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Roots and fruits:
Highlighting the BIPOC Botanists legacy

Review

Cultural Woods in Brazil: Historical Legacy and Future Frontiers

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ABSTRACT

Historical woods express cultural relations around the use of biodiversity by human societies. This article presents an overview of woods used for cultural purposes in Brazil based on the epistemological concept of historical anatomy. Based on 64 publications between 1994 and 2025, this study maps the taxonomic diversity and categories of cultural use of wood, as well as the approaches and contributions to the field made by research groups and wood anatomists. The results show regional asymmetries, with a predominance of studies in the South and Southeast regions of the country and temporal gaps in the other regions. Furthermore, interest in the field has grown in recent years, contributing to a better understanding of the historical use of woods from Brazilian flora. A search was conducted for specialized literature in the main online databases that related historical woods to anatomical identification of the wood. A total of 164 species were recorded in 14 use categories, with emphasis on shelters/buildings, sacred statuary, and watercraft. The concentration of studies in a few states and the prevalence of some species indicate cultural patterns and structural limitations of national research. The work proposes guidelines to expand geographic and thematic coverage, strengthen research networks, and guide public policies aimed at valuing the cultural heritage of wood in Brazil.

Keywords: ancestral knowledge, biodiversity conservation, cultural use of wood, historical anatomy, historical woods, wood anatomy, wood heritage

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Introduction

Brazil is recognized worldwide for its vast biological diversity (Giulietti *et al.*, 2005; Silva *et al.*, 2022), being the country with the greatest richness of woody species on the planet (Beech *et al.*, 2017). It is also home to the greatest diversity of trees in the world, with approximately 9,397 cataloged species — the equivalent of about 35 % of tree species in tropical America and approximately 14.5 % of the estimated global total of 60,065 species (Slik *et al.*, 2015; Beech *et al.*, 2017; Brazil Flora Group, 2021). This diversity is distributed across all of Brazil's biomes, with emphasis on the Amazon (134 families and 4,928 species), the Atlantic Forest (130 families and 3,405 species) and the Cerrado (119 families and 1,826 species), in addition to important occurrences in the Caatinga (108 families and 941 species), the Pantanal (70 families and 236 species) and the Pampa (78 families and 229 species) (Silva *et al.*, 2022).

The Atlantic Forest stands out among Brazilian biomes for its exceptional biodiversity, floristic composition, and high levels of endemism (Joly *et al.*, 2014), in addition to its ecological importance and high vulnerability to anthropogenic disturbances. It is the biome with the longest history of intensive occupation (since the 16th century), driven by European colonization and the arrival of enslaved Africans (Carnaval *et al.*, 2009). Recognized as one of the most threatened tropical forests on the planet and one of the main global biodiversity hotspots (Martini *et al.*, 2007), the Atlantic Forest has a wide territorial distribution, covering approximately 65 % of the federative units of Brazil and occurring in four of the five geographic regions evaluated in this study.

In addition to its ecological value, Brazil's diversity of wood also has an undeniable historical and cultural dimension, marked by its extensive use as an essential raw material for the social development of the different human cultures established throughout the country (Melo Júnior, 2024a). The close connection between human civilization and wood makes it one of the most important renewable raw materials worldwide (Domínguez-Delmáz *et al.*, 2023). Archaeological evidence indicates that forests have been used and modified by human groups since ancient times (Machado-Mello & Peroni, 2015; Maezumi *et al.*, 2023). For thousands of years, wood has been used to produce tools, fuel, weapons, structures and everyday objects (Kisternaya & Kozlov, 2015), and for many other purposes classified by the so-called categories of cultural use of wood (Melo Júnior, 2024a). In Brazil, it shaped the ancient way of life of native peoples (Cabral, 2014) and, later, the lives of those who characterized the migratory fronts of settlement throughout the national territory for more than 500 years (Melo Júnior, 2024a).

The availability of woody species in natural stocks and the workability and quality of wood, in addition to its sensory, aesthetic and symbolic attributes, are all factors that surround the relations established between societies and the historical use of wood (Gonzaga, 2006; Melo Júnior *et al.*, 2019; Silva *et al.*, 2020; Kruel *et al.*, 2021; Pscheidt & Melo Júnior, 2022; Santos *et al.*, 2022; Melo Júnior, 2023). The different colors, textures, aromas and densities make wood extremely dynamic in terms of its applicability, as reflected in the production of material culture that represents different cultures and produces identity meaning (Ennos, 2021; Melo Júnior, 2024a). The material culture produced through the historical use of wood differs from that of other existing wooden objects in that it adds historical and patrimonial value (Cruz *et al.*, 2015).

Understanding the multiplicity of historical uses of wood in a country with a continental geographic area and high cultural diversity, such as Brazil, is a complex task that requires the construction of a solid and articulated research network. In addition, there is a need for a convergent conceptual and methodological basis. The concept of historical anatomy, coined more recently, reveals a promising line of research, especially for integrating knowledge about the diversity of woods with the cultural contexts of their use. Historical anatomy is defined as an interdisciplinary category of wood anatomy that studies woods in cultural use by historical human societies. The analysis and interpretation of wooden artifacts involves the articulation of different fields of knowledge through an integrative dialogue that considers their historical-cultural insertion, the anatomical characterization of the wood, and the identification of the taxon and its forest origin, as well as its biological characterization (Melo Júnior, 2024b).

Despite the growing interest of researchers in the historical use of wood over the last three decades, much more research is still needed to examine artifacts made from one of the most essential materials in the cultural, economic, and social history of humanity (Melo Júnior *et al.*, 2025b). The cultural use of forests and their woody species has been continuous and diverse throughout history, having been initiated by indigenous peoples and subsequently perpetuated by them (Paulino *et al.*, 2025) and by traditional communities and other social groups, including *quilombolas*, *ribeirinhos*, *caiçaras*, *raizeiros*, *caboclos*, *sertanejos* and European immigrants, among others (Cunha *et al.*, 2022). All these groups, in different temporalities and cultural contexts, made use of forest resources, contributing to the construction of multiple forms of management and historical use of wood. However, mapping this historical-cultural use is still a serious gap in the knowledge about Brazilian woody flora. This gap represents a limitation to the full understanding of the relationship between biological diversity and cultural diversity in Brazil and makes it difficult to recognize the historical, ecological and social value of the species used, as well as the formulation of effective public policies aimed at biocultural conservation.

The present study aimed to survey and systematize scientific productions on woods used in culture in Brazil, from the perspective of historical anatomy, to understand the national panorama of research on the topic and outline future strategic actions for this field of knowledge. It is hoped that, beyond this diagnostic phase, the data from this research can inform the development of public policies for research on wood heritage, support conservation practices for both wood heritage and sociobiodiversity, and promote a deeper appreciation of wood in Brazil.

Materials and Methods

The survey of scientific productions on the historical and cultural use of wood in Brazil was guided by a central criterion: the link with wood anatomy. This delimitation ensured adherence to the conceptual scope of historical anatomy, which includes the analysis of wooden artifacts from an interdisciplinary approach, necessarily involving anatomical knowledge (Melo Júnior, 2024b). Thus, the study only considered publications that, in addition to discussing the cultural use of wood, applied or engaged in dialogue with anatomical methods, descriptions or interpretations, highlighting the interface between the material culture of wood and its trajectory of use by different societies throughout space and historical time.

Artifacts falling into the following use categories were considered as part of this material culture: ornaments and garments, handicrafts, dyes and pigments, ritual objects, sacred statuary, recreational objects, musical instruments, fuel, weapons, structures, shelters/buildings, furniture, machinery, implements and tools, means of transport and household utensils (Melo Júnior, 2024c).

The studies were also grouped according to the interpretative bias of the research, considering patrimonial, technological, environmental and conservationist approaches to historical anatomy. The patrimonial approach is considered to be the one that problematizes the cultural field by accessing memories, inheritances, knowledge and practices linked to the material and/or immaterial dimensions of a wooden artifact produced by human societies. The technological approach relates the processes of choosing wood, permeated by its structural, physical-mechanical and chemical properties and by the dimensional aspects of the species, to its employability. The environmental approach allows us to understand the conformation of ancient forests and their transformations over time. The conservationist approach assesses the possible impact of the cultural use of wood on the natural populations of the species, generating support for understanding the current state of ecological conservation of the species and forest ecosystems (Melo Júnior, 2024a). This made it possible to systematize the results presented in the surveyed publications to guide the understanding of the field.

The search was organized by geographic region (North, Northeast, Central-West, Southeast and South) and covered academic databases for the period between 1994 and May 2025, considering the year of the first publication on the subject in the country (Lisboa, 1994). The following bibliographic databases and repositories were used: Web of Science, Scopus, SciELO, Google Scholar, Periódicos CAPES and cross-references. The Google Scholar database was maintained for retrieving studies as it presents scientific journals not indexed in Scopus or WoS, but of importance in the Brazilian botany scene. The following keywords were considered for the search: "wood AND heritage AND Brazil", "historic AND wood AND Brazil", "anatomy AND wood AND Brazil", "timber AND history" OR historical AND Brazil", "wooden AND artifacts AND Brazil", combined in Portuguese and English. Some articles did not appear in the searches and were found by active search. After identifying the primary research sources, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used to ensure the eligibility of studies for inclusion in the analysis (Page *et al.*, 2021). All retrieved studies were read during the screening phase. Duplicate studies or studies with topics unrelated to the research topic were manually excluded. Documents such as course completion papers, dissertations, theses, extended abstracts or presentations at scientific events were not included. The collected data were organized in a matrix (Supplementary Document 1, Melo Júnior *et al.*, 2025a dataset). To effectively describe the status of knowledge, characteristics, and trends within the investigated topic, bibliometric and scientometric principles were used with Excel tools (Silva & Bianchi, 2001; Vieira & Silva, 2023).

Scientific and vernacular names and the geographic distribution of taxa were verified using Flora e Funga do Brasil (2025), complemented, when necessary, by the literature (Carvalho, 2003; 2006; 2008; 2010; 2014).

Results

Bibliometric data

Sixty-four publications, published between 1994 and 2025, were mapped, with a significant increase in scientific interest in the topic in the last two decades, with approximately 77% of the works concentrated after 2010 (Figure 1). Vehicle type included 54 (84.1%) articles in scientific journals and 10 (15.9%) books, book chapters or identification guides. The 54 scientific articles are distributed among 24 different journals, with emphasis on four that concentrate the largest number of works on the topic, accounting for 57.4% of the publications: Balduinia (14 publications; 25.9%), Rodriguésia (7; 13.0%), IAWA Journal (six; 11.1%) and Ciência da Madeira (three; 5.6%). The other 20 journals accounted for 42.6% of the publications (Figure 2).

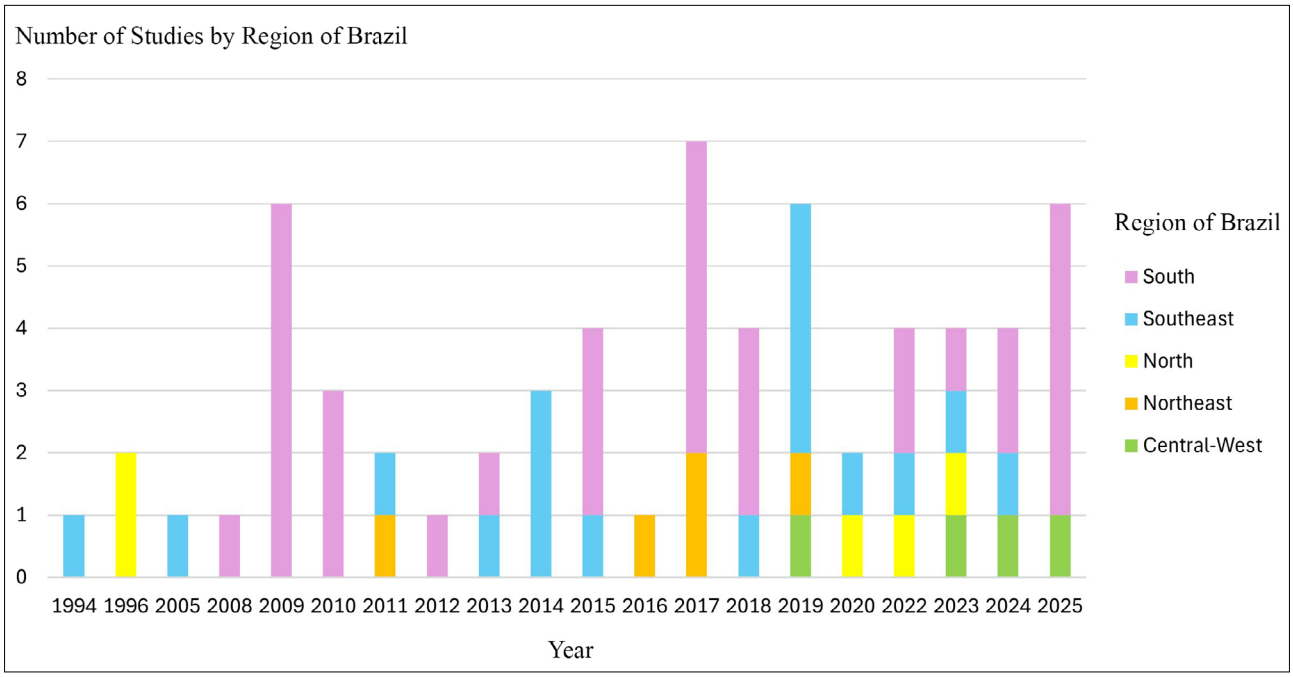

Figure 1. Temporal evolution of studies on historical woods in Brazil (1994–2025).

