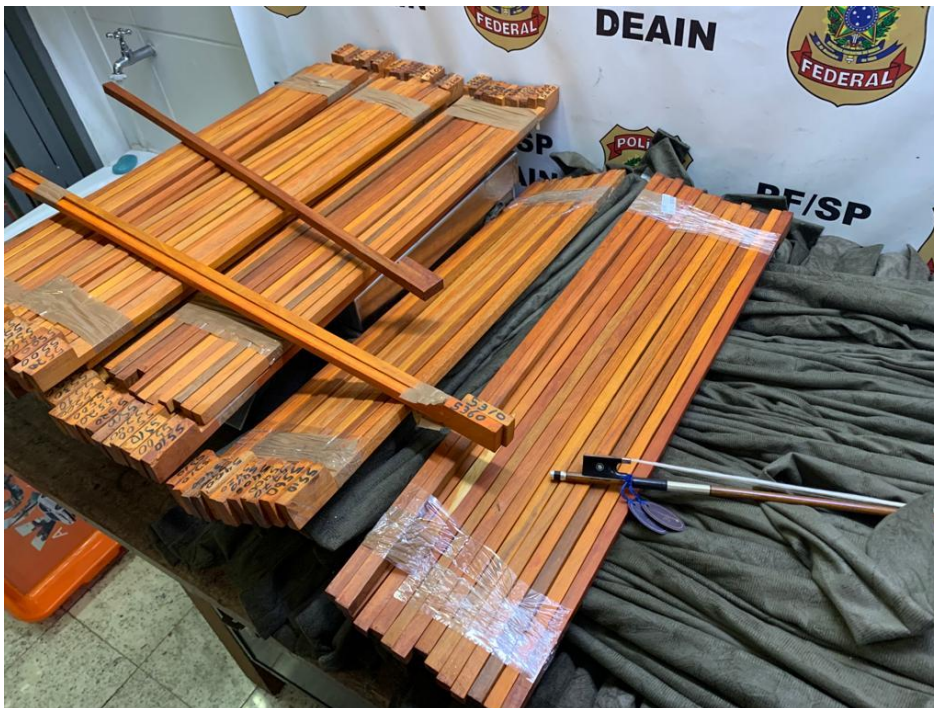


Figure 5 - 120 bow blanks and 114 bows without any documentation of origin, caught in a smuggling operation being transported in suitcases to England by a famous Brazilian bow maker arrested at the Guarulhos (SP) airport in April 2022.

Even with all the efforts undertaken by IBAMA and the Federal Police, in recent months, new loads of bow blanks and bows have been caught being smuggled through Brazilian airports, shipped as packages or carried by the bow makers themselves in their checked luggages and carry-on bags on trips abroad.

6.5 Actual or potential trade impacts

At the national level, the transfer of *P. echinata* from Appendix II to Appendix I will not bring great changes since the Brazilian legislation does not allow the exploitation of the species in nature, allowing only planting registered with the environmental agency or material considered pre-convention and obtained in accordance with the Brazilian legislation.

We currently have CITES permits issued only for bow blanks (unfinished product, prior to the bows). The transfer of the species from Appendix II to Appendix I will bring the trade of finished bows under control, as well. No international trade of seedlings, seeds or bark is known.

There will be bureaucratic impacts for companies that commercialize the species products and by-products, especially in transactions involving the bows of musical instruments, which we intend to see included in the CITES controls, due to the need to obtain the export permits in the administrative agencies that issue them in each country, generating delays in commercial transactions or definitive trade barriers for cases in which there is no proof of origin, chain of custody or pre-convention certificate. It is expected that such restrictive measures will ensure greater protection for the species.

7. Legal instruments

7.1 National

The legislation concerning the preservation of *P. echinata* consists of a series of specific legal instruments and more generalized measures that govern the exploitation and transport of native Brazilian plants. These are:

Federal Law nº 6.607 of December 7th, 1978 - Declares Brazilwood as the national tree and determines the realization of an elucidative campaign about the relevance of that species in the History of Brazil and the implantation, in all the national territory, of Brazilwood tree nurseries, aiming at its conservation and distribution for civic purposes.

Federal Law nº 11.428, of December 22, 2006 - that provides for use and protection of native vegetation of the Atlantic Forest Biome.

