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Jaguars and raptorial birds: The ancient wood carving arts of Northeastern South America (Trombetas River region, Brazil)

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ABSTRACT

This paper presents the results of the first systematic study aimed at defining the chronology, provenience and material components of 14 distinctive wood carvings featuring jaguar and raptorial bird imagery broadly attributed to northeastern South America, centred on Brazil's Trombetas River region. These carvings, largely confined to drug-related paraphernalia and ceremonial objects (trumpets, rattles, staffs/sceptres and a hafted anchor axe), were part of antiquarian collections deposited in European museums mainly in the 19th century, with very little associated information. ^{14}C AMS dating of their wood, cotton and resins shows that they have deeper histories, spanning the 14th to late 17th/early 18th centuries. Wood identification indicates a relatively narrow range of taxa, mainly from the genera *Brosimum* and *Swartzia*, likely selected for their hardness and striking "snakeskin" or "leopard skin" patterns. Bindings of human hair are identified on a ceremonial weapon. Strontium isotope (^{87}Sr/^{86}Sr) analysis of the wood is used to explore the possible provenience of the carvings,

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with the results divided into two groups, one from a more radiogenic region consistent with the Trombetas, and the other from a less radiogenic region, possibly the Amazon floodplain.

1. Introduction

Scattered across some of the oldest European museum collections in Britain, The Netherlands, Denmark, France and Germany are a small group of carvings broadly attributed to northeastern South America in museum records. Spanning a variety of objects, from drug related paraphernalia to trumpets, rattles, bows, ceremonial staff/sceptres and an axe, they are unified by highly restricted stylistic conventions and an iconography focused mainly on jaguars, raptorial birds and humans as well as chimerical beings, typically depicted in pairs, often one atop the other (Fig. 1). Despite their small size (ca. 10–12 cm), many fitting comfortably in the hand or featured as finials or focal points on larger



Fig. 1. Study corpus coded alphabetically by institutional acronym (e.g., BM1 = British Museum), including trumpets (NMD1, NMWC1, PRM1), vessels (BM2, MQB2, REM1), staff/sceptres (MFK2, MQB1), a rattle (NMD2), ceremonial axe (BM3), bow (MFK1) and ritual paraphernalia (REM2-3). Where some of the larger carvings feature multiple depictions along their length (NMD1; NMD2, NMCW1), their position (top, middle, bottom) is listed; in total, some 18 figural carvings are depicted on the 14 carvings in the studied corpus. See SI1 for detailed measurements and histories of individual carvings.

objects, they give the impression of much more monumental carvings. They are intricately carved in dark woods with engraved designs infilled with pigments, their round or comma-shaped eyes inlaid with shell and their limb joints, tails and nostrils often depicted as volutes. The carving and smooth finish give the impression of well curated, highly prized pieces, their deep patinas suggesting long biographies. Most entered European museum collections in the 19th century, but their study was not initiated until the 1950s with a brief, two paragraph article presenting 12 surviving carvings (Gerbrands 1955). Sporadic investigations of individual pieces followed in the 1960s–1980s (e.g., Zerries 1960; 1965; 1977), raising the total count to ca. 20 pieces, each featuring between one and three figural depictions (frequently referred to as "alter egos" or "plural beings") (e.g., Alves 2020). In more recent investigations, these wood carvings are occasionally compared with the better known, stylistically similar stone carvings long acknowledged as the "treasures" of Brazilian archaeology, and loosely provenienced to the Trombetas River region (e.g., Fonseca 2010; Porro 2010). But there remains little consensus on their chronology (whether stone or wood), provenience, cultural affiliation or their wider context within the region's Indigenous material culture. In efforts to better situate the wood carvings both in time and place, and so also inform on their stone counterparts, a select corpus was studied as part of the jagWARS project, with 14 wood carvings undergoing scientific analyses, including radiocarbon dating, materials identifications and strontium isotope analysis.