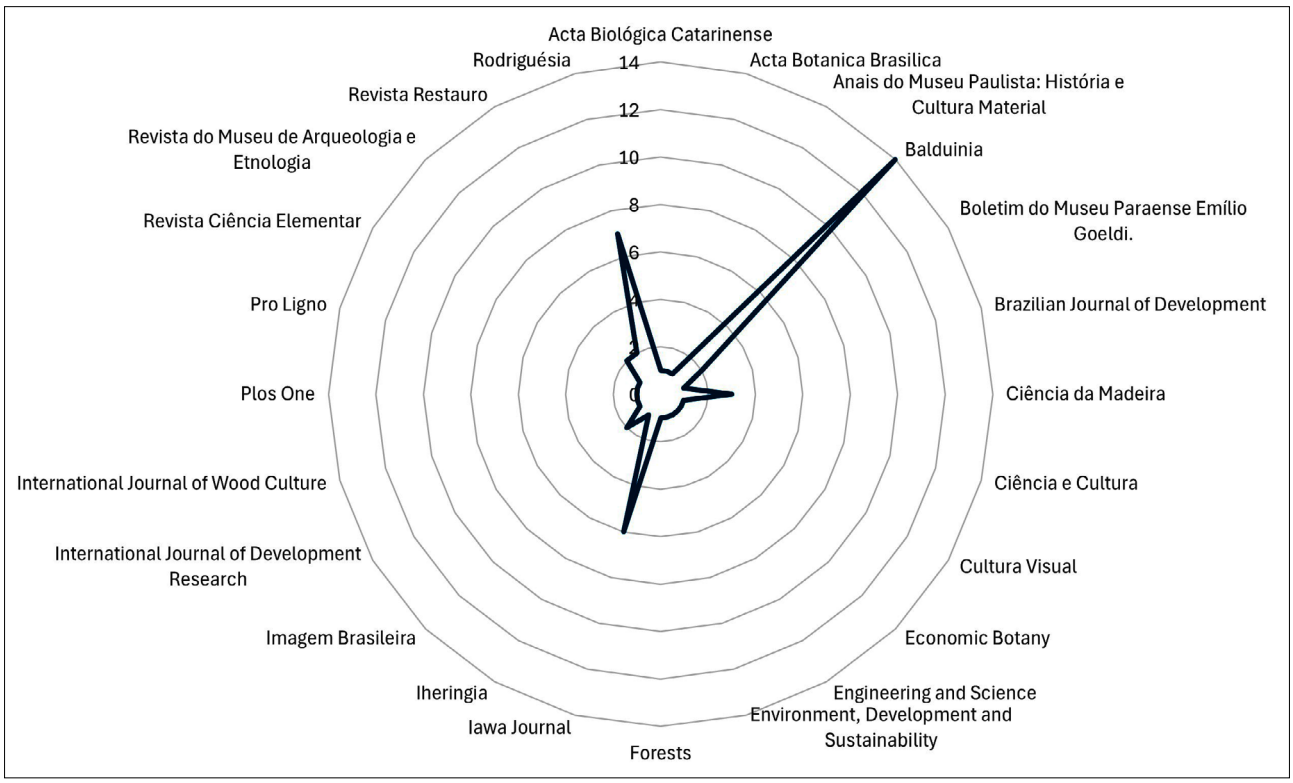

Figure 2. Map of scientific journals that published articles on historical woods (1994–2025).

Regionally, the South Region of Brazil concentrates the majority of publications (33; 51.6 %), followed by the Southeast (17; 26.6 %), Northeast and North (five; 7.8 % each) and Central-West (four; 6.3 %). Case studies are the predominant study type (96.9 %), with conceptual and methodological studies making a minor contribution (3.1 %).

Scientific production involved 24 national institutions and one international institution, among institutions linked to the first author and collaborators. The oldest study was authored by the Museu Paraense Emílio Goeldi. Four institutions accounted for approximately 65.6 % of the first authors of publications, with emphasis on the Universidade da Região de Joinville (UNIVILLE) with 23 studies (35.9 %), the Universidade Federal de Santa Maria (UFSM), with 13 studies (20.3 %) and the Museu Paraense Emílio Goeldi (MPEG) and the Universidade de São Paulo (USP) with three studies (4.7 % each). The remaining 20 institutions contributed two or fewer studies, together accounting for 34.4 % of the publications (Figure 3).

Thirteen different institutions participated as secondary partners in the publications (Figure 3). The most frequent collaborators were the Instituto de Pesquisas Jardim Botânico do Rio de Janeiro (JBRJ), which collaborated in nine studies (40.9 %), and the Universidade Federal da Bahia and the Universidade Federal do Paraná (UFPR), in two studies (9.1 % each). The partnerships were largely national, but there are signs of the formation of a network of international cooperation, represented by the cooperation between the Consiglio Nazionale delle Ricerche (CNR) in Italy and UNIVILLE. International collaborations account for approximately 4.5 % of the publications (one study).

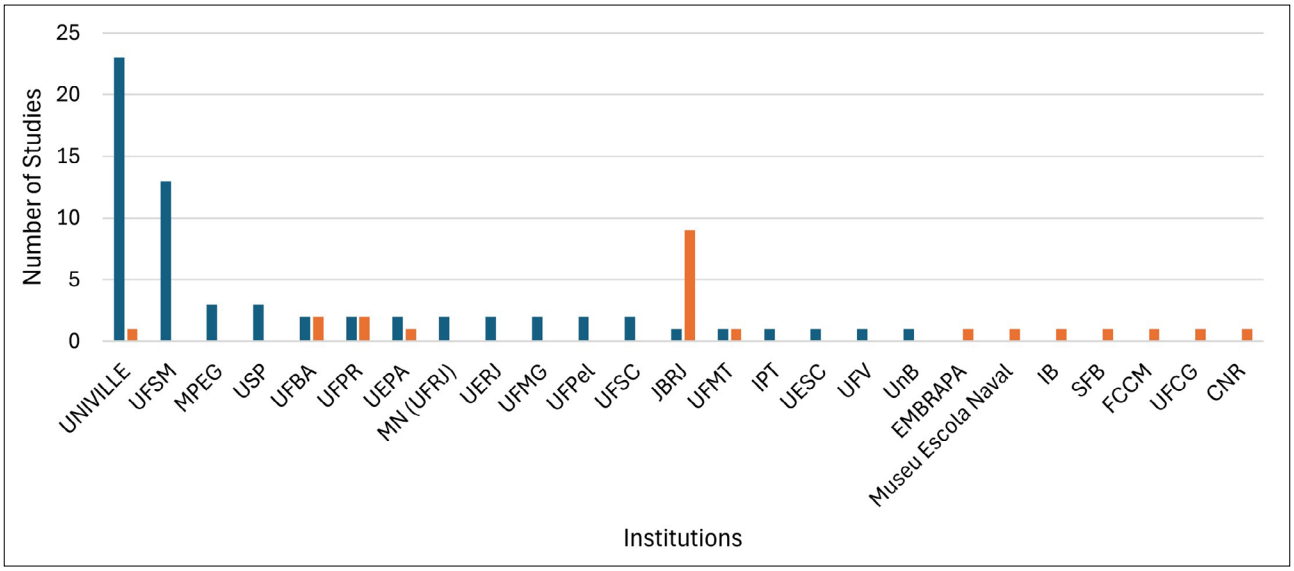

Figure 3. Overall contribution of institutions to publications on historical woods (1994–2025). Legend: first authorship, blue column; co-authorship, red column.

Species diversity and use categories for historical wood at the national scale

Table 1 summarizes the diversity of historical woods in Brazilian cultural heritage with records in the literature. Forty botanical families were identified, totaling 345 records, with emphasis on Fabaceae, which represents 26.7 % of the total (92 records), followed by Lauraceae with 11.0 % (38); Meliaceae with 9.9 % (34); Bignoniaceae with 6.4 % (22); Moraceae with 4.6 % (16); Apocynaceae, Araucariaceae and Lecythidaceae with 4.3 % (15 each); and Sapotaceae with 3.8 % (13). These families account for almost 75 % of the citations. Families with lower representation included Anacardiaceae and Malvaceae with 2.6 % (nine each), followed by Pinaceae with 2.3 % (eight); Vochysiaceae with 1.7 % (six); Boraginaceae, Caryocaraceae and Fagaceae with 1.4 % (five each); Calophyllaceae and Combretaceae with 1.2 % (four each); Asteraceae, Euphorbiaceae and Melastomataceae with 0.9 % (three each); and Cunnoniaceae and Sapindaceae with 0.6 % (two each). The families with the lowest frequency, all with 0.3 % (one each), were Annonaceae, Araliaceae, Arecaceae, Cannabaceae, Goupiaceae, Hypericaceae, Lythraceae, Malpighiaceae, Myristicaceae, Myrtaceae, Nyctaginaceae, Ochnaceae, Peraceae, Phyllanthaceae, Rubiaceae, Rutaceae and Salicaceae.

Taxa exotic to Brazil represented seven botanical families, with Fagaceae and Pinaceae being the most recurrent. The other families — Moraceae, Meliaceae, Myrtaceae, Lauraceae and Salicaceae — have a single record each. These families account for 9.5 % of the families registered, with the remaining 90.5 % being represented by Brazilian native flora.

Table 1. Taxonomic diversity of the historical woods in Brazil (1994-2025).

Family	Wood Species	Author	North	Northeast	Central-West	Southeast	South	Total of Artifacts
Anacardiaceae	*Anarcadium occidentale*	L.		1				1
Anacardiaceae	*Astronium aff. graveolens*	Jacq.		1		1		2
Anacardiaceae	*Astronium macrocalyx*	Engler		1				1
Anacardiaceae	*Astronium* sp.	Jacq.		1				1
Anacardiaceae	*Astronium urundeuva*	(M.Allemão) Engl.		1	10	9		20
Annonaceae	*Annona glabra*	L.		1				1
Apocynaceae	*Aspidosperma australe*	Müll.Arg.					1	1
Apocynaceae	*Aspidosperma polyneuron*	Müll.Arg.			1	2		3
Apocynaceae	*Aspidosperma* sp.	Mart. & Zucc.	1	1		3	12	17
Araliaceae	*Schefflera morototonii*	(Aubl.) Maguire *et al.*					5	5
Araucariaceae	*Araucaria angustifolia*	(Bertol.) Kuntze				13	33	46
Arecaceae	não identificada					1		1
Asteraceae	*Gochnatia* sp.	Kunth				1		1
Asteraceae	*Moquinia* sp.	DC.				1		1
Asteraceae	*Moquiniastrum polymorphum*	(Less.) G.Sancho				3		3
Bignoniaceae	*Handroanthus chrysotrichus*	(Mart. ex DC.) Mattos					1	1
Bignoniaceae	*Handroanthus heptaphyllus*	(Vell.) Mattos					6	6
Bignoniaceae	*Handroanthus pulcherrimus*	(Sandwith) Mattos					1	1
Bignoniaceae	*Handroanthus serratifolius*	(Vahl) S.Grose				1		1
Bignoniaceae	*Handroanthus* sp.	Mattos	1		4	1	1	7
Bignoniaceae	*Paratecoma peroba*	(Record) Kuhlm.		1		7		8
Bignoniaceae	*Tabebuia aurea*	(Silva Manso) Benth. & Hook.f ex S.Moore	1				1	
Bignoniaceae	*Tabebuia cassinoides*	(Lam.) DC.		1		2		3
Bignoniaceae	*Tabebuia* sp.	Gomes ex DC.		1		4		5
Boraginaceae	*Cordia* sp.	L.			1	8		9
Calophyllaceae	*Calophyllum brasiliense*	Cambess.		1	1	9		11
Cannabaceae	*Celtis* sp.	L.				2		2

Table 1. Cont.

Family	Wood Species	Author	North	Northeast	Central-West	Southeast	South	Total of Artifacts
Caryocaraceae	*Caryocar brasiliense*	Cambess.		1		2		3
Caryocaraceae	*Caryocar* sp.	L.				1		1
Caryocaraceae	*Caryocar villosum*	(Aubl.) Pers.	20					20
Combretaceae	*Buchenavia* sp.	Eichler					1	1
Combretaceae	*Terminalia glabrescens*	Mart.		2				2
Combretaceae	*Terminalia* sp.	L.				1		1
Combretaceae	*Terminalia triflora*	L.					1	1
Cunnoniaceae	*Lamanonia* sp.	Vell.				2		2
Euphorbiaceae	*Alchornea glandulosa*	Poepp. & Endl.				1		1
Euphorbiaceae	*Alchornea triplinervia*	(Spreng.) Müll.Arg.					5	5
Euphorbiaceae	*Aleurites moluccanus*	(L.) Willd.				1		1
Fabaceae	*Albizia polycephala*	(Benth) Killip. ex Record		1				1
Fabaceae	*Albizia* sp.	Durazz.				2		2
Fabaceae	*Alexa grandiflora*	Ducke	16					16
Fabaceae	*Anadenanthera colubrina*	(Vell.) Brenan				1		1
Fabaceae	*Andira* sp.	Lam.				2		2
Fabaceae	*Apuleia leiocarpa*	(J.Vogel) J.F.Macbr.	21	1		2		24
Fabaceae	*Bowdichia* sp.	Kunth				1		1
Fabaceae	*Bowdichia virgilioides*	Kunth		1		1		2
Fabaceae	*Cassia* sp.	L.					1	1
Fabaceae	*Cedrelinga cateniformis*	Ducke	15					15
Fabaceae	*Cenostigma* sp.	Tul.	1					1
Fabaceae	*Centrolobium microchaete*	(Mart. ex Benth.) H.C.Lima					16	16
Fabaceae	*Copaifera trapezifolia*	Hayne				2	1	3
Fabaceae	*Dalbergia brasiliensis*	Vogel					2	2
Fabaceae	*Dalbergia cearensis*	Ducke.		1				1
Fabaceae	*Dalbergia nigra*	(Vell.) Allemão ex Benth.				25	4	29
Fabaceae	*Dalbergia* sp.	L.f.				1		1

Table 1. Cont.