Federal Decree nº 6,660, of November 21, 2008 - which regulates Federal Law nº 11,428/2006.

MMA Ordinance nº 320/2012, of September 21, 2012 - Creates the National Program for Pau- Brasil Conservation.

MMA Ordinance nº. 443, December 17, 2014 - which lists *Paubrasilia echinata* threatened of extinction in Brazil, classified under the IUCN criteria as Endangered (EN). It imposes full protection for species in the categories Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), and Vulnerable (VU), including prohibition of collection, harvesting, transportation, storage, handling, processing, and commercialization, among others.

MMA Normative Instruction nº 01, of February 12, 2015 - details the procedures for approval of SFMPs for VU species and indicates a time frame for restrictions on the use of CR and EN species.

Federal Law nº 12,651, of May 25, 2012 - which provides for the protection of native vegetation, empowering federal and state authorities to prohibit or restrict the cutting of endangered species.

IBAMA Normative Instruction nº 21, of December 14, 2014 - establishing the national forest origin control system (SINAFLOR).

CONAMA Resolution nº 278, of May 24, 2001 - which determines to IBAMA the suspension of authorizations granted by its own act or by delegation to the other agencies of the National System of Environment - SISNAMA, for the cutting and exploitation of endangered species, included in the official list of that agency, in natural populations in the Atlantic Forest biome, until technical criteria are established, scientifically based, that guarantee the sustainability of the exploitation and the genetic conservation of the exploitable populations.

CONAMA Resolution nº 300, of March 20, 2002 - that complements the cases subject to cutting authorization foreseen in art. 2º of Resolution nº 278, of May 24, 2001.

CONAMA Resolution nº 317 of December 4th, 2002 establishes the criteria necessary for genetic conservation and sustainability of the exploitation of endangered flora species in the Atlantic Forest, which must be substantiated in State Plans of Conservation and Use based on technical and scientific studies.

7.2 International

Paubrasilia echinata has been on Appendix II since 2007 (CoP 14), by annotation #10 designates logs, sawn wood, veneer sheets, including unfinished wood articles used for the fabrication of bows for stringed musical instruments to CITES permit. Finished bows are exempted from CITES permit.

8. Species management

8.1 Management measures

Brazilian legislation does not allow exploitation of the species in its natural habitat. However, we are aware that illegal exploitation of the species continues and even within protected areas. Transactions of wood between the companies and bow makers are controlled by the Document of Forest Origin (DOF) since September 2006. Yet, there were serious flaws in the evaluation of the origins of the stocks initially registered in this system, only recently discovered. Furthermore, the system controls breakdown and transport only up to the point where the wood is split into bow blanks. Bows, as finished products, are exempted from being declared to authorities, and require no environmental documents to be transported and commercialized. The system also does not require information about unusable byproduct residual waste (improper defective bow blanks). For these reasons, the mechanisms for controlling pre-convention stocks in company yards are inefficient, providing incomplete data for environmental authorities. In terms of conservation, the National Program for the Conservation of Brazilwood created in 2012 has not shown significant progress in taking measures to protect the species. There are projects underway that foresee the production and distribution of seedlings of the species. Still, the mechanisms for governmental monitoring and follow-up of these programs are unknown, and they have apparently been used more as marketing tools by actors linked to the bow making industry, in an attempt to give a veneer of sustainability to the predatory activity of logging secular Brazilwood trees.

8.2 Population monitoring

There is no population monitoring for the *Paubrasilia echinata* species by government institutions, nor data about the feasibility of harvesting the native tree wood in the natural environment.

8.3 Control measures

8.3.1 International

Paubrasilia echinata has been listed in Appendix II of CITES since September 2007. But, due to annotation #10, finished bows are exempted from CITES control, so that trade is controlled only up to the unfinished stage of the bows: bow blanks.

8.3.2 Domestic

Despite the existence of restrictive legislation and protection for the Atlantic Forest biome and for the species *P. echinata*, there is still illegal exploitation of the species, both inside and outside protected areas. Brazilian legislation is also silent on the commercialization of finished products (bows) due to the dispensation of the Document of Forest Origin (DOF) given by Normative Instruction nº 21/2014. Thus, Brazilian authorities do not know how many bows are sold per year. There is an estimated number based on the invoices submitted by the companies, but this number does not necessarily reflect the reality, considering the several cases of commercialization caught abroad without any customs documentation. The National Program for Brazilwood Conservation is not active under the Ministry of Environment.