2. Defining the "Trombetas style": Historic attributions

A. A. Gerbrands (1955:267-268) first brought attention to a group of surviving ancient Amazonian "masterpieces," rare wood carvings depicting zoo/anthropomorphic and transformative figures, many featuring "comma-shaped" eyes, which he considered diagnostic (though circular eyes also occur). He referenced a small collection of stone carvings recovered from Lower Trombetas River – the more widely known stone "idols" (e.g., Fonseca 2010; Porro 2010; Rodrigues 1899) – some of which also feature matching eye-form and volute designs, and the same visual themes (raptorial birds and felines), suggesting that they also reflect this style. However, most stone carvings were recovered in the 19th century outside of archaeological contexts, washed out mainly



Fig. 2. Distribution of 'Trombetas' stone carvings compiled by Ostapkowicz and Alves. Numbers in bold align with numbered images on map, and are listed in alphabetical order by holding institution, with respective accession numbers in brackets. Musée Dobrée, Nantes (887.13.1–2): **7**; Museum of World Culture, Gothenburg (1925.12.0001–6): **3, 5, 12, 13, 16, 19**; Museu de Arte Sacra do Pará, Belém (no number): **21** upper left; Museu de Arqueologia e Etnologia da USP (72/1): **6**; Museu de História Natural e Jardim Botânico da UFMG (no number): **10**; Museu Nacional da UFRJ (10.774, 20.755, 23.171): **8, 14, 21** lower left; MCTI/ Museu Paraense Emílio Goeldi (2163, 2162 – photos by Maurício de Paiva): **21** centre right and lower right; Primeira Comissão Demarcadora de Limites, Belém (131): **11**; University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia (60–2-1): **2**. Bibliographic/pers. com. sources: Alves and Prous 2016 (local community collection): **9**; Alves (2025): **17**; Alves (pers. com. 2025) (local community collection): **1**; Barbosa Rodrigues 1899 (current location unknown): **20**; Figueiredo 1982 (Universidade Federal do Pará, 14513): **15, 18** (Maria Tereza carving); Nimuendajú (2004): **22**; Palmatary 1960 (MPEG 1596): **23**; Sanjad and Batista Poça da Silva 2009 (current location unknown): **4**. Map: Le Cointe, Paul. Carte du Bas Amazone de Santarem à Parintins (Municipe de Obidos et Partie des Municipes limitrophes – État du Pará), Le Gouvernement de l'État du Pará, 1911, http://purl.stanford.edu/kg035zh5402. Images courtesy of institutions listed.



Fig. 3. Side blown trumpets and rattle. **a.** Side blown trumpet with anthropo/zoomorphic carving [PRM1], calAD 1517–1667 (95.4 %, of which the greatest likelihood at 70.6 % is calAD 1625–1667); full L: 97.5 cm; Diam: ca. 7 cm; height of figure only: 12.9 cm. *Brosimum* cf. *rubescens*, plant fibres, resins, shell inlay, Pitt Rivers Museum, Oxford, 2000.43.1. **b.** Side blown trumpet with two jaguar carvings and a bird finial [NMWC1], calAD 1450–1620 (95.4 %, combined date); full L: 124 cm; Diam: ca. 8 cm; *Platymiscium* sp., plant fibres, resins, shell inlay, National Museum of World Cultures, Leiden, RV-360–815. **c.** Rattle fragment [NMD2], calAD 1485–1630 (95.4 %, combined date on two resin samples); full L: 104 cm; W: 6.1 cm; D: 2.7 cm.; *Swartzia* cf. *panacoco*, resin, shell inlay, National Museum of Denmark, Copenhagen, Ia.4. Photos: Ostapkowicz, courtesy institutions listed.