Family	Wood Species	Author	North	Northeast	Central-West	Southeast	South	Total of Artifacts
Fabaceae	*Dalbergia* sp./ *Machaerium* sp.	L.f. / Pers.				2		2
Fabaceae	*Dimorphandra* sp.	Schott				1		1
Fabaceae	*Dinizia excelsa*	Ducke	15					15
Fabaceae	*Dipteryx odorata*	(Aubl.) Forsyth f.				1		1
Fabaceae	*Dipteryx* sp.	Schreb.			1	1		2
Fabaceae	*Enterolobium contortisiliquum*	(Vell.) Morong				8	2	10
Fabaceae	*Enterolobium schomburgkii*	(Benth.) Benth	15					15
Fabaceae	*Enterolobium* sp.	Mart.				1		1
Fabaceae	*Hydrochorea pedicellaris*	(DC.) M.V.B.Soares, Iganci & M.P.Morim				28		28
Fabaceae	*Hymenaea courbaril*	L.		1		2		3
Fabaceae	*Hymenolobium* sp.	Benth.		1		3		4
Fabaceae	*Inga* sp.	Mill.				34		34
Fabaceae	*Machaerium pedicellatum*	Vogel				1		1
Fabaceae	*Machaerium scleroxylon*	Tul.				1		1
Fabaceae	*Machaerium villosum*	Vogel				1		1
Fabaceae	*Melanoxylum brauna*	Schott				8		8
Fabaceae	*Melanoxylum* sp.	Schott				1		1
Fabaceae	*Myroxylon balsamum*	(L.) Harms				2		2
Fabaceae	*Myroxylon peruiferum*	L.f.				1		1
Fabaceae	*Paubrasilia echinata*	(Lam.) Gagnon, H.C.Lima & G.P.Lewis		1		9		10
Fabaceae	*Peltogyne confertiflora*	(Mart. ex Hayne) Benth.		1				1
Fabaceae	*Peltophorum dubium*	(Spreng.) Taub.				2		2
Fabaceae	*Piptadenia* sp.	Benth.				1		1
Fabaceae	*Plathymenia reticulata*	Benth.		1		11		12
Fabaceae	*Plathymenia* sp.	Benth.				1		1
Fabaceae	*Platycyamus regnellii*	Benth.				1		1
Fabaceae	*Schizolobium parahyba*	(Vell.) Blake				128	7	135

Table 1. Cont.

Family	Wood Species	Author	North	Northeast	Central-West	Southeast	South	Total of Artifacts
Fabaceae	*Senna multijuga*	(Rich.) H.S.Irwin & Barneby				2		2
Fabaceae	*Stryphnodendron* sp.	Mart.				3		3
Fabaceae	*Swartzia laxiflora*	Bongard et Benth.		1		1		2
Fabaceae	*Tachigali denudata*	(Vogel) Oliveira-Filho				11		11
Fabaceae	*Tachigali paniculata*	Aubl.				1		1
Fabaceae	*Tachigali* sp.	Aubl.				6		6
Fabaceae	*Vatairea* spp.	Aubl.		1				1
Fabaceae	*Zollernia ilicifolia*	(Brongn.) Vogel				2		2
Fagaceae	*Castanea* sp.	Daubenton				2		2
Fagaceae	*Quercus sessiliflora*	Salisb.					9	9
Fagaceae	*Quercus* sp.	L.				17		17
Goupiaceae	*Goupia glabra*	Aubl.				1		1
Hypericaceae	*Vismia aff. cayennensis*	(Jacq.) Pers.				1		1
Lauraceae	*Aniba* sp.	Aubl.				1		1
Lauraceae	*Laurus nobilis*	L.				3		3
Lauraceae	*Mezilaurus navalium*	(Fr.All.) Taub.				1		1
Lauraceae	*Nectandra* sp.	Rol. ex Rottb.				19	6	25
Lauraceae	*Ocotea aciphylla*	(Nees & Mart.) Mez					6	6
Lauraceae	*Ocotea diospyrifolia*	(Meisn.) Mez					1	1
Lauraceae	*Ocotea divaricata*	(Nees) Mez					3	3
Lauraceae	*Ocotea odorifera*	(Vell.) Rohwer					2	2
Lauraceae	*Ocotea porosa*	(Ness & Mart.) Barroso					24	24
Lauraceae	*Ocotea* sp.	Aubl.		1		19	53	73
Lauraceae	*Sextonia rubra*	(mez) van der Werff		1				1
Lecythidaceae	*Bertholletia excelsa*	H.B.K.	19			1		20
Lecythidaceae	*Cariniana estrellensis*	(Raddi) Kuntze					3	3
Lecythidaceae	*Cariniana legalis*	(Mart.) Kuntze				11		11
Lecythidaceae	*Cariniana* sp.	Casar.				8		8

Table 1. Cont.

Family	Wood Species	Author	North	Northeast	Central-West	Southeast	South	Total of Artifacts
Lecythidaceae	*Eschweilera ovata*	Miers		1				1
Lecythidaceae	*Eschweilera* sp.	Mart. ex DC.				1		1
Lecythidaceae	*Lecythis pisonis*	Cambess.		1		1		2
Lythraceae	*Physocalymma scaberrimum*	Pohl			2			2
Malpighiaceae	*Banisteriopsis caapi*	(Spruce ex Griseb.) Morton	1					1
Malvaceae	*Apeiba tibourbou*	Aubl.		4				4
Malvaceae	*Ceiba pentandra*	(L.) Gaertn.				1		1
Malvaceae	*Eriotheca pentaphylla*	(Vell.) A.Robyns				1		1
Malvaceae	*Guazuma ulmifolia*	Lam.	1					1
Malvaceae	*Pseudobombax sp.*	Dugand				1		1
Malvaceae	*Tilia* sp.	L.				2	1	3
Melastomataceae	*Miconia* sp.	Ruiz & Pav.				3		3
Meliaceae	*Cabralea canjerana*	(Vell.) Mart.				1		1
Meliaceae	*Cedrela fissilis*	Vell.				42	22	64
Meliaceae	*Cedrela odorata*	L.	38					38
Meliaceae	*Cedrela* sp.	P.Browne		1	4	225	1	231
Meliaceae	*Entandrophragma* sp.	C.DC.				1		1
Meliaceae	*Guarea* sp.	F.Allam. ex L.	1			3		4
Moraceae	*Artocarpus heterophyllus*	Lam.		1				1
Moraceae	*Bagassa guianensis*	Aubl.	15					15
Moraceae	*Brosimum* sp.	Sw.	1					1
Moraceae	*Brosimum gaudichaudii*	Trécul		1				1
Moraceae	*Brosimum guianense*	(Aubl.) Huber				1		1
Moraceae	*Brosimum rubescens*	Taub.		1		4		5
Moraceae	*Clarisia ilicifolia*	(Spreng.) Lanj. & Rossberg			1			1
Moraceae	*Clarisia racemosa*	Ruiz & Pav.				12		12
Moraceae	*Ficus cestrifolia*	Schott ex Spreng.					3	3
Moraceae	*Ficus* sp.	L.				9		9

Table 1. Cont.

Family	Wood Species	Author	North	Northeast	Central-West	Southeast	South	Total of Artifacts
Myristicaceae	*Virola* sp	L.				3		3
Myrtaceae	*Eucalyptus* sp.	L'Hér.				1		1
Nyctaginaceae	*Ramisia brasiliensis*	Oliv.				1		1
Ochnaceae	*Ouratea* sp.	Aubl.				3		3
Peraceae	*Pogonophora schomburgkiana*	Miers ex Benth.		1				1
Phyllanthaceae	*Hieronyma alchorneoides*	Allemão				2		2
Pinaceae	*Pinus* sp.	L.	2	1		6		9
Pinaceae	*Pinus sylvestris*	L.					2	2
Pinaceae	*Pinus sylvestris / Pinus nigra*	L. / J.F.Arnold				6		6
Rubiaceae	*Psychotria* sp.	L.				1		1
Rutaceae	*Euxylophora paraensis*	Huber				1		1
Salicaceae	*Populus* sp.	L.				1		1
Sapindaceae	*Cupania vernalis*	Cambess.				1		1
Sapindaceae	*Matayba guianensis*	Aubl				1		1
Sapotaceae	*Chrysophyllum* sp.	L.				1		1
Sapotaceae	*Manilkara dardanoi*	Ducke		1				1
Sapotaceae	*Manilkara salzmanni*	(D.DC.) H.J.Lam.		1				1
Sapotaceae	*Manilkara* sp.	Adans.		1		5		6
Sapotaceae	*Micropholis gardneriana*	(A.DC.) Pierre				1		1
Sapotaceae	*Pouteria* sp.	Aubl.	1			1		2
Sapotaceae	*Sideroxylon obtusifolium*	(Roem. & Schult.) T.D.Penn.				2		2
Vochysiaceae	*Erisma* sp.	Rudge				1		1
Vochysiaceae	*Erisma uncinatum*	Warm.				1		1
Vochysiaceae	*Qualea* sp.	Aubl.				1		1
Vochysiaceae	*Vochysia bifalcata*	Warm.				3		3
Vochysiaceae	*Vochysia* sp.	Aubl.	2		1			3

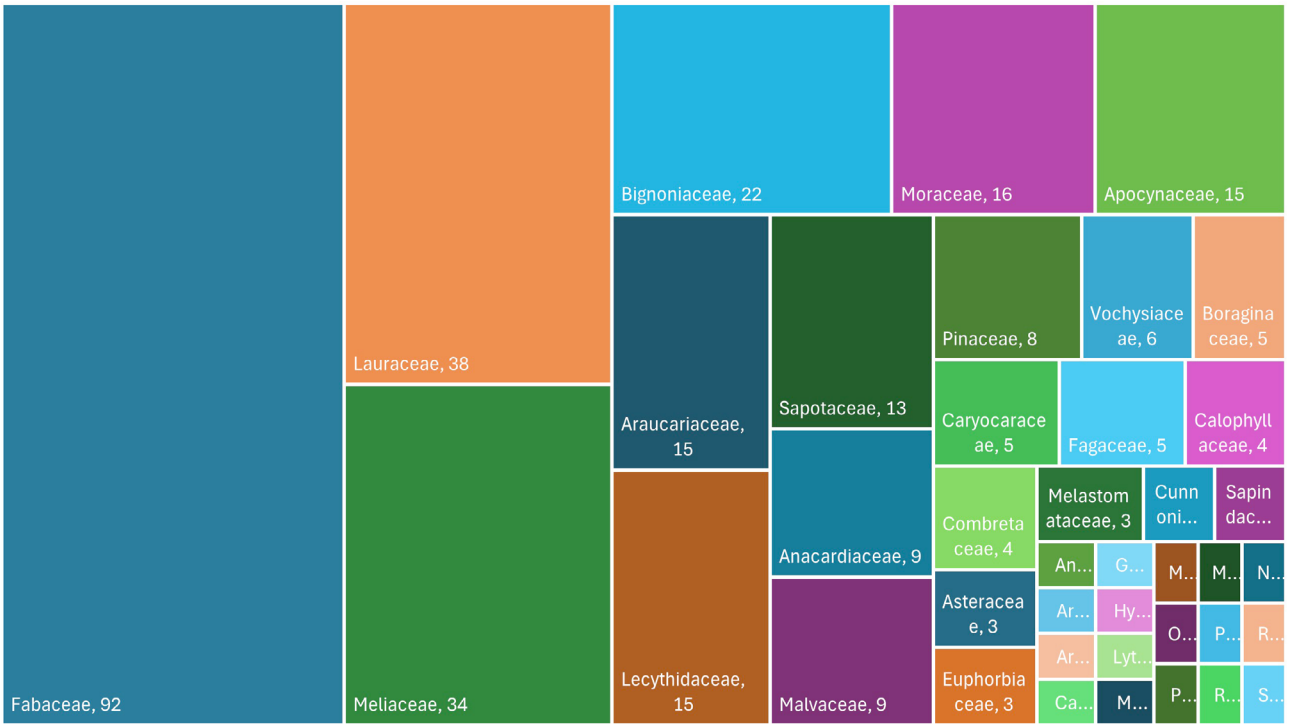

Figure 4. Representativeness, by citation, of botanical families on historical woods in Brazil (1994–2025).

Figure 4 summarizes the representation of the mapped botanical families, highlighting the predominance of Fabaceae and the marked asymmetry in the distribution of the other families.

A total of 111 botanical genera were recorded. The genera with the highest number of occurrences within the set of 64 studies were *Cedrela*, with 27 records, and *Ocotea*, with 24 records, followed by *Araucaria* and *Aspidosperma*, with 15 records each, and *Handroanthus*, with 14 records. Also noteworthy are *Cariniana* with nine records, *Pinus* with eight records and *Astronium*, *Dalbergia* and *Manilkara*, with seven records each. The genera *Brosimum*, *Centrolobium*, *Nectandra* and *Schizolobium* had six records each. The genera with five records were *Apuleia*, *Caryocar*, *Cordia*, *Plathymenia*, *Tabebuia* and *Tachigali*. *Calophyllum*, *Clarisia*, *Enterolobium*, *Ficus*, *Guarea*, *Melanoxylum*, *Paubrasilia* and *Vochysia* were recorded four times. With three records, *Albizia*, *Bertholletia*, *Bowdichia*, *Copaifera*, *Dipteryx*, *Hymenaea*, *Hymenolobium*, *Machaerium*, *Miconia*, *Myroxylon*, *Paratecoma*, *Quercus*, *Terminalia* and *Tilia*. Another 10 genera had two records each, namely *Alchornea*, *Alexa*, *Andira*, *Apeiba*, *Castanea*, *Erisma*, *Eschweilera*, *Lamanonia*, *Pouteria* and *Sideroxylon*. The remaining 59 genera had only one record each, which shows high diversity and strong asymmetry in the distribution of records, with few predominant genera and many with low representation (Table 1).

A total of 164 woody species were recorded, totaling 1,314 citations of use (number of cultural artifacts investigated). Of these, 74 species (45.1 %) were cited only once, while 90 (54.9 %) were cited more than once. The ten most cited species together accounted for 703 citations, representing approximately 53.5 % of all recorded citations. The most cited species were *Cedrela* sp. (Meliaceae), with an expressive 231 records, *Schizolobium parahyba* (Fabaceae), with 135 records, and *Ocotea* sp. (Lauraceae), with 73 records. These are followed by *Cedrela fissilis* (Meliaceae), with 64 records, *Araucaria angustifolia* (Araucariaceae), with 46, *Cedrela odorata* (Meliaceae), with 38, and *Inga* sp. (Fabaceae), with 34, *Dalbergia nigra* (Fabaceae), with 29 records, *Hydrochorea pedicellaris* (Fabaceae), with 28, and *Nectandra* sp. (Lauraceae), with 25.