8.4 Captive breeding and artificial propagation

There are no large commercial plantations of this species. Only small commercial plantations and conservation initiatives such as those carried out by IPCI - International Pernambuco Conservation Initiative (<http://www.ipci-usa.org/index.html>), but there is still no wood from the plantations being traded (Groves & Rutherford, 2016). Most of the plantations that exist today do not meet the registration requirements by the environmental legislation, and are not listed in IBAMA's National System of the Control of Origin of Forest Products (SINAFLOR). Nor are there any reports of commercial plantations that have been correctly managed and conducted for future harvesting to produce raw material with the required characteristics for bow making activities. According to Brazilian laws, the existing plantations must be registered in a timely manner with the environmental agencies, with technical projects prepared by legally qualified professionals. There were some events authorising logging of planted trees for commercial purposes, but the inspection found evidence that they seemed to be just fraudulent movements to acquire virtual credits in the control systems to cover up wood of illegal origin.

There is no consensus about the ideal age for harvesting planted trees. Carvalho (2003) indicates that Brazilwood presents very slow and irregular growth, taking decades to reach the ideal cutting point for the production of bows. It is said that it takes 80 years to be ready for harvesting, but there are no studies that prove this age as being the minimum for the use of planted wood in bows for musical instruments. Northeastern states of Pernambuco, Rio Grande do Norte and Alagoas have some plantations being monitored by the NGO *Associação Plantas do Nordeste*, which indicates a good average increment rate in height and diameter, but still does not indicate the possibility of harvesting the planted trees (Santana et al, 2020).

Rolim & Piotto (2018) conducted an extensive study in a 24-year-old Brazilwood plantation and presented in a technical sheet a detailed evaluation of the growth and productivity data and results of physical-mechanical evaluations of the wood - bulk density, basic density, shrinkage, anisotropy coefficient, modulus of rupture in static bending, maximum shear strength, maximum compressive strength parallel to the fibers and Janka hardness. They indicate that Brazilwood needs long cycles, 40 to 50 years, to reach at least 30 cm DBH.

Few studies have evaluated the quality of wood from Aracruz plantations (Marques, 2009; Marques et al, 2012; Schimleck et al, 2013). Some parameters evaluated were considered promising, nevertheless, there was no proof that the qualities of these woods would be the same as those of native woods. In a recent interview, an experienced bow makers from Aracruz who had access to these woods of planted origin said that the woods were "soft". Lichtemberg et al (2022) reports that until today, wood quality of planted trees compared to high-quality wood from trees in natural habitats has been seriously questioned, as have ambiguous regulations for their commercial use.

We have no information on *Paubrasilia echinata* plantations outside of Brazil.

8.5 Habitat conservation

Pernambuco populations exist in several fully protected and sustainable use conservation units. Table 2 shows the protected areas that have populations of the species (Rocha & Simabukuro, 2008; Rocha, 2010; CNTFlora, 2012).

Table 2: Protected areas with recorded occurrence of natural populations of Brazilwood.

State	Occurrence area
Rio Grande do Norte - RN	Parque Estadual das Dunas; RPPN Mata da Estrela; Parque Ecológico Água das Dunas; Parque Estadual Mata de Pipa;
Paraíba - PB	ESEC Pau-brasil; REBIO Guaribas;
Pernambuco - PE	ESEC Tapacurá
Alagoas - AL	ESEC Serra do Ouro; RPPN Usina Coruripe
Bahia - BA	ESEC Pau-brasil, RPPN Estação Veracruz, PARNA do Descobrimento, PARNA do Monte Pascoal, PARNA do Pau-brasil, REBIO de Una, RPPN Serra do Teimoso
Espírito Santo - ES	APA Lagoa Grande*
Rio de Janeiro - RJ	APA Serra da Capoeira Grande, REBIO Tinguá, APA Massambaba, RESEC Estadual de Jacarepiá, APA Serra de Sapiatiba, APA do Pau-brasil, Parque Estadual Serra da Tiririca; Parque Municipal da Boca da Barra; Reserva Ecológica Darcy Ribeiro
Sergipe - SE	There are no known native populations in protected areas.

* New data that has not yet been published

8.6 Safeguards

See 7.1.