along the banks between the Nhamundá and Tapajós Rivers, concentrated on the Trombetas River (Fig. 2), and so had no cultural or chronological context. Similarly, early museum records for the wooden carvings, which were acquired indirectly through collectors, rarely provide detailed histories. Of the wood carvings discussed by Gerbrands, only one had an ostensibly clear provenience, attributed to the Sateré-Mawé (Mawé, Mauhé, Maué) cultural group, currently settled between the Tapajós and Madeira Rivers; it was collected in the first half of the 19th century (1830; Augustat 2012:130). Gerbrands (1955:268) considered the construction of the three composite, side-blown trumpets in this style to be comparable in construction to those documented among the neighbouring Munduruku (though Munduruku trumpets do not feature figural carvings – e.g. Dias 1992: cat. 129–134). Notably, the 17th century historian Mauricio de Heriarte, called attention to the fact that the Trombetas River owed its name to the numerous trumpets used by the local inhabitants. On the basis of these designations, Gerbrands attributed this distinctive style to the "Lower Trombetas" region and potentially the work of the Sateré-Mawé and/or the Munduruku (both Tupi linguistic stock). Since Gerbrand's initial synopsis, subsequent studies by Reichlen (1961), Zerries (1965; 1977; 1981; 1986) and Wassen (1967) have also drawn parallels to the traditions of the Kaxuyana (Kachuyana, Katxuyana, Kaxúyana, Kaxuiâna, Cashuena), Carib-speaking inhabitants of the Cachorro River (a tributary of the Trombetas), whose ceremonies also include wood carvings featuring jaguars, snakes and raptorial birds (Polykrates 2021; Frikel 1961; see references in Russi and Fajardo 2021). A Trombetas River provenience has largely been accepted for these pieces, though this relies on chance finds and broad stylistic and cultural attributions.

These cultural attributions, based largely on 19th and 20th century ethnographic accounts and collection histories, did not address the potential time-depth of these rare survivors. Opinions differed as to their possible age: McEwan (2009:58), for example, suggested that the Trombetas-style carvings in the British Museum [BM] – including a zoomorphic bowl (Fig. 1, BM2) and an elaborate ceremonial axe (Fig. 1, BM3) (see also Fig. 1, BM1; Fig. 5a) – dated to the 19th century, not long before their accession into the museum's collections. In contrast, the carvings now in the Reiss-Engelhorn-Museen [REM], Mannheim (Fig. 1, REM1-3; Fig. 5b and c) were thought to have a deeper history than their 19th century accession date: Zerries (1965:193) considered that "[many in this style] were made much earlier, in the 17th or 18th century". Reichlen (1961:29) believed that most of the carvings were brought back to Europe in the 17th century, and indeed the earliest acquisition of an object in this style – the trumpet featuring what may be a pregnant jaguar in the National Museum of Denmark [NMD], Copenhagen (Fig. 1, NMD1; Fig. 8a) – can be traced back to 1617 (see SI1). Zerries (1965:192; 1977:82) considered the NMD trumpet, and that in the collections of Leiden's National Museum of World Cultures [NMWC] (Fig. 1, NMWC1; Fig. 8b), to be a matched pair (one male, the other female) dating between 1600 and 1800. The general impression was that these carvings were 'old' – though how old was unclear. Reichlen (1961:29) judged the wooden carvings to "derive directly" from their stone predecessors (though there is no reason to assume a linear progression from stone to wood carvings; they could equally be contemporaneous, or the wood carvings might precede the stone). Reichlen (1961:27-28) further proposed that the morphological differences in the eyes (whether comma-shaped or circular) could be one means of more accurately determining the date and provenience of the carvings, though he notes that the circular eye was widespread during pre-Columbian times and has remained fairly common in the Amazon basin and Guianas well into the 20th century. These discussions foreshadowed some of the work undertaken here; six decades later, we can begin to explore these issues in more detail.