Species exotic to Brazilian flora represent an important component of the analyzed set. The most cited taxa were *Quercus* sp. (Fagaceae), with 17 records, followed by *Pinus* sp. (Pinaceae) and *Quercus sessiliflora* (Fagaceae), with nine records each. Other species were *Pinus sylvestris/Pinus nigra* (Pinaceae), with six records, *Laurus nobilis* (Lauraceae) and *Tilia* sp. (Malvaceae), with three each, and *Castanea* sp. (Fagaceae), with two. Other exotic taxa, *Populus* sp. (Salicaceae), *Peltogyne confertiflora* (Fabaceae) and *Eucalyptus* sp. (Myrtaceae), were cited once each. The vast majority of citations (approximately 94 %) refer to native Brazilian species.

The distribution of the analyzed studies among categories of historical use of wood highlights regional differences (Figure 5). Despite the asymmetry in the absolute number of publications, studies in the North and South contribute to diversifying the categories of wood use. However, while studies in the North focus on sacred statuary, those of the South concentrate on shelters/buildings, sacred statuary and watercraft. The Northeast stands out especially for studies on watercraft and the use of wood as firewood and fuel. Studies in the Southeast present the second biggest diversity of categories of wood use, but with greater emphasis on sacred statuary, furniture and musical instruments.

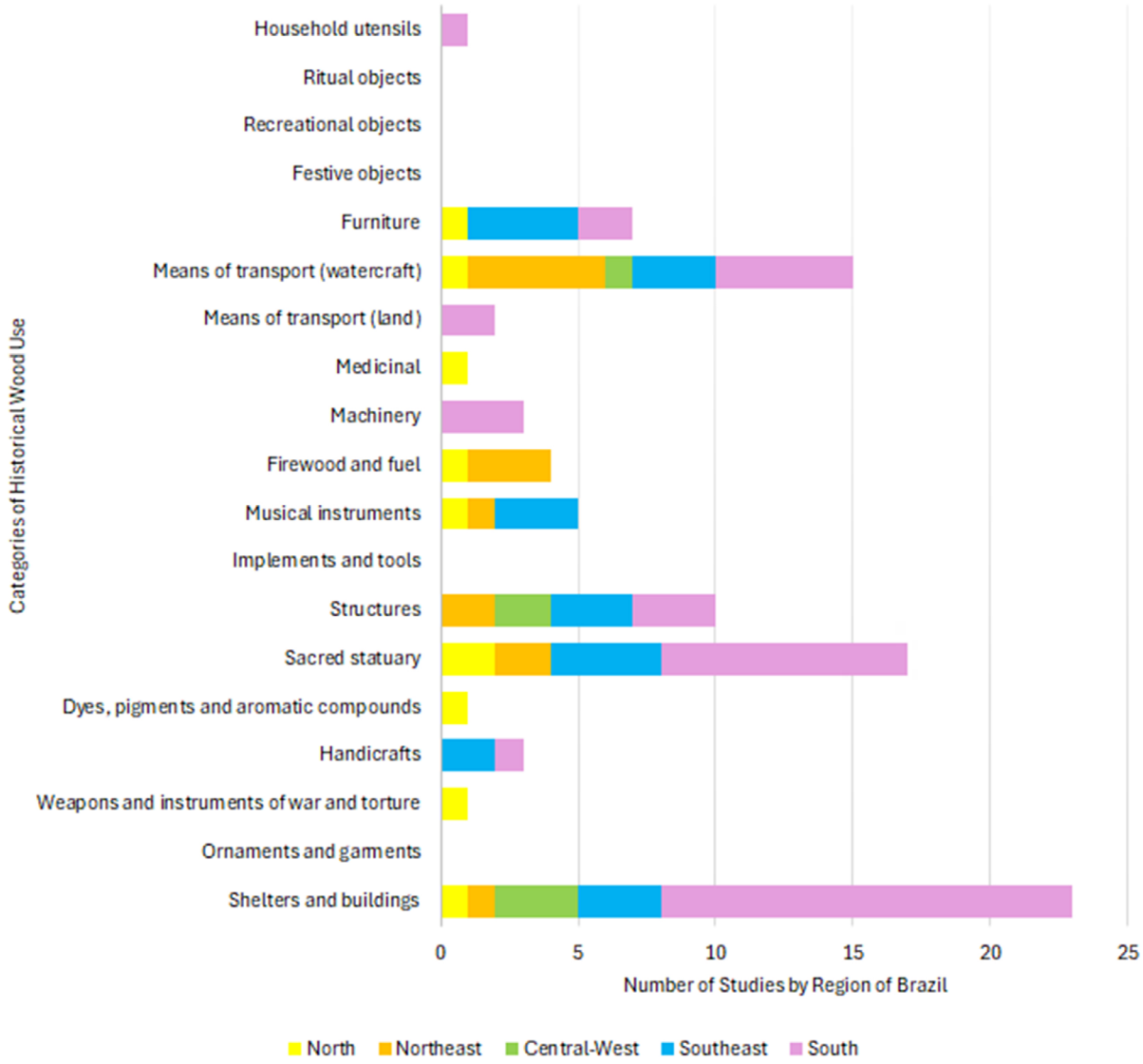

Figure 5. Representativeness of categories of historical use of wood by region (1994–2025).

Studies in the Central-West Region favor shelters/buildings. There are no records of wood use for adornments and clothing, implements and tools, festive objects, recreational objects and ritualistic objects for any region of the country.

Thus, 14 of the 19 categories of wood use are represented among the studies conducted in the country (Figure 6). Shelters/buildings represent the main category, with 23 records, which corresponds to approximately 24.7 % of the total. Next are sacred statuary with 17 records (18.3 %) and means of water transport with 15 records (16.1 %). Structures account for 10 records (10.8 %), while furniture accounts for seven (7.5 %). The remaining categories are less represented: musical instruments with five records (5.4 %), firewood and fuel with four (4.3 %), machinery with three (3.2 %) followed by handicrafts, weapons and instruments of war, dyes and pigments, medicinal, means of land transport and household utensils with only one or two records and representing less than 3.2 % each.

Asymmetry is also apparent in the representativeness of Brazilian states among studies with historical woods. States of the South Region are fully represented, but Santa Catarina stands out with 24 records, equivalent to 31.2 % of the total studies in the country. Rio Grande do Sul follows with 15 records (19.5 %) and Paraná with only one (1.3 %). The highlight in the Southeast is Rio de Janeiro with nine records (11.7 %), followed by Minas Gerais with six (7.8 %), while São Paulo and Espírito Santo have three (3.9 %) and one (1.3 %), respectively. The Northeast has records in six states: Bahia with three (3.9 %), Pernambuco with two (2.6 %) and Alagoas, Sergipe and Ceará with one (1.3 %). Mato Grosso and Mato Grosso do Sul were the only Central-West states with records, having three (3.9 %) and two (2.6 %), respectively. The North region only has records for Acre and Pará, with one (1.3 %) and four (5.2 %), respectively.

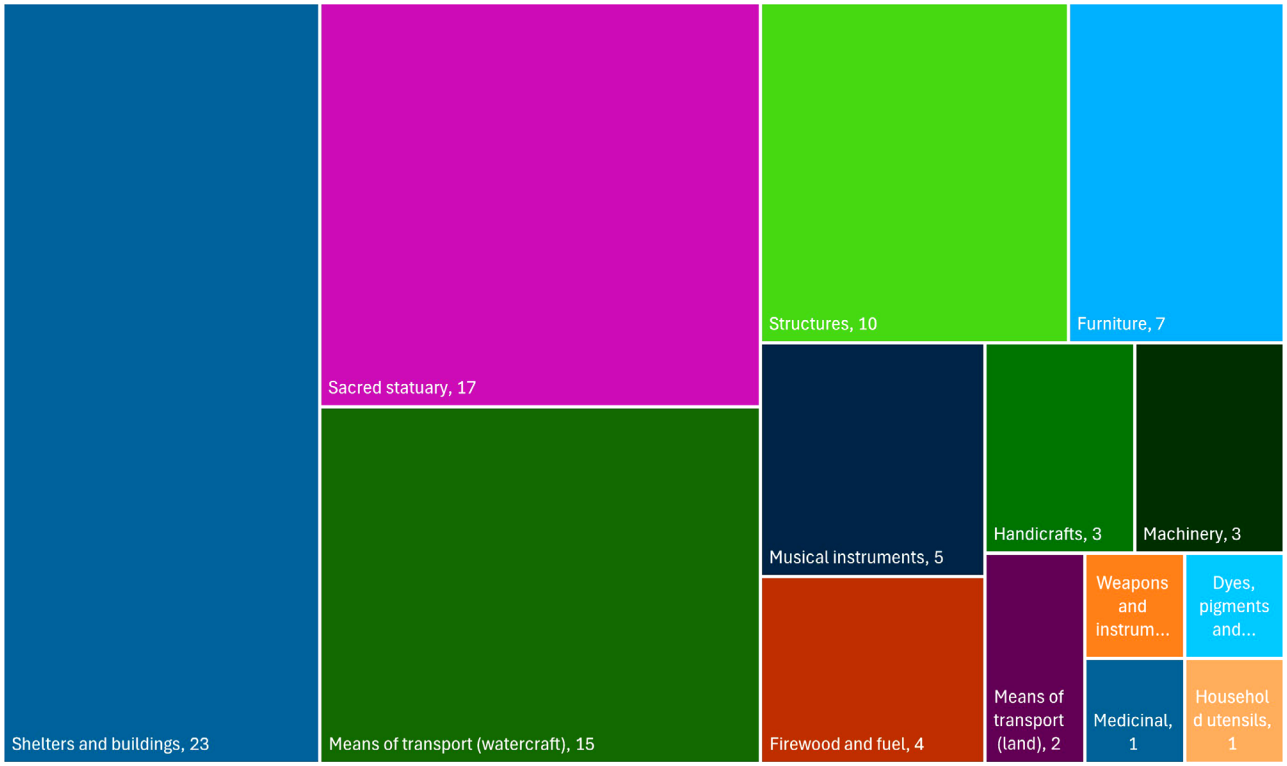

Figure 6. Representativeness of categories of historical use of wood in Brazilian studies (1994–2025).

Species diversity and use categories for historical wood at the regional scale

North Region

Five scientific publications were found for the North Region that consider wood anatomy within an interdisciplinary and historical context, in which wood is used as a tool to understand its cultural use by human societies in the past.

The first studies date back to the 1990s, when the authors applied wood anatomy to the taxonomic determination of specimens present in sacred statuary. These studies proposed an anatomical approach aimed at the restoration and conservation of wooden religious sculptures in the city of Belém, state of Pará (Ono *et al.*, 1996a; Ono *et al.*, 1996b).

The literature review indicates a gap in research on historical anatomy in the North Region between the 1990s and the beginning of the 2020s.

The most recent studies used anatomy to interpret wood use by traditional populations. One of these focused on the anatomical and technological characterization of wood used in the production of traditional watercraft in the southeastern region of the state of Pará (Braga Júnior *et al.*, 2020). Two other studies investigated the importance of wood for the maintenance of the material culture of indigenous peoples of Pará (Santos *et al.*, 2021) and in religious and ritualistic contexts by traditional Brazilian peoples, including those of the state of Acre (Oliveira *et al.*, 2023).

The works were distributed among the following categories of historical use of wood: sacred statuary (Ono *et al.*, 1996a; Ono *et al.*, 1996b); means of transport – watercraft (Braga Júnior *et al.*, 2020); shelters/buildings, weapons and instruments of war, dyes and pigments, structures, firewood and fuel, and musical instruments (Santos *et al.*, 2021); and medicinal and ritualistic uses (Oliveira *et al.*, 2023).

The works found for the North Region basically focused on the patrimonial approach (Ono *et al.*, 1996a; Ono *et al.*, 1996b; Braga Júnior *et al.*, 2020; Santos *et al.*, 2021; Oliveira *et al.*, 2023), and the technological and conservationist approaches (Braga Júnior *et al.*, 2020; Santos *et al.*, 2021; Oliveira *et al.*, 2023).

Studies that predominantly followed the patrimonial approach addressed the importance of anatomy for the taxonomic identification of the species of wood used in sacred statuary on the property of religious orders. The results demonstrated that anatomical identification was essential not only for reconstructing the material history of the pieces, but also for establishing specific methodologies for the conservation/restoration and protection of this valuable collection, which is subject to attack by xylophagous organisms (Ono *et al.*, 1996a; Ono *et al.*, 1996b).

The most recent works can be framed within the technological and conservationist approaches. These demonstrate that historical anatomy can help to understand the contemporary relationships that indigenous peoples and traditional populations of the Amazon have with the forest, and how wood is present in the life relationships and practices of these communities today.

With the category of technological uses and conservation, Braga Júnior *et al.* (2020) investigated the use of wood of different species in the construction of boats in southeastern Pará, revealing a complex technical and socioeconomic panorama. Historical anatomy not only allowed the taxonomic identification of the woods used but also demonstrated that the activity has direct implications for the sustainability of the timber sector and the conservation of biodiversity in the state. Finally, the identified species and determined properties allowed tracing an unusual technological aptitude among the woods used in traditional boats in the region (Braga Júnior *et al.*, 2020).

Santos *et al.* (2021) investigated the uses of woods by two indigenous groups in southeastern Pará — the Gavião and the Suruí — highlighting the relationship between the choice of species and the technological properties of the wood. The study classified wood into several categories of uses within ethnic groups, such as construction, charcoal or firewood, hunting/war artifacts, furniture, and musical instruments, and found that some identified taxa have technological properties that justify their use by the studied indigenous peoples. The research articulates cultural, linguistic, and ecological aspects, emphasizing the role of wood anatomy as a tool for preserving and interpreting traditional knowledge.

Oliveira *et al.* (2023) addressed the relationship between ethnobotany and wood anatomy, from the technological and conservationist approaches, in the context of ayahuasca production — a ritual drink traditionally used among peoples of the Amazon and, more recently, in Brazilian urban religions such as Santo Daime, Barquinha and União do Vegetal. The study combined historical anatomy with ethnobotanical datasets to understand the ethnoclassification of *Banisteriopsis caapi* in Brazilian rituals. It also provided new anatomical descriptions for each ethnotaxon to inform their cultural importance and discuss their possible domestication based on morphological variation. This also demonstrated that wood anatomy and stem morphology can help in understanding the categorization of ethnotaxa.