9. Information on similar species

Pernambuco wood can be easily identified by its orange/reddish coloration, storied rays on the tangential face, and the presence of brazilein, which appears as a reddish dye when in contact with a basic solution.

It is possible to separate *Paubrasilia echinata* from similar species, such as *Brosimum rubescens*, *Centrolobium* spp. and *Manilkara* spp. by the general aspect and colour, and only in *Centrolobium* there are storied structures. Also similar are some species of *Handroanthus* spp. and *Dialium guianense*, due to their use for the same purpose, the production of bows for musical instruments. Both are distinguished from Pernambuco colour, deposits in heartwood vessels by ipein common in *Handroanthus*, and by axial parenchyma in narrow bands in *Dialium*. None of these Brazilwood similar woods shed ink.

Macroscopic wood anatomy descriptions of Pernambuco are available in Mainieri (1960), Manieri et al (1983), Coradin et al (2010), Alves et al (2013), Ruffinato & Crivellaro (2019). Microscopic wood anatomy descriptions in Mainieri (1960), Richter & Dallwitz (2000) Insidewood (2004) Angyalossy et al (2005), Alves et al (2008), Gasson et al (2009; 2011); Richter et al (2014), Melo Júnior & Barros (2017), Macedo et al (2019), Brandes et al (2020).

10. Consultations

Paubrasilia echinata is endemic to Brazil. Therefore, there is no reason to consult data from other countries.

11. Final considerations

Investigations by IBAMA and the Federal Police found that the Brazilian bow making industry is reportedly using illegally harvested native wood to feed the growing international market for musical instrument bows in the US, Europe, and Asia. Serious frauds recently discovered indicate that companies and independent bow makers have been deceiving the environmental inspection, fraudulently entering data in the control systems, and bringing illicit material into the companies, making materials of illegal origin appear legal.

Urgent measures are needed to repress these criminal activities, not only with actions at the national level, but also with increased rigor and control of the international transport of these woods. The inclusion of Brazilwood in Appendix I of CITES aims to increase these restrictions on international trade, with the expectation that the pressures on the remaining native populations of this species on the Brazilian coast will be reduced.

12. References

- Alves, E.S.; Longui, E.L.; Amano, E. 2008. Pernambuco wood (*Caesalpinia echinata*) used in the manufacture of bows for string instruments. IAWA J. 29: 323–335. DOI: 10.1163/22941932-90000190
- Alves R.C.; Oliveira, J.T.S.; Motta, J.P.; Paes, J.B. 2013. Elaboração de uma chave de identificação das principais madeiras comercializadas no estado do Espírito Santo. Enciclopédia Biosf. 9: 979–988.
- Angyalossy, V.; Amano, E. & Alves, E. S. 2005. Madeiras utilizadas na fabricação de arcos para instrumentos de corda: aspectos anatômicos. Acta bot. bras. 19(4): 819-834
- Brasil. Lei federal nº 6.607 de 07 de dezembro de 1978.
- Bueno, E. 2002. Pau-brasil. São Paulo, Axis Mundi.
- Brandes, A.F.N.; Novello, B.Q.; Lemos, D.N.; Nascimento, L.B.; Albuquerque, R.P., Tamaio, N.; Barros, C.F. 2020. Wood anatomy of endangered Brazilian tree species. IAWA Journal 41 (4). 510–576
- Camargos, J.A.A.; Coradin, V.T.R.; Czarneski, C.M.; Oliveira, D.; Meguerditchian, I. 2001. Catálogo de árvores do Brasil. Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis - Laboratório de Produtos Florestais: Brasília, Ed. IBAMA. 896p.
- Carvalho, P.E.R. 2003. Espécies arbóreas brasileiras. Colombo: EMBRAPA Florestas. v. 1. 1040 p.
- CNCFlora. *Caesalpinia echinata* in 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/Caesalpinia_echinata>. Accessed on 13 may 2022.
- Coradin VTR, Camargos JAA, Pastore TCM, Christo AG. 2010. Madeiras comerciais do Brasil: chave interativa de identificação baseada em caracteres gerais e macroscópicos. Serviço Florestal Brasileiro, Laboratório de Produtos Florestais, Brasília.
- Fontes, R. S. 1995. Pau-brasil, um sonho de resgate. Recife: FUNBRASIL. p.218.
- Fundação SOS Mata Atlântica. 2022. Atlas dos remanescentes florestais da Mata Atlântica: período 2020-2021 Relatório técnico. São Paulo: SOS Mata Atlântica/INPE. 72p. www.sosma.org.br