3. Materials and methods

Undertaken as part of the jagWARS project (https://jagwars.site.ox.ac.uk/sculpture), the 14 pieces selected here for scientific analyses comprise roughly 70 % of the known 'Trombetas'-style wood carvings in public collections. For ease of reference in the following discussions, each object is given the curating institutional acronym (e.g., BM = British Museum); if several pieces are in the same institution, they are numbered sequentially [BM1, BM2, BM3] in chronological order based on their ^{14}C results, from oldest [BM1] to youngest [BM3] (Fig. 1, BM1-3; Table 1). Detailed reviews of individual artefacts, including collection histories, relevant references, measurements and results are provided in Table SI1. The artefacts appear to cluster broadly within the theme of ceremonial paraphernalia, comprising three trumpets [NMD1, NMWC1, PRM1], an elaborately carved bow [MFK1] (Fig. 4a), a rattle [NMD2] (Fig. 3c), three vessels [BM2, MQB2, REM1] (Fig. 1), two staff or sceptres [MFK2, MQB1] (Fig. 4b and c), a ceremonial axe [BM3] (Figs. 4d, 10a), two finials (components of composite carvings) [BM1, REM2] (Fig. 5a-b) and a bifurcated snuff tube [REM3] (Fig. 5c). Some of the larger objects feature multiple single or grouped figures, such as three single figures featured along the shaft of the Leiden side-blown trumpet [NMWC1], or the two pairs on rattle NMD2 (Fig. 3b and c).

The methods applied here comprise the following: chronological placement through ^{14}C accelerator mass spectrometry (AMS) radiocarbon dating; material identification through transmitted light microscopic wood identification, scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDX) of resins and pigments; and provenience investigation through strontium isotope analysis. Sampling the small, well-finished objects was challenging and was strategically accommodated to each carving to ensure minimal (but sufficient) sample size while safeguarding the appearance and integrity of the object. Given that only very small samples were possible with most objects, and ideally a minimum of three analyses were to be undertaken on each piece, five samples first underwent minimally invasive analyses (wood ID) prior to being submitted for destructive analyses (^{14}C, $^{87}Sr/^{86}Sr$) [NMD2; PRM1; REM 1–3]. Of the 14 objects studied, eight had sufficient sample size for all three core analyses (^{14}C, wood ID, $^{87}Sr/^{86}Sr$) [MFK1; MQB2; NMD1-2; PRM1; REM1-3], three underwent ^{14}C and wood ID [BM2-3; NMWC1], while in three cases only ^{14}C dates were possible [BM1; MFK2; MQB1]. Two carvings [NMD1-2] had sufficient resin samples to undergo assessment of the effect of chemical pre-treatment vs. no treatment on results (see SI2.3). In summary, the 38 samples taken from the 14 carvings undergoing analysis provided 46 results (Tables 1-3). Eighteen radiocarbon dates were run (two dates on different materials on the bow finial MFK1 and the trumpet NMWC1), the majority being on resins (Table 1). Eleven samples were taken for wood identification (three pieces could not be sampled as they presented limited damaged surfaces) (Table 2), and eight samples underwent strontium isotope ($^{87}Sr/^{86}Sr$) analysis (Table 3). A further nine samples were taken for materials identification, including pigments and a black strand used as ornamental binding on the British Museum's ceremonial axe (BM3) (section 3.3, below, SI3.2 and SI5).

Wherever possible, original resins were preferred over wood for radiocarbon dating. Targeting resins fulfilled several criteria: first and foremost, resins are ideal for dating as they are sourced from a short-lived plant material used as an adhesive to secure inlays (e.g., Ostapkowicz et al. 2018). In contrast, dating wood may be subject to the old-wood effect, where wood from the inner portions of a tree (closer to the pith) can be considerably older than outer sapwood. Dating objects made of "old wood" could therefore overestimate the age of the carving. Hence, dates on wood represent *a terminus post quem*. Secondly, resins are generally high in carbon content, meaning that in most cases dates can be run on very small samples (<10 mg), which is an important consideration when dealing with such small and finely finished carvings. Thirdly, the resins were typically present in previously damaged areas, sometimes in relatively large amounts, such as an eye cavity, where the decorative inlay had dislodged at some point in the object's history [e.g., NMD2], or where two pieces of a composite object were previously joined together [e.g., BM1]. In some cases, already present cracks within