The conservationist approach of some studies enabled biodiversity conservation and ethnoknowledge to interface by identifying the wood of species such as *Banisteriopsis caapi* and *Bertholletia excelsa* as important for the maintenance of the material culture of the studied traditional peoples. The studies reaffirm the importance of ethnobotany and historical anatomy as bridges between science and tradition and reinforce the role of indigenous and traditional peoples as guardians of sustainable practices and knowledge about the rational use of wood in the Amazon (Braga Júnior *et al.*, 2020; Santos *et al.*, 2021; Oliveira *et al.*, 2023).

A total of 19 distinct taxa were reported as used in artifacts from the North Region. Of these, eleven were identified to the level of species and eight to the level of genus (Table 1). Of all the taxa identified in the studies, only one, *Pinus* L., was classified as exotic (Ono *et al.*,1996a; Ono *et al.*,1996b) and four were recorded in more than one study: *Cedrela odorata* L. (Ono *et al.*,1996a; Ono *et al.*,1996b), *Bertholletia excelsa*, *Apuleia leiocarpa* and *Alexa grandiflora* (Braga Júnior *et al.*,2020; Santos *et al.*,2021).

Assuming that the North Region is completely inserted within the Brazilian Amazon, all of the botanical species and/or genera identified in the studies occur in the Amazon biome (Brazil Flora Group, 2021). However, many of the identified taxa occur in more than one phytogeographic domain in Brazil.

Northeast Region

Five publications were found dealing with historical woods located in the Northeast Region. The artifacts are dated from the 17th to the 21st century: Cerqueira & Oliveira (2019) from the 17th to the 19th century, Silva *et al.* (2011) from the 18th century and Andrade *et al.* (2016) from the 21st century. The artifacts of Melo Júnior & Barros (2017a) and Melo Júnior (2017) had no known date.

The artifacts from the Northeast Region were classified into three use categories: shelters/buildings, including construction and renovation elements, such as beams, ceilings and floors, as described by Cerqueira and Oliveira (2019); means of transport (watercraft), whose construction, repair and restoration were addressed by Andrade *et al.* (2016), Melo Júnior and Barros (2017b) and Melo Júnior *et al.* (2017); and sacred statuary, studied by Silva *et al.* (2011) for the identification and analysis of the wood used in the work of Senhor do Bonfim.

Most of the studies focused on the category of watercraft, especially projects aimed at construction and restoration, in which the authors often associate their analyses with environmental issues.

Among the five reviewed works, four focused on historical woods from Bahia (Silva *et al.*, 2011; Andrade *et al.*, 2016; Melo Júnior *et al.*, 2017; Cerqueira & Oliveira, 2019; Melo Júnior *et al.*, 2021), two from Pernambuco (Andrade *et al.*, 2016; Melo Júnior *et al.*, 2017), one from Maranhão (Cerqueira & Oliveira, 2019), Alagoas and Sergipe (Melo Júnior & Barros, 2017a) and Ceará (Melo Júnior *et al.*, 2017).

Thirty-seven taxa were listed in the studies of the Northeast Region, with the family Fabaceae being the most cited (10), followed by Anacardiaceae (5) and Bignoniaceae (4). Most of the taxa occur in the Atlantic Forest (32), Cerrado (25), Caatinga (24) and Amazon (23). The most cited species were *Apeiba tibourdou* (4) and *Terminalia glabrescens* (2), both with citations for use in watercraft.

Patrimonial approaches have focused on the processes of building and restoring watercraft. Melo Júnior *et al.* (2017) studied *jangadas* (traditional sailing rafts for fishing) from the collection of the Museu Nacional do Mar and showed that these watercraft were mostly built in the Northeast (Ceará, Pernambuco and Bahia). In complementary studies, Melo Júnior & Barros (2017a) examined watercraft of Northeast origin (Alagoas and Sergipe), identifying 11 species distributed in seven families, with a predominance of Fabaceae, including *Dalbergia nigra* and *Paubrasilia echinata*. Andrade *et al.* (2016), through interviews with raftsmen from southern Bahia, listed 13 species belonging to 11 families, emphasizing the relationship between the cultural identity of the community and the species used in the construction of the *jangadas*.

Buildings were investigated by Cerqueira & Oliveira (2019), who examined through macroscopic and microscopic analyses, wood samples from colonial buildings in Bahia, such as the Convento de Santo Antônio de Cairu and the churches of Nossa Senhora da Concepção de Boqueirão and São Pedro dos Clérigos. The most frequent taxa in these locations included individuals of *Cedrela* sp., *Ocotea* spp., *Vatairea* spp., *Plathymenia foliolosa*, *Manilkara* sp., *Tabebuia* sp. and *Bowdichia virgilioides*, among others.

The category of sacred sculpture was addressed by Silva *et al.* (2011), who investigated the sculpture of Senhor do Bonfim. During the last restoration of the work, the authors collected fragments of wood to perform radiographic, tomographic and dendrochronological analyses. They determined that the material, with approximately 50 years of use, did not correspond to an angiosperm (*Cedrela*), but to a gymnosperm, probably a type of pine (*Pinus* sp.).

Central-West Region

Four scientific publications were found that studied the anatomy of historical wood of the Central-West Region. The first of these analyzed a *chalana*, a typical watercraft used in the Pantanal — located in the states of Mato Grosso and Mato Grosso do Sul, in the Upper Paraguay River Basin — although without precise dating or exact indication of the place of use or manufacture (Melo Júnior *et al.*, 2019). This artifact is in the collection of the Museu Nacional do Mar. The other publications refer to the study of wooden pieces used in historical buildings. Two studies focus on urban constructions in the historic center of Cuiabá, Mato Grosso, and involve wooden elements from an 18th-century building (Hoffmann *et al.*, 2023) and from two other buildings, one from the 19th century and another that the authors suggest is from the early 20th century (Hoffmann *et al.*, 2024). The fourth study investigated wood used in different construction components of a farm located in Bonito, Mato Grosso do Sul, founded in 1966 (Conceição *et al.*, in press).

The artifacts analyzed in the Central-West Region were grouped into three main use categories. One of the studies addressed a movable cultural asset — a *chalana* (Melo Júnior *et al.*, 2019) — while the others focused on immovable cultural assets, specifically historical buildings (Hoffmann *et al.*,2023; 2024; Conceição *et al.*, in press).

The cited studies predominantly adopted a patrimonial approach, relating the anatomical identification of wood to the conservation of cultural assets. There is also a study in the works with environmental and technological approaches. Melo Júnior *et al.* (2019) highlighted the empirical knowledge of traditional communities in the selection of tree species and recorded ethnological aspects of the construction process of monoxylon *chalanas*. Conceição *et al.* (in press) discussed the need to conserve endangered species that were widely used in historical buildings. Hoffmann *et al.* (2023; 2024) also evaluated the deterioration rate of pieces and suggested replacing them with others of the same species to preserve the identity of historical buildings. In addition, Hoffmann *et al.* (2024) presented recommendations for the use of the evaluated woods based on the current scientific literature, comparing them to the uses observed in the buildings.

Ten distinct taxa were reported as used in artifacts from the Central-West Region (Table 1). Of these, five were identified to the level of species: *Clarisia ilicifolia*, *Physocalymma scaberrimum*, *Astronium urundeuva*, *Calophyllum brasiliense* and *Aspidosperma polyneuron*. The others correspond to the genera *Handroanthus*, *Cedrela*, *Vochysia*, *Dipteryx* and *Cordia*. Only two taxa were recorded in more than one study: *Handroanthus* (Hoffmann *et al.*, 2023; Hoffmann *et al.*, 2024) and *Astronium urundeuva* (Hoffmann *et al.*, 2024; Conceição *et al.*, in press), with emphasis on the first.

Astronium urundeuva stood out for its use in ten artifacts, being the most recurrent taxon, followed by *Cedrela* sp. and *Handroanthus* spp., in four artifacts each, and *Physocalymma scaberrimum* in two. The remaining taxa were recorded in only one artifact.

Handroanthus spp. (Hoffmann *et al.*, 2023) and *Cedrela* sp., *Dipteryx* sp. and *Astronium urundeuva* (Hoffmann *et al.*, 2024) were used in door and/or window frames. *Astronium urundeuva* was also used in the manufacture of handrails and flooring (Conceição *et al.*, in press). The wood of *Handroanthus* sp., *Physocalymma scaberrimum*, *Vochysia* sp., *Calophyllum brasiliense* and *Cordia* sp. (Hoffmann *et al.*, 2024), in addition to *Aspidosperma polyneuron* (Conceição *et al.*, in press), was identified in roof structures, such as rafters. *Astronium urundeuva* was recorded in several structural elements such as columns, beams, platforms, bridges and roof parts (Conceição *et al.*, in press). Melo Júnior *et al.* (2019) identified the species *Clarisia ilicifolia* (Spreng.) Lanj. & Rossberg (Moraceae) in watercraft, being the first scientific reference of the use of this species in the production of *chalanas* in the Brazilian Pantanal.

Of the four analyzed studies, three were carried out in areas of the Cerrado biome (Hoffmann *et al.*, 2023; Hoffmann *et al.*, 2024; Conceição *et al.*, in press), while one refers to the Pantanal biome (Melo Júnior *et al.*, 2019). Hoffmann *et al.* (2024) suggested that the wood probably came from areas close to the construction sites, considering the logistical limitations for land transport in the colonial period. The authors also highlighted that some identified woods, such as *Vochysia* sp., *Cedrela* sp., *Handroanthus* sp., *Calophyllum brasiliense* and *Cordia* sp., also occur in the Atlantic Forest — the predominant biome in the state of São Paulo, from where the *bandeirantes* responsible for expeditions to the region departed. Although the other studies do not directly address the origin of their studied wood, the data presented indicate that the use of locally available native species was the main strategy for the selection of materials, since the reported taxa occur in the Cerrado (Machate *et al.*, 2016; Teixeira & Machado, 2020). It is noteworthy, however, that *Clarisia ilicifolia*, a species typical of semideciduous and ombrophilous seasonal forests in the Atlantic Forest and Amazon biomes (Teixeira & Machado, 2020), was used in the manufacture of a *chalana* in the Pantanal (Melo Júnior *et al.*, 2019), although this can be explained by the fluvial transport of wood via the region's rivers (Melo Júnior, 2023).

Of the ten identified taxa (Table 1), eight occur in the Amazon, five in the Pantanal, seven in the Caatinga, eight in the Cerrado, nine in the Atlantic Forest and four in the Pampa. The most notable are *Handroanthus* sp., *Cedrela* sp. and *Cordia* sp., which occur in all Brazilian biomes.

Southeast Region

Seventeen publications were found dealing with historic woods located in the Southeast Region. The artifacts are dated from the 17th to the 20th century, with the majority from the 18th and 19th centuries. Two studies included artifacts from the 17th century (Miranda & Pigozzo, 2013; Siston *et al.*, 2024), six from the 18th century (Lisboa, 1994; Coelho & Quites, 2014; Quites *et al.*, 2015; Pagani *et al.*, 2018; Borrego *et al.*, 2019; Nisgoski *et al.*, 2019), six from the 19th century (Maioli-Azevedo & Callado, 2014; Paula *et al.*, 2019; Neto Boschetti *et al.*, 2014; Barreto *et al.*, 2019; Andreacci & Melo Júnior, 2011; Macedo *et al.*, 2020) and two from the 20th century (Angyalossy *et al.*, 2005; Silva *et al.*, 2023). The study by Pagani *et al.* (2022) hypothesizes that the wooden panels they analyzed may have been built in the 16th century (between 1525 and 1530).

The analyzed artifacts of the Southeast Region fall into seven use categories. Four studies analyzed immovable cultural assets, three in the category of buildings (Maioli-Azevedo & Callado, 2014; Neto Boschetti *et al.*, 2014; Andreacci & Melo Júnior, 2011) and three in the category of structures (Silva *et al.*, 2023; Miranda & Pigozzo, 2013; Neto Boschetti *et al.*, 2014). The other artifacts analyzed in the studies were movable assets. Most studies evaluated sacred statuary (Lisboa, 1994; Miranda & Pigozzo, 2013; Coelho & Quites, 2014; Quites *et al.*, 2015; Nisgoski *et al.*, 2019) and furniture (Miranda & Pigozzo, 2013; Pagani *et al.*, 2018; Nisgoski *et al.*, 2019; Siston *et al.*, 2024). Three studies analyzed means of transport, more specifically canoes (Barreto *et al.*, 2019; Borrego *et al.*, 2019; Paula *et al.*, 2019). Two studies evaluated painting on wooden panels, categorized as crafts (Miranda & Pigozzo, 2013; Pagani *et al.*, 2022). Angyalossy *et al.* (2005) and Macedo *et al.* (2020) carried out studies with violin bows, categorized as musical instruments. It is worth noting that many studies were carried out with artifacts from buildings and ecclesiastical statuary (Lisboa, 1994; Andreacci & Melo Júnior, 2011; Miranda & Pigozzo, 2013; Coelho & Quites, 2014; Quites *et al.*, 2015; Pagani *et al.*, 2018; Nisgoski *et al.*, 2019; Siston *et al.*, 2024).

Although some of the studied artifacts are located in the states of São Paulo (Angyalossy *et al.*, 2005; Borrego *et al.*, 2019; Paula *et al.*, 2019) and Espírito Santo (Neto Boschetti *et al.*, 2014), most of the analyzed Southeast Region specimens are in the states of Rio de Janeiro (Maioli-Azevedo & Callado, 2014; Pagani *et al.*, 2018; Barreto *et al.*, 2019; Paula *et al.*, 2019; Macedo *et al.*, 2020; Pagani *et al.*, 2022; Silva *et al.*, 2023; Siston *et al.*, 2024) and Minas Gerais (Lisboa, 1994; Andreacci & Melo Júnior, 2011; Miranda & Pigozzo, 2013; Coelho & Quites, 2014; Quites *et al.*, 2015; Nisgoski *et al.*, 2019).

Most of the analyzed studies presented a predominantly patrimonial approach. However, Silva *et al.* (2023) and Macedo *et al.* (2020) also incorporated environmental and conservationist perspectives into their analyses. The authors evaluated the origin of the woods and related them to aspects of the region's past forest composition and the reduction of native populations of species. The study by Angyalossy *et al.* (2005) had a technological approach, evaluating anatomical characteristics of *Paubrasilia echinata* and other species that are used as replacements, related to their use for bows in stringed instruments. The studies by Paula *et al.* (2019) and Barreto *et al.* (2019) presented an ethnobotanical approach, associating the use of woods with traditional knowledge in the manufacture of canoes. Nisgoski *et al.* (2019) used a methodological approach, in addition to the patrimonial approach, to evaluate the potential of using near-infrared spectrometry to identify sacred art.