- Gagnon, E.; Bruneau, A.; Hughes, C.E.; De Queiroz, L.P.; Lewis, G.P. 2016 A new generic system for the pantropical *Caesalpinia* group (Leguminosae). *PhytoKeys* 71: 1–160. doi: 10.3897/phytokeys.71.9203
- Gasson, P.; Warner, K.; Lewis, G. 2009. Wood anatomy of *Caesalpinia* s.s., *Coulteria*, *Erythrostemon*, *Guilandina*, *Libidibia*, *Mezoneuron*, *Poincianella*, *Pomaria* and *Tara* (Leguminosae, Caesalpinioideae, Caesalpinieae). *IAWA J.* 30: 247–276. DOI: 10.1163/22941932-90000218.
- Gasson, P.; Baas, P.; Wheeler, E. 2011. Wood anatomy of CITES-listed tree species. *IAWA J.* 32: 155–198. DOI: 10.1163/22941932-90000050.
- Groves, M. & Rutherford, C. 2016. CITES and timber: a guide to CITES-listed tree species. Kew, Royal Botanical Gardens.
- Insidewood. 2004. Published on the Internet. <http://insidewood.lib.ncsu.edu> Accessed 31 May 2022.
- Juchum, F.S.; Costa, M.A.; Amorin, A.M.; Corrêa, R.X. 2008. Phylogenetic relationships among morphotypes of *Caesalpinia echinata* Lam. (Caesalpinioideae: Leguminosae) evidenced by trnL intron sequences. *Naturwissenschaften* 95:1085–1091. DOI 10.1007/s00114-008-0424-6
- Lichtenberg, S., E. Huber-Sannwald, J. Reyes-Agüero, D. Anhof, and U. Nehren. 2022. Pau-brasil and string instrument bows telecouple nature, art, and heritage. *Ecology and Society* 27(1):32. <https://doi.org/10.5751/ES-13047-270132>
- Lima, H.C.de, Lewis, G.P. & Bueno, E. 2002. Pau-brasil: uma biografia. *In*: Bueno, E. Pau-brasil, São Paulo, Axis Mundi Editora. p.39-76.
- Lima, H.C. de. 2004. As pesquisas sobre Pau-brasil (*Caesalpinia echinata* Lam.) no Instituto de Pesquisas Jardim Botânico do Rio de Janeiro: situação atual e perspectivas. Oficina de Trabalho sobre Conservação do Pau-brasil. IBAMA, Diretoria de Florestas.
- Lobão, E.V.P. 2007. Agroecossistema cacauero da Bahia: cacau-cabruca e fragmentos florestais na conservação de espécies arbóreas. Tese (Doutorado) - Faculdade de Ciências Agrárias e Veterinárias - Unesp, Jaboticabal, 98 p.
- Macedo, T.M.; Lima, H.C.; Souza, N.D.; Gonçalves, A.C.; Costa, C.G.; Barros, C.F. 2019. Intraspecific variation of *Paubrasilia echinata* (Fabaceae) wood along a latitudinal gradient in Brazil. *Flora* 258: 151437. DOI: 10.1016/j.flora.2019.151437
- Mainieri, C. 1960. Estudo macro e microscópico de madeiras conhecidas por Pau-brasil. São Paulo, Publicação IPT 612p.
- Mainieri, C.; Chimelo, J.P. & Angyalossy, V. 1983. Manual de identificação das principais madeiras comerciais brasileiras. São Paulo, Promocet.
- Marques, S.S. 2009. Características de madeiras de *Caesalpinia echinata* Lam. proveniente de reflorestamento e de floresta natural para confecção de arco de arco de violino. Dissertação (Mestrado em Produção Vegetal). Universidade Federal do Espírito Santo, Alegre, 127p.
- Marques, S.S.; Oliveira, J.T.S.; Paes, J.B.; Alves, E.S., Silva, A.G. e Fiedler, N. C. 2012. Estudo comparativo da massa específica aparente e retratibilidade da madeira de Pau-Brasil (*Caesalpinia echinata* Lam.) nativa e de reflorestamento. *Revista Árvore*, 36 (2). p. 373-380.
- Melo Júnior, J.C.F.; Barros, C.F. 2017. Madeiras históricas em embarcações tradicionais do baixo rio São Francisco. *Rev. do Mus. Arqueol. e Etnol.* 28: 109–123. DOI: 10.11606/issn.2448-1750.revmae.2017.125770
- Richter, H.G.; Gembruch, K.; Koch, G. 2014. CITESwoodID: descriptions, illustrations, identification, and information retrieval. In English, French, German, and Spanish. Version: 20th August 2019. deltaintkey.com.
- Richter, H.G.; Dallwitz, M.J. 2000. Commercial timbers: descriptions, illustrations, identification, and information retrieval. In English, French, German, Portuguese, and Spanish. Version: 9th April 2019. delta-intkey.com.
- Rocha, Y.T.; Simabukuro, E.A. Estratégias de conservação *in situ* e *ex situ* do Pau-brasil. *In*: Pau-brasil, da semente à madeira: conhecer para conservar. Instituto de Botânica, São Paulo, p. 102-113, 2008.
- Rocha, Y.T. 2010. Distribuição geográfica e época de florescimento do Pau-brasil (*Caesalpinia echinata* Lam. – Leguminosae). *Revista do Departamento de Geografia*, 20. p 23-36