Table 1
AMS radiocarbon results (both unmodelled and modelled) for 14 selected artefacts in the jagWARS ("Jaguars, Raptors and the Patterns of War: 14-18th century South American Indigenous sculptural arts") project, organized in chronological order according to ^{14}C BP date, from earliest to latest (for object histories see Table SI1; for wood IDs see Table 2; for strontium (^{87}Sr/^{86}Sr) results, Table 3; for pigments and other material IDs see section 3.3, SI3.2 and SI5). The lab numbers (OxA: Oxford Radiocarbon Accelerator Unit, Oxford; SacA: Laboratoire de Mesure du Carbone 14 (LMC14), Saclay; MAMS: the Curt-Engelhorn-Center Archaeometry gGmbH) are provided alongside an indication of the material dated (whether resin, wood or fibres). Dates BP and calibrations at 95.4% are listed, with the most likely calibration ranges highlighted in bold. All dates are calibrated using a mixed curve (Bronk Ramsey and Lee 2013) for the northern (IntCal20; Reimer et al. 2020) and southern (SHCal20; Hogg et al. 2020) hemispheres in in OxCal v4.4.4 (Bronk Ramsey 2009, 2025) (for further discussion, see SI2.4).

Ref code	Object, Collection, Acc. No. [earliest doc. date]	Lab no. Dated material	δ^{13}C	^{14}C BP	Calibrated date AD (95.4 % confidence)	*Calibrated modelled date AD (95.4 % confidence)*
BM1	Finial British Museum, Am.4103 [1860–1869]	OxA-43482 resin	−29.3	667 ± 18	**1291–1395 (95.4 %)**	*1310–1318 (1.6 %)* ***1350–1397 (93.9 %)***
NMD1	Trumpet National Museum of Denmark, Gc.18 [1617]	OxA-V-3176–13 resin OxA-45981 resin Combined (χ^2, df = 1, T = 0.5 [5 %, 3.8])	−31.0 −31.4	582 ± 17 565 + 17 574 ± 13	1324–1351 (21.1 %) **1391–1425 (74.4 %)** 1329–1337 (2.7 %) **1393–1429 (92.7 %)** 1327–1340 (8 %) **1393–1421 (87.5 %)**	***1393–1420 (95.4 %)***
MQB1	Staff/sceptre Musée du Quai Branly, 71.1878.5.36 [1897]	SacA-73454 wood	−31.3	420 ± 30	**1437–1515 (70.4 %)** 1551–1564 (1.5 %) 1573–1625 (23.5 %)	***1438–1513 (75.3 %)*** *1579–1624 (20.2 %)*
NMWC1	Trumpet National Museum of World Cultures, Leiden RV-360–8157 [1883]	OxA-43479 resin OxA-43484 plant fibres Combined (χ^2, df = 1, T = 0.5 [5 %, 3.8])	−25.6 −29.6	396 ± 17 379 ± 17 388 ± 13	**1452–1513 (63.5 %)** 1577–1624 (31.9 %) 1459–1519 (42.1 %) **1545–1627 (53.4 %)** **1450–1509 (63.1 %)** 1590–1620 (32.3 %)	***1458–1509 (62.9 %)*** *1519–1620 (32.6 %)*
BM2	Vessel British Museum, Am.7204 [1871]	OxA-43481 resin	−29.9	385 ± 17	**1457–1515 (49.0 %)** **1547–1625 (46.4 %)**	***1456–1515 (56.8 %)*** *1574–1625 (38.7 %)*
REM1	Vessel Reiss-Engelhorn-Museen, V Am 1988 [1882]	MAMS-62718 wood	−30.0	385 ± 16	**1457–1515 (49.0 %)** **1547–1625 (46.4 %)**	***1456–1514 (57.4 %)*** *1578–1624 (38.0 %)*
REM2	Finial Reiss-Engelhorn-Museen, V Am 1987 [1882]	MAMS-62716 resin	−27.5	371 ± 16	1465–1526 (35.1 %) **1581–1624 (60.3 %)**	*1465–1521 (39.8 %)* ***1551–1628 (55.7 %)***
NMD2	Rattle National Museum of Denmark, Ia.4 [1847]	OxA-V-3400–27 resin OxA-46100 resin Combined (χ^2, df = 1, T = 1.5 [5 %, 3.8])	−29.0 −29.5	345 ± 17 375 ± 18 359 ± 13	**1499–1601 (79.1 %)** 1611–1637 (16.4 %) 1461–1525 (38.8 %) **1540–1629 (56.5 %)** 1485–1527 (28.8 %) **1544–1630 (66.7 %)**	*1485–1527 (28.8 %)* ***1544–1630 (66.7 %)***
MFK1	Bow finial Museum Fünf Kontinente, I-102[1897]	OxA-X-3373–30 wood OxA-X-3373–31 Cotton (?) Combined (χ^2, df = 1, T = 6.2 [5 %, 3.8])	−25.8 −26.7	344 ± 20 277 ± 18 307 ± 14	**1495–1640 (95.4 %)** 1526–1544 (3.6 %); 1628–1671 (85.9 %); 1782–1797 (5.9 %) Fails the R_combine; wood older than fibres	***1495–1639 (95.4 %)*** *1526–1545 (5.7 %)* ***1630–1668 (89.8 %)***
BM3	Ceremonial axe British Museum, Am.1949,22.178[1949]	OxA-43483 resin	−29.6	313 ± 17	**1510–1585 (57.7 %)** 1621–1653 (37.8 %)	***1511–1586 (65.5 %)*** *1621–1649 (29.9 %)*
PRM1	Trumpet Pitt Rivers Museum, 2000.43.1 [1886]	OxA-V-3174–35 resin	−27.9	292 ± 18	1517–1572 (24.8 %) **1625–1667 (70.6 %)**	*1518–1572 (30.3 %)* ***1625–1663 (65.1 %)***
REM3	Snuff tube Reiss-Engelhorn-Museen, V Am 1894 [1882]	MAMS-62717 resin	−29.5	262 ± 16	**1636–1674 (78.7 %)** 1745–1751 (1.0 %) 1780–1799 (15.7 %)	***1640–1668 (95.4 %)***
MQB2	Vessel Musée du Quai Branly, 71.1930.54.1785D [1833]	SacA-73455 wood	−28.7	255 ± 30	1525–1550 (3.3 %) **1628–1686 (47.2 %)** **1731–1806 (45 %)**	*1517–1574 (9.3 %)* ***1625–1684 (86.2 %)***