Two studies present the artifacts as museum collections (Borrego *et al.*, 2019; Pagani *et al.*, 2022) and two other studies present violin bows found in xylotheques in the Southeast Region (SPw and RBw). These artifacts are donations from archers and come from Europe (Angyalossy *et al.*, 2005; Macedo *et al.*, 2020).

A total of 116 taxa were reported as used in artifacts from the Southeast Region. Forty-four taxa were used in shelters/buildings, three of which stand out as having been reported for this purpose in more than one study: *Aspidosperma* sp. (Maioli-Azevedo & Callado, 2014; Neto Boschetti *et al.*, 2014) and *Melanoxylum brauna* and *Manilkara* sp. (Maioli-Azevedo & Callado, 2014; Neto Boschetti *et al.*, 2014).

Dipteryx odorata, *Handroanthus* sp., *Zollernia ilicifolia* and *Melanoxylum brauna* were reported for use in structures, more specifically in bridges (Neto Boschetti *et al.*, 2014; Silva *et al.*, 2023).

Thirty-six taxa have been reported for use in sacred statuary, of which eleven were cited by Coelho & Quites (2014) and Quites *et al.* (2015). Five studies report the use of *Cedrela* sp. for this purpose (Lisboa, 1994; Miranda & Pigozzo, 2013; Coelho & Quites, 2014; Quites *et al.*, 2015; Nisgoski *et al.*, 2019). The studies by Miranda & Pigozzo (2013), Coelho & Quites (2014) and Quites *et al.* (2015) are compilations presented by collaborators and may contain results of analyses of common works. These three studies and the study by Lisboa (1994) highlighted the use of species of the genus *Cedrela* for sacred statuary (Miranda & Pigozzo, 2013; Coelho & Quites, 2014; Quites *et al.*, 2015).

Forty-nine taxa are reported for use in the manufacture or repair of canoes, which fall into the category of means of transport. *Caryocar brasiliense*, *Cedrela* sp., *Clarisia racemosa*, *Manilkara* sp. and *Schizolobium parahyba* were cited for this purpose in two studies (Paula *et al.*, 2019; Barreto *et al.*, 2019). Barreto *et al.* (2019) and Paula *et al.* (2019) highlight *Schizolobium parahyba* and *Cedrela* sp. as the most commonly used woods for this purpose. *Albizia pedicellaris*, *Inga* sp., *Tachigali denudata*, *Clarisia racemosa*, *Caryocar brasiliense*, *Cariniana* sp. and *Ocotea* sp. are also cited by these authors as widely used in the manufacture of canoes.

Eleven species are cited by Pagani *et al.* (2018) and Siston *et al.* (2024) for use in ecclesiastical furniture, with *Cedrela* sp. standing out with mention in three studies (Pagani *et al.*, 2018; Nisgoski *et al.*, 2019; Siston *et al.*, 2024;). Siston *et al.* (2024), who analyzed several pieces of ecclesiastical furniture (chairs, doors, pulpit, railings), highlighted the use of *Dalbergia nigra*.

Paubrasilia echinata, *Brosimum guianense*, *B. rubescens* and *Swartzia laxiflora* were reported for use in the manufacture of violin bows (musical instruments) (Angyalossy *et al.*, 2005; Macedo *et al.*, 2020).

Pagani *et al.* (2022) report the use of two species for crafts (painting on wooden panels), namely *Pinus* sp. and *Quercus* sp. Both of these woods are exotic to the national flora, which supports the hypothesis that the panels were made in Europe and brought to Brazil. They are currently in the Museu Dom João VI at the Escola de Belas Artes of the Universidade Federal do Rio de Janeiro.

Miranda & Pigozzo (2013) list 17 species that were used for sacred statuary, structures, furniture and crafts. However, the use of each taxon was not specified.

The woods that stood out by having more than five use categories in the Southeast Region are: *Araucaria angustifolia* (six categories), used for shelters/buildings, sacred statuary, structures, furniture, crafts and means of transport (Miranda & Pigozzo, 2013; Coelho & Quites, 2014; Maioli-Azevedo & Callado, 2014; Quites *et al.*, 2015; Paula *et al.*, 2019); *Cedrela* spp. (five categories) used for sacred statuary, structures, furniture, crafts and means of transport (Lisboa, 1994; Miranda & Pigozzo, 2013; Coelho & Quites, 2014; Quites *et al.*, 2015; Pagani *et al.*, 2018; Barreto *et al.*, 2019; Nisgoski *et al.*, 2019; Paula *et al.*, 2019; Siston *et al.*, 2024); and *Nectandra* sp., *Ocotea* sp. and *Plathymenia reticulata* (five categories) used for means of transport, sacred statuary, structures, furniture and crafts (Miranda & Pigozzo, 2013; Coelho & Quites, 2014; Quites *et al.*, 2015; Barreto *et al.*, 2019; Paula *et al.*, 2019; Siston *et al.*, 2024).

Other species fall into four to two use categories in the Southeast Region, namely: *Cordia* sp., *Dalbergia* sp., *Guarea* sp., *Lamanonia* sp., *Melanoxylum brauna, Miconia* sp., and *Myroxylon balsamum* (four categories) were used for sacred statuary, structures, furniture and crafts (Miranda & Pigozzo, 2013; Coelho & Quites, 2014; Maioli-Azevedo & Callado, 2014; Neto Boschetti *et al.*, 2014; Pagani *et al.*, 2018; Quites *et al.*, 2015); *Tachigali* sp. (three categories) used for shelters/buildings, means of transport and furniture (Maioli-Azevedo & Callado, 2014; Paula *et al.*, 2019; Siston *et al.*, 2024); *Pinus* sp. and *Quercus* sp. (two categories), both exotic woods, used for crafts and sacred statuary (Quites *et al.*, 2015; Pagani *et al.*, 2022); *Dalbergia nigra* and *Paratecoma peroba* (two categories) used for shelters/buildings and furniture (Neto Boschetti *et al.*, 2014; Siston *et al.*, 2024); *Calophyllum brasiliense* and *Hymenolobium* sp. (two categories) used for means of transport and furniture (Pagani *et al.*, 2018; Paula *et al.*, 2019); and *Andira* sp., *Apuleia leiocarpa*, *Aspidosperma polyneuron*, *Aspidosperma* sp., *Clarisia racemosa*, *Hymenaea courbaril*, *Manilkara* sp., *Sideroxylon obtusifolium* (two categories) used for shelters/buildings and means of transport (Andreacci & Melo Júnior, 2011; Maioli-Azevedo & Callado, 2014; Neto Boschetti *et al.*, 2014; Barreto *et al.*, 2019; Paula *et al.*, 2019). The species cited by Miranda & Pigozzo (2013; *e.g.*, *Cabralea canjerana*, *Cariniana estrellensis*, *Gochnatia* sp., *Machaerium scleroxylon*) were considered by the present study to have four use categories, namely sacred statuary, structures, furniture and crafts, as there was no specification for each.

Cedrela spp. also stood out for being used in the largest number of artifacts (258 artifacts) analyzed in studies of the Southeast Region (when the number of artifacts is reported). However, it is worth mentioning that these data may be overestimated due to the possibility of some artifacts being the same as in the analyses carried out by Miranda & Pigozzo (2013), Coelho & Quites (2014) and Quites *et al.* (2015). Next, *Schizolobium parahyba* is highlighted with 127 artifacts. Other taxa present in many artifacts (>10) are *Inga* sp. (34), *Nectandra* sp. / *Ocotea* sp. (30), *Hydrochorea pedicellaris* (28), *Dalbergia nigra* (25), *Quercus* sp. (17), *Plathymenia reticulata* (11), *Araucaria angustifolia* (11), *Tachigali denudata* (11), *Cariniana legalis* (10) and *Clarisia racemosa* (10).

Some studies from the Southeast Region present arguments about the origin of the wood. These studies report that the wood probably came from the Atlantic Forest (*Aspidosperma* sp., *Handroanthus* sp., *Paratecoma peroba*, *Nectandra* sp., *Ocotea* sp., *Cariniana* sp., *Dalbergia nigra*, *Melanoxylum brauna*, *Paubrasilia echinata*, *Tachigali* sp., *Zollernia ilicifolia*, *Cedrela* sp., *Clarisia racemosa* and *Sideroxylon obtusifolium*). No arguments were presented about the origin of the wood of the other species in the studies.

Of all the taxa reported for use in artifacts in the Southeast Region, 95 have been recorded in the Atlantic Forest, 77 in the Cerrado, 75 in the Amazon, 62 in the Caatinga, 40 in the Pantanal, and 32 in the Pampa. However, several taxa are widely distributed and occur in more than one biome.

South Region

Forty-five scientific publications on the subject were found for the Southern Region, of which 36 were exclusively about artifacts produced and located in this region of the country. These studies covered different use categories, with a predominance of research focused on shelters/buildings, with 15 records, followed by sacred art (nine) and watercraft (five). Other categories include structures (three), machinery (three), furniture (two), land transport (two), crafts (one) and household utensils (one). The main foci of the investigations were categories related to architectural and religious heritage, as well as fishing activities, reflecting the historical importance of the region in the context of colonization and the development of coastal activities.

Fifteen botanical families were recorded, represented by 21 distinct genera and approximately 34 species, of which 27 were identified to the level of species. Together, they account for 90 records and 236 citations of use in artifacts in a total of 36 surveyed publications. The family Lauraceae stands out, with 95 citations of use, representing 40.3 % of the total, followed by Araucariaceae and Fabaceae, with 33 citations corresponding to 14 % each, Meliaceae with 22 (9.3 %), and Apocynaceae with 13 (5.5 %). These five most representative families account for 83.1 % of all records.

The genus *Ocotea* sp. (Lauraceae) stands out among the most represented taxa, appearing in 21 publications and with 53 citations of use, followed by *Araucaria angustifolia* (Araucariaceae) with 33, *Ocotea porosa* (Lauraceae) with 33, *Cedrela fissilis* (Meliaceae) with 22 and *Centrolobium microchaete* (Fabaceae) with 16. Together, these taxa account for 66.5 % of the total citations for all species recorded in all studies.

The predominance of Lauraceae, in particular, reaffirms the role of *Ocotea*/*Nectandra* and *Ocotea porosa* as key elements in the material heritage associated mainly with the construction tradition in South Brazil (Melo Júnior & Boeger, 2015; Oliveira *et al.*, 2019; Melo Júnior *et al.*, 2022a; Melo Júnior *et al.*, 2022b; Melo Júnior *et al.*, 2025c; Pscheidt & Melo Júnior, 2025) and watercraft (Melo Júnior & Barros, 2017c; Orofino *et al.*, 2018). Lower prevalences were recorded for structures (Rodrigues & Melo Júnior, 2015), machinery and colonial furniture in Santa Catarina (Melo Júnior, 2012a).

Use of the species *Araucaria angustifolia* was predominantly related to historical buildings (Gonçalves *et al.*, 2015; Pscheidt & Melo Júnior, 2025; Melo Júnior *et al.*, 2025c), but there are records of its use for domestic objects (Melo Júnior & Boeger, 2015) and watercraft on the coast of Santa Catarina (Melo Júnior & Barros, 2017c; Melo Júnior, 2023).

Fabaceae is highly diverse, with emphasis on *Centrolobium microchaete*, which was widely used in buildings, machinery, land and water transport, furniture, and household objects (Melo Júnior, 2012a; 2015; Melo Júnior & Boeger, 2015). *Schizolobium parahyba* and *Enterolobium contortisiliquum* were exclusively in watercraft (Melo Júnior & Barros, 2017c; Orofino *et al.*, 2018; Melo Júnior, 2023). The species *Dalbergia brasiliensis* was used for machinery and transport and *Dalbergia nigra*, exotic to the southern Brazilian flora, in luxury colonial furniture (Melo Júnior & Boeger, 2015). The species *Copaifera trapezifolia* and *Cassia* sp. were used in structures (Rodrigues & Melo Júnior, 2015).

Bignoniaceae, in turn, is represented by different species of *Handroanthus*. The species *Handroanthus heptaphyllus* has the greatest number of citations of use, being in shelters/buildings of the Jesuit missions of Rio Grande do Sul (Marchiori & Schulze-Hofer, 2008; Marchiori & Schulze-Hofer, 2009b, c; d; Schulze-Hofer & Marchiori, 2009a; b; Marchiori & Schulze-Hofer, 2010a; Schulze-Hofer & Marchiori, 2010) and in structures in 19th century colonies in Santa Catarina (Rodrigues & Melo Júnior, 2015). The species *Handroanthus pulcherrimus* was recorded in buildings (Marchiori & Schulze-Hofer, 2010b), while *Handroanthus chrysotrichus* was documented in machinery (Melo Júnior, 2017) and land transport in Santa Catarina (Melo Júnior & Boeger, 2015).

Watercraft is the use category with the greatest diversity of woods, bringing together 26 species. Of note are wooden canoes made only with *Schizolobium parahyba* (Orofino *et al.*, 2018) and *Ficus cestrifolia* (Melo Júnior, 2023), while woods of *Ocotea* sp., *Araucaria angustifolia* and *Aspidosperma* sp. were used in parts of mixed watercraft (Orofino *et al.*, 2018; Melo Júnior, 2023).

Cedrela fissilis and *Cedrela odorata* were most commonly used in sacred statuary (Marchiori & Schulze-Hofer, 2009a, Schulze-Hofer & Marchiori, 2009c; Schulze-Hofer & Marchiori, 2010 ; Marchiori & Machado, 2017; Rodrigues *et al.*, 2024) but are also present in finishing pieces of buildings (Gonçalves *et al.*, 2015; Pscheidt & Melo Júnior 2025), furniture (Melo Júnior, 2012a) and watercraft (Melo Júnior, 2023).