- Rolim, S.G. & Piotto, D. 2018. Silvicultura e tecnologia de espécies da Mata Atlântica. Belo Horizonte, Ed. Rona. 160p.
- Ruffinatto F, Crivellaro A. 2019. Atlas of macroscopic wood identification. Springer International Publishing, Cham.
- Santana, J.A.S.; Canto, J.L.; Pareyn, F.G.C.; Cabral, M.J.S.G. 2020. Comportamento de *Paubrasilia echinata* (Lam.) Gagnon, H. C. Lima & G. P. Lewis (Pau-brasil) em plantios homogêneos experimentais no Nordeste do Brasil. *Diversitas Journal*. Santana do Ipanema (AI). vol. 5, n. 4, p. 2422-2438. DOI: 10.17648/diversitas-journal-v5i4-990
- Sarnaglia Junior, V.B.; Zani, L.B.; Gomes, J.M.L.; Thomaz, L.D. 2014. Estrutura e composição florística de um trecho de Mata Atlântica com *Caesalpinia echinata* Lam. (Pau Brasil). *Bol. Mus. Biol. Mello Leitão* 34: 39-62.
- SERVIÇO FLORESTAL BRASILEIRO. Inventário Florestal Nacional: principais resultados: Espírito Santo. Brasília, DF: MAPA, 2019. 81p. (Série Relatórios Técnicos - IFN)
- SERVIÇO FLORESTAL BRASILEIRO. Inventário Florestal Nacional: principais resultados: Paraíba. Brasília, DF: MAPA, 2019. 84p. (Série Relatórios Técnicos - IFN).
- SERVIÇO FLORESTAL BRASILEIRO. Inventário Florestal Nacional: Rio de Janeiro: principais resultados. Brasília, DF: MMA, 2018. 111 p. (Série Relatórios Técnicos - IFN)
- SERVIÇO FLORESTAL BRASILEIRO. Inventário Florestal Nacional: Sergipe: principais resultados. Brasília, DF: MMA, 2017. 87 p. (Série Relatórios Técnicos - IFN)
- SERVIÇO FLORESTAL BRASILEIRO. Inventário Florestal Nacional: principais resultados: Rio Grande do Norte. Brasília: MMA, 2018. 64 p. (Série Relatórios Técnicos - IFN)
- Schimleck, L.R.; Matos, J.L.M.; Muniz, G.I.B., Espey, C.; Taylor, A; Harper, D. 2013. Examination of wood properties of plantation-grown Pernambuco (*Caesalpinia echinata*). *IAWA Journal* 34 (1), 34-48.
- Zani, L.B.; Sarnaglia Junior, V.B.; Gomes, J.M.L.; Thomaz, L.D. 2012. Estrutura de um fragmento de Floresta Atlântica em regeneração com ocorrência de *Caesalpinia echinata* Lam. (Pau-brasil). *Biotemas*, 25 (4), 75-89. doi: 10.5007/2175-7925.2012v25n4p75