To a lesser extent, there is a record of *Schefflera morototonii* and *Alchornea triplinervia* wood used exclusively in handicrafts of the Guarani people in Santa Catarina (Melo Júnior *et al.*, 2013). There are also a few records of exotic taxa, with emphasis on *Quercus sessiliflora* and *Pinus sylvestris* in luxury furniture in Santa Catarina (Melo Júnior, 2012b) and *Tilia* sp. in sacred statuary in Rio Grande do Sul (Santos *et al.*, 2018).

Discussion

The present study analyzed the diversity of historical uses of wood in Brazil based on 64 studies carried out between 1994 and 2025 across different regions of the country. The research sought to map the diversity of wood species, the types of artifacts produced, the institutions involved, and the national and international partnerships established, in addition to identifying regional and temporal asymmetries in scientific production.

The pioneering work of researcher Pedro L. B. Lisboa (MPEG) inaugurated research in Brazil that combined cultural artifacts and wood anatomy, but it was practically discontinued until nearly the end of the 2000s. From that moment on, isolated research groups emerged, making the South Region the most consistent in the field, followed by the Southeast, while the other regions of the country made contributions more recently. The epistemological and methodological outline of the field, brought about by the concept of historical anatomy, is recent and marks important progress, especially in proposing an interdisciplinary approach that links wood anatomy to the historical-cultural interpretation of artifacts. However, the field still lacks advances in specific protocols capable of standardizing criteria for collecting, analyzing and documenting historical woods.

Temporal and regional asymmetries

Studies on historical woods in Brazil, mediated by wood anatomy, are still marked by their infancy, when compared to other parts of the world with more ancient records, such as the avant-garde studies of the Italian school (Melo Júnior *et al.*, 2025b). The beginning of Brazilian studies, marked by the historical pioneering of the North Region in 1994 (Lisboa, 1994), is accompanied by long gaps in publications or by the late start of studies in the Central-West (Melo Júnior *et al.*, 2019). Although the South and Southeast regions have important research centers, production has been concentrated in a few hubs, such as Santa Catarina, Rio Grande do Sul, Minas Gerais and Rio de Janeiro. This highlights a recent field of research in a phase of consolidation, with great potential for expansion and deepening in several regions and patrimonial typologies of the country.

The unequal representation among Brazilian states is a point of concern. Sixteen states of the federation have records, which correspond to approximately 59 % of all Brazilian states. This indicates that approximately 41 % of the national territory remains without any recorded study in the analyzed context, including states with large territorial extensions and environmental diversity. The concentration of studies in the South and Southeast regions, especially in Santa Catarina (31.2 %), Rio Grande do Sul (19.5 %) and Rio de Janeiro (11.7 %), reflects the intensification and strengthening of research groups and evidences a marked appreciation and preservation of their cultural and patrimonial collections that are strongly associated with the Atlantic Forest and Cerrado. On the other hand, several states in the North, Northeast and Central-West regions remain underrepresented, which can be partially explained by the lack of wood anatomy research groups, the large territorial extension of these regions and difficulties with access. This points to the need to expand research in different parts and biomes of the country, including the Amazon, Caatinga and Pantanal.

Despite the diversity of studies within the categories of historical use of wood, with only four of the 19 categories that reflect the ways of life and cultural expressions of human societies (Melo Júnior, 2024b) missing, important asymmetries can be seen in the way Brazilian cultures and their material heritage in wood are viewed. In general, the emphasis of research on use categories linked to construction traditions, sacred sculptures and watercraft seems to express vocations, but it clearly reflects national policies of cultural appreciation. They highlight, as focal points, built heritage, including historical sites, urban groups of monuments, churches and their collections (Brazil, 2005a; b), and naval heritage, because it is one of the most threatened segments of Brazilian heritage (Museu Nacional do Mar, 2008).

Greater attention has been directed to building cultural heritage worldwide, as demonstrated by Heritage Building Information Modeling (HBIM) (Zhang & Zou, 2022), which allows a comprehensive analysis of structural health to guide better decisions in built heritage preservation efforts (Santos *et al.*, 2022). Traditional watercraft are represented by more than 150 typologies associated with the river and marine landscapes of Brazil (Cruz *et al.*, 2019), but great concern is shown by heritage management agencies due to the gradual replacement of wood by new materials that have altered and redefined the cultural meanings of traditional watercraft (Orofino *et al.*, 2018) and that can reflect social changes (Chenoweth & Wilkie, 2022).

In addition to the clear opportunity to advance knowledge in use categories that are still little explored or absent in the national territory, this trend points to the need to elect, in the field of historical woods, new paradigms on the right to memory and the recording of narratives and cultural heritages. Greater emphasis should be given to historically silenced cultures, as only three studies (4.7 %) dealt with indigenous cultural artifacts (Melo Júnior *et al.*, 2013; Santos *et al.*, 2022; Oliveira *et al.*, 2023). The decentralization of studies linked to the influence of European immigrants could reveal rich cultural and historical diversity that is still little considered in scientific records.

The observed asymmetries may compromise the representativeness and completeness of national data, directly impacting the country's ability to understand the diversity and dynamics of historical use of wood in different biomes and sociocultural contexts. The gaps make it difficult, for example, to plan integrated public policies and preserve traditional knowledge in less studied regions. Furthermore, the concentration of studies in specific years and regions creates a scenario in which certain areas have a greater scientific body to support conservation, patrimony education and sustainable management actions, while others remain invisible or underrepresented. This reinforces the need for coordinated efforts to fill temporal and regional gaps by expanding the research network and consolidating a more equitable national agenda.

Diversity of historic woods and key species

The concentration of citations for a few species suggests a pattern of preferential or recurrent use that reflects aspects of both regional availability and cultural or technological value attributed to certain woods. This trend, observed in each region, indicates the presence of key species. In the North Region, *Cedrela odorata* and *Bertholletia excelsa* stand out; in the Northeast, *Apeiba tibourbou*; in the Central-West, *Astronium urundeuva* and *Handroanthus* sp.; in the Southeast, *Cedrela* sp. and *Schizolobium parahyba*; and in the South, *Ocotea* sp. and *Araucaria angustifolia*. These species, being of great historical and cultural value, are discussed below in the same order.

The species *Cedrela odorata* occurs in different types of vegetation, such as Open Ombrophilous Forest (Acre, Amazonas, Rondônia), Dense Ombrophilous Forest (Amazonas, Pará, Amapá) and Floodplain Forest (Amapá, Amazonas, Pará) (Flores, 2025). The importance of the use of its wood transcends aspects of biology and ecology, extending deeply into the cultural and historical spheres. The name of the genus itself, *Cedrela*, refers to *Cedrus*, in allusion to the perfume exuded by these gymnosperm trees. The specific epithet *odorata* reinforces this characteristic, indicating the pleasant aroma of the wood (Klein, 1984). It is widely used in carpentry and joinery, especially in the manufacture of luxury furniture, interior decoration and articles destined for export. Its versatility also allows its use in the production of plywood, laminates, crates, office supplies, picture frames and musical instruments. In the construction industry, it is used in window frames and interior works and is also used in the aeronautical industry. The wood is valued in the construction of boats, chessboards and planks (Carvalho, 2008). Its historical and contemporary use is due to the wood's striking characteristics — in addition to its pleasant aroma and natural beauty, it has medium density, high durability, good mechanical resistance and excellent workability, which allows for excellent finishing (Melo *et al.*, 2002). One of the most significant cultural uses of *Cedrela odorata* is in the production of religious sculptures, and it is often the preferred wood for this purpose (Bustamante, 1948). In addition to its timber use, *Cedrela odorata* has a rich history of applications in traditional medicine, especially for its astringent, antirheumatic and antimalarial properties (Lorenzi & Mattos, 2002). The species currently faces intense overexploitation, in addition to fragmentation of its habitats, which has contributed to the reduction of its area of occurrence and to the loss of the genetic diversity of its populations. The species is listed as "Vulnerable" by the International Union for Conservation of Nature (IUCN, 2017) and is subject to regulation by CITES (Appendix II). Given this scenario, it is imperative to develop conservation and management actions in the areas where the species naturally occurs.

The species *Bertholletia excelsa* is considered one of the most emblematic trees of the North Region of Brazil, playing a central role in several historical and cultural contexts. Although naturally distributed in several states of this region, it is often found in groves called *castanhais* near ancient sites of human occupation, which indicates its role in anthropized landscapes and possible domestication by indigenous peoples thousands of years ago (Levis *et al.*, 2018). Its wood has anatomical and physical characteristics that confer high mechanical resistance, good dimensional stability and high durability, although with only moderate workability (ITTO, 2024). Four main categories of historical use can be attributed to the wood of *Bertholletia excelsa* in the North Region: (i) sacred statuary; (ii) construction of traditional watercraft; (iii) indigenous and traditional material culture, encompassing architectural, military, utilitarian and symbolic uses; and (iv) medicinal and ritualistic use. From a socioeconomic point of view, *Bertholletia excelsa* represents one of the main sources of income for traditional Amazonian populations through the extraction of its fruits (Wadt *et al.*, 2005). For riverside and indigenous peoples, its symbolism reveals an ancestral relationship with the forest environment, marked by traditional ecological knowledge transmitted between generations (Nunes *et al.*, 2023). The species is currently classified as "Vulnerable" by the IUCN (IUCN, 2023), being threatened by deforestation, forest fragmentation and unsustainable extractivism, which compromises its natural regeneration.

The species *Apeiba tibourbou* stands out for its ecological relevance as a pioneer or climax plant, as it is light-demanding (Carvalho, 2008) and adapted to dry and sandy soils. It presents morphoanatomical characteristics typical of xeric environments and has a wide geographic distribution, being found in all states of the Northeast Region (Colli-Silva, 2025). The low density and durability (Souza *et al.*, 2025) of its wood limit long-term structural applications, but it is especially valued for its lightness, buoyancy and malleability, qualities that make it ideal for artisanal uses, especially maritime.

Culturally, *Apeiba tibourbou* was, and still is, a central piece in the construction of *jangadas* on the Northeast coast, being used in components such as yokes, ballasts, masts, carts, lathes and oars (Andrade *et al.*, 2016), which connects the species to historical and ethnographic patrimony. The species is currently under no threat of extinction (IUCN, 2018).

The species *Astronium urundeuva* is found in the states of Goiás, Mato Grosso, and Mato Grosso do Sul (Silva-Luz *et al.*, 2025). It is heliophytic, deciduous, and adapted to Cerrado environments, with a preference for drained and stony soils. Its wood is notoriously dense, with a basic density greater than 0.80 g/cm^3, and has great natural resistance, properties attributed mainly to the composition of its extractives (Queiroz, 2001). These characteristics have made it the ideal wood for demanding structural applications, including railway sleepers, posts, stakes, floors, and rustic furniture (Longui *et al.*, 2024). Historically, it was widely used in the construction of traditional rural houses and structures in the Central-West, such as corrals and fences, and is considered the main resistant wood in the region (Domingos & Silva, 2020). Its cultural importance remains alive in the memory of communities that traditionally used it. From a conservation perspective, the species was intensively exploited and listed as "Endangered" by the IUCN and Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA) in the 1980s and 1990s, which led to a ban on its harvest and commercialization in native areas (IBAMA, 1992). Although it was removed from the IUCN Red List in 2019, it is still considered vulnerable due to the continued degradation of its habitats and illegal exploitation.

The genus *Handroanthus* is widely distributed throughout Brazil, with occurrences recorded in all biomes — Amazon, Cerrado, Atlantic Forest, Caatinga, Pantanal and Pampa. The Central-West region, marked mainly by the Cerrado and Pantanal, is home to a significant diversity of species of the genus, such as *Handroanthus serratifolius*, *Handroanthus impetiginosus*, *Handroanthus heptaphyllus* and *Handroanthus ochraceus*. These species are frequently identified in studies of historical wood and their applications allow their traditional use to be grouped into three main categories: (i) structural elements, such as rafters in roof coverings; (ii) frames, such as doors and windows; and (iii) other architectural components, including floors and possibly handrails (Hoffmann *et al.*, 2023; Hoffmann *et al.*, 2024; Conceição *et al.*, in press). Such applications reinforce the versatility of *Handroanthus* wood in the context of historical civil construction. The traditional and contemporary use of *Handroanthus* wood is mainly due to its exceptional qualities. In addition to its color, which varies from olive yellow to greenish brown, and its medium texture and natural luster, attributes that give it aesthetic appeal, the wood has high mechanical resistance, excellent dimensional stability and high natural durability against fungi, termites and weathering (Oliveira *et al.*, 2021). Furthermore, it has good workability, with generally satisfactory gluing and finishing, resulting in uniform, high-quality surfaces. These characteristics justify its high economic value, widely recognized in both domestic and international markets. The growing demand for wood has put pressure on its natural populations. According to the IUCN, most species of *Handroanthus* are not currently included in high-risk categories, with many classified as "Least Concern" due to their wide distributions and stable populations. However, some species, such as *Handroanthus impetiginosus*, can be locally assessed as "Vulnerable", especially in areas that suffer intense logging and habitat loss. Therefore, the conservation of the genus requires integrated sustainable management strategies, combined with ongoing research on genetic variability, density and wood anatomical properties, to support preservation practices and conscientious use.

The genus *Cedrela* is represented by two native species — *Cedrela fissilis* and *Cedrela odorata* — that are widely recognized for their economic importance and are key species in the Southeast Region. This is attributed mainly to the high quality of their wood (Flores, 2025; Souza & Lorenzi, 2019), which has been used since the colonial period, especially in the production of sacred sculptures (Miranda & Pigozzo, 2013; Florsheim *et al.*, 2020). Among the historical use categories of this wood in the Southeast Region, statuary, furniture and means of transport (watercraft) stand out, although it is also used, less frequently, for structural purposes and for the production of handicrafts. The wood of these species is characterized as soft to cut, easy to machine and highly durable in indoor and outdoor environments, features that make it especially suitable for artisanal carving (Reitz *et al.*, 1988; Mainieri & Chimelo, 1989; Grings & Brack, 2011). The wood of both species presents remarkable resistance to biotic agents, including xylophagous organisms, although they are susceptible to deterioration under conditions of burial or submersion (Reitz *et al.*, 1988; Mainieri & Chimelo, 1989; Grings & Brack, 2011; Saueressig, 2014; Souza & Camargos, 2024; Melo & Camargos, 2016). Due to these attributes, they are classified as high quality (Reitz *et al.*, 1988; Souza & Camargos, 2024) and are among the most versatile woods for use in the country (Mainieri & Chimelo, 1989). The protection against deterioration and high durability of *Cedrela fissilis* are attributed to the presence of essential oils in the wood, while the presence of a slightly bitter resin gives the wood of *Cedrela odorata* resistance to attack by xylophages (Ono *et al.*, 1996a; Grings & Brack, 2011;). Both species are widely distributed in Brazil; *Cedrela fissilis* occurs in all biomes, while the distribution of *Cedrela odorata* is more restricted, with no records for the Pantanal and Pampa (Flores, 2025). The high anatomical similarity of the woods of the two species represents an obstacle to their identification at the level of species. The differences highlighted in the literature are largely concentrated on quantitative traits that present wide intraspecific variation, in addition to significant overlap between species (Silva *et al.*, 2025).

Cedrela fissilis and *Cedrela odorata* are listed as "Vulnerable" on the IUCN Red List, with decreasing populations, representing a high level of concern considering the possibility of extinction in the medium term. The progressive degradation of their habitats throughout their area of occurrence is mainly driven by the conversion of native forests into agricultural areas and intense and unsustainable logging, reflecting the high commercial value of their timber in Brazilian and international markets (IUCN, 2025).

The species *Schizolobium parahyba* is native and non-endemic to Brazil. It occurs in the Amazon and Atlantic Forest biomes (Lewis, 2016), with a more pronounced natural distribution on the coastal slope of the Serra do Mar (Rizzini, 1995). Its low-density wood (Mainieri & Chimelo, 1989) is widely used, being employed in the production of everyday and recreational objects and in naval carpentry (Backes & Irgang, 2004; Paula & Alvez, 2007). As observed in this study, *Schizolobium parahyba* is given greater prominence in naval carpentry, intended for the manufacture of canoes in several fishing communities on the Brazilian coast (Miranda and Hanazaki, 2008; Santos *et al.*, 2009; Luz & Martins, 2014; Melo Júnior and Barros, 2017c). Its popular name derives from this traditional use in *Tupi Guarani*: *ignara* = canoe; *p´vú* = trunk (Gonzaga, 2006).

The genus *Ocotea* is highly diverse in Brazil, with 179 species recorded, of which approximately 63 % are endemic. There are 31 species in the South Region, including two endemic taxa (Flora e Funga do Brasil, 2025). The main use categories associated with the wood of *Ocotea* spp. in the South include the construction of shelters/buildings, means of transport (watercraft) and furniture. Additional uses, although less frequent, involve architectural structures, machinery manufacturing and means of land transport. The mentioned species of *Ocotea* vary in terms of extinction risk and conservation status. The species with the greatest cultural relevance for timber use in the South Region of Brazil, *Ocotea porosa*, is currently classified as "Vulnerable" (VU) and is included in the official list of species of Brazilian flora threatened with extinction. Its populations are severely fragmented and in continuous decline because of the progressive reduction in its area of occupation and extension and quality of habitats, combined with intense logging. The situation is aggravated by its slow growth and high extraction rates, placing the species among the most threatened in the country, behind only *Araucaria angustifolia* (IUCN, 2025). The species *Ocotea aciphylla*, *Ocotea diospyrifolia* and *Ocotea divaricata* are classified as "Least Concern". However, these species also face increasing pressures on their populations, mainly due to deforestation and the conversion of natural habitats into agricultural areas, factors that have contributed to the decline of their ranges (IUCN, 2025; Kok, 2022). The most critical situation is with *Ocotea odorifera*, currently classified as "Endangered", which indicates a very high risk of extinction in the wild in the near future. The main threats to the species include unsustainable logging, habitat loss and degradation due to human actions, and failures in recruitment, reproduction and natural regeneration, as well as possible negative effects resulting from inbreeding (Moraes & Messina, 2012).

Lastly, the species *Araucaria angustifolia* is a native gymnosperm of Brazil, and the only species of the genus in the country (Garcia, 2002). It occurs predominantly in the states of Paraná, Santa Catarina and Rio Grande do Sul, in addition to records in São Paulo, Minas Gerais and Rio de Janeiro, and extending to Paraguay and Argentina. It is distributed in the Atlantic Forest and Pampa biomes, preferably in phytophysiognomies such as Campos de Altitude, Semi-deciduous Seasonal Forest and Mixed Ombrophilous Forest, between 500 and 1,800 m above sea level (Iganci *et al.*, 2025; IUCN, 2025). The cultural use categories for its wood include the construction of shelters/buildings and as a means of transport (watercraft), although other less frequent uses are cited, such as the manufacture of sacred statuary, furniture and household utensils. The species is listed as "Critically Endangered" on the IUCN Red List, the highest threat category short of "Extinct in the Wild", indicating an extremely high risk of imminent extinction (IUCN, 2025). Intense logging of the species began in the 16th century, intensified in the 19th century, and peaked between 1950 and 1970, resulting in a drastic reduction in its range (Roque *et al.*, 2023; Vasconcellos *et al.*, 2024). The critical conservation situation of this species is due to a historical severe population reduction, from which recovery is not projected since habitat loss is considered irreversible, even if the causative factors are no longer active (IUCN, 2025). It is strictly protected by federal legislation in Brazil, which prohibits the logging and commercial exploitation of native individuals, except when authorized by competent environmental agencies. Such measures aim to contain the population collapse of the species, which has already lost more than 97 % of its original range (IUCN, 2025). Its exploitation for timber or forest management purposes has been prohibited since 2006 (Brazil, 2006; 2008; MMA, 2008) to preserve the remnants of the species (Hess *et al.*, 2018). The *Araucaria angustifolia* plays a fundamental ecological role in forest formations, providing food and shelter for several species of fauna. The *Ocotea porosa*, the official symbol of the state of Santa Catarina, has recognized ecological, historical and cultural value. Both are celebrated through monuments made of wood in the entrance portals of cities, squares and other public spaces, symbolizing the timber cycle that marked the regional economy (Scipioni *et al.*, 2019).

The list of key species presented here demonstrates that each type of wood has a specific regional relationship that reveals local knowledge and historical processes, but also severe ecological problems. Understanding this diversity allows us to contextualize patrimony historically and geographically, strengthening the idea of interdependence between human societies and Brazilian flora. It is important

to emphasize that some historical surveys of the use of wood can also provide valuable information regarding the cultural use of Brazilian woody flora. However, since they are based on popular names for taxonomic assignment, they should be used with some caution and their collections deserve to be searched for confirmation through wood anatomy. In this context, we can mention the studies by Hutter (1986), Gonzaga (2006), Dias (2010) and Silva *et al.* (2020), which provide lists of woods historically used to repair watercraft on the Brazilian coast during the period of great navigation, for general carpentry, for traditional Brazilian naval production, and those transported to supply the European market between the 18th and 19th centuries, respectively.

Future perspectives and research and conservation policies for wood cultural patrimony in Brazil

Despite the crucial importance of wood in the development of societies and in the production of countless cultural artifacts (Ennos, 2021), it is notable that in-depth studies on its anatomy and species identification are still scarce. This limitation represents a challenge for the field in expanding the training of anatomy researchers, as well as those trained for the interdisciplinary dialogue essential for the understanding of historical woods (Melo Júnior, 2024b).

The proposition of a common conceptual basis for wood anatomy aimed at studies involving woods used in cultural purposes — historical anatomy — is a milestone for the field. It is capable of guiding the theoretical-epistemological *corpus* in all stages of research and directing approaches, interpretations and applications of results from different perspectives, such as patrimonial, technological, environmental and conservationist approaches (Melo Júnior, 2024a).

Methodological obstacles — which include the complexity of field recording processes, required experience, degradation of historical materials, safeguarding techniques, creation of systematized collections, and restricted access to reference wood collections — hinder the accuracy of analyses and the comparison of results. Addressing these problems requires the development of specific protocols for studies involving historical woods. The systematization of sample collection and collection records (Melo Júnior, 2024b) must be accompanied by new protocols that identify the needs of each category of wood use and its alignment with patrimony conservation principles (Marshall, 2016).

The adoption of more comprehensive and integrated protocols favors the exchange of information between researchers, patrimony managers and institutions responsible for safeguarding cultural assets, thereby promoting the development of public policies and coordinated actions for the protection of historical heritage (Cerqueira & Oliveira, 2019). These protocols can also stimulate technological and methodological innovation in the area, expanding the possibilities for research and ensuring that the collection process respects the historical, symbolic and material values of the studied artifacts.

From another perspective, the relevance of anthracology stands out as a complementary tool to the historical anatomy of wood, especially in the identification of carbonized artifacts and products that are not necessarily linked to archaeobotany or paleoenvironmental reconstruction (*e.g.*, Scheel-Ybert, 2001; Scheel-Ybert *et al.*, 2003; Beauclair *et al.*, 2009). In this context, the analysis of recently carbonized wood, used for cultural purposes by traditional populations and indigenous peoples, reveals new possibilities for investigation. An example of this is the use of *Guazuma ulmifolia* wood, which is carbonized to produce paint for body painting (graphics) by the Suruí (Aikewara) indigenous people in southeastern Pará, Brazil (Santos *et al.*, 2022). Considering that, even after the carbonization process, the anatomical structure of the wood remains generally well preserved (Prior & Gasson, 1993; Perdigão *et al.*, 2020; Braga Júnior *et al.*, 2021; Haag *et al.*, 2023; Silva *et al.*, 2024), anthracology becomes a promising strategy to associate the identification of the material with the cultural heritage and history of the social groups that use it.

The importance of testing new techniques and tools in the collection of historical woods allows the discovery of faster, safer and more efficient ways to perform the same procedure and, in this way, develop new protocols. Some tools and equipment that already exist on the market, but are applied in other situations, can be directed to new uses than those that were primarily proposed, that is, they can generate opportunities for the creation of new methods and solutions, reduce work time and improve the quality of the results (Calderon *et al.*, 2025). An example of this is the use of the oscillating saw, developed in 1947 for use in the medical field, which allows the cutting of hard materials such as plaster, but not human tissue (Stryker Corporation, 2021). Currently, this type of tool is also used in civil construction to cut various types of materials, including wood, with the great advantage of precision and less damage. Due to these advantages, its use can also be applied in the field of historical anatomy, as it allows the removal of small samples with minimal damage to the artifact, aspects that should be prioritized when dealing with a cultural asset (Calderon *et al.*, 2025).

In addition to methodological advances, attention is drawn to the strengthening of scientific cooperation networks in order to integrate inter- and multidisciplinary knowledge, share good practices, optimize technical and human resources, and promote comparative studies in different cultural and regional contexts. As pointed out by Melo Júnior *et al.* (2025b), the global scenario highlights the centrality of countries such as Italy, China, France, Spain, and England in studies of wood patrimony. However, it is worth noting that Latin American countries, such as Brazil, Mexico, and Argentina, have significant potential in this field given their notable cultural expression in wood.

The internationalization of Brazil and the articulation between academic institutions, patrimony preservation agencies, and local communities are essential to expand the scope of research, promote the training of specialists in the area, and consolidate more effective strategies for the preservation (Brazolin *et al.*, 2004) and appreciation of the cultural patrimony of wood.

This study focused on studies of historical anatomy. Wood identification using anatomy has been recognized as an efficient, inexpensive, and fast method compared to other analytical methods (Dormontt *et al.*, 2015; Lowe *et al.*, 2016; UNODC, 2016; Schmitz *et al.*, 2020; Low *et al.*, 2022). The differences between the analyses of macroscopic and microscopic characteristics are worth highlighting. The former evaluates characteristics with hand lenses at low magnification and proves to be a very fast and low-cost method, but with lower resolution power. While the latter uses equipment with greater magnification power, allowing the evaluation of a greater number of anatomical characteristics with greater resolution in identifications, it presents a higher cost and longer time for analysis (Dormontt *et al.*, 2015; Lowe *et al.*, 2016; UNODC, 2016; Schmitz *et al.*, 2020; Low *et al.*, 2022). Given the comparative nature of identification methods, the existence and development of reference data is essential, such as wood collections, anatomical descriptions and electronic databases (*e.g.*, interactive identification keys) (Dormontt *et al.*, 2015; UNODC, 2016; Lowe *et al.*, 2016; Brandes *et al.*, 2020; Schmitz *et al.*, 2020; Low *et al.*, 2022). Despite the advantages of anatomy for wood identification and the existence of many reference materials for this purpose (Low *et al.*, 2022), there are limitations, which make the distinction of some woods a challenge (Bernal *et al.*, 2011; Gasson, 2011; Gasson *et al.*, 2010; Ruffinatto & Crivellaro, 2019), requiring advances in research for accurate identification. The incorporation of other methods for wood identification, such as the use of chemical methods (*e.g.*, direct analysis in real-time time-of-flight mass spectrometry, near-infrared spectroscopy, isotopic analysis) and genetic methods (*e.g.*, DNA Barcoding, phylogeography, population genetics), can help in the identification of historical wood and assist in determining its origin, despite the limitations of reference data for the application of these methods (Low *et al.*, 2022).

The appreciation and protection of the historical heritage of wood requires interdisciplinary and interinstitutional efforts, with investments in training specialists, expanding research networks, developing integrated databases and promoting management and conservation strategies that respect the country's ecological and sociocultural diversity. In this way, it is expected to contribute to a scientific and heritage agenda that is more equitable, inclusive and representative of the historical complexity of the use of wood in Brazil.

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Conceptualization, JCFMJ, LBS and LELM; methodology, JCFMJ, LBS, LELM, AFNB, CHC; validation, JCFMJ and AFNB; formal analysis, JCFMJ, AFNB, CHC; investigation, JCFMJ, GBO, LBS, LELM, ERC, LSNA, BLCP, AFNB, CHS, SNS, TS; resources, JCFMJ; data curation, JCFMJ, AFNB, CHC, CFB, HHSC, MCS, MSS, RSLS —original draft preparation, JCFMJ, LBS, LELM, BLCP, AFNB, CFB, CHC, CMAC, MPC, MSS; writing—review and editing. JCFMJ; visualization, JCFMJ; supervision, JCFMJ, LBS and LELM; project administration, JCFMJ, LBS and LELM; funding acquisition, JCFMJ, LBS and LELM, CHC. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest

Data Availability

All data supporting the findings of this study are available at: https://zenodo.org/records/15739247

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