(*continued on next page*)

Table 1 (*continued*)

Ref code	Object, Collection, Acc. No. [earliest doc. date]	Lab no. Dated material	$\delta^{13}C$	^{14}C BP	Calibrated date AD (95.4 % confidence)	*Calibrated modelled date AD (95.4 % confidence)*
MFK2	Staff/sceptre Museum Fünf Kontinente, Erl-35 [1857]	OxA-X-3373–32 resin	−28.0	220 ± 18	1656–1685 (20.4 %); **1731–1805 (75.1 %)**	***1646–1687 (94 %)*** *1740–1751 (1.5 %)*
					18 radiocarbon dates (excl. combined)	

the resins – which would have eventually dislodged of their own accord, even in ideal museum conditions – were exploited. In all cases, only a small amount of resin was sampled, leaving most of the material intact and *in-situ*. Resin ^{14}C samples were taken from 10 of the 14 artefacts discussed here [BM1-3; MFK2; NMD1-2; NMWC1, PRM1, REM2-3].

While there are many benefits to targeting resins for dating, there is also the possibility that non-wood components (e.g., inlays, pigments, cordage, featherwork) on older artefacts were renewed during the course of their use-lives, and so the date would underestimate its original manufacture age. Of course, this would be informative on the use-life of the artefact if paired with a wood date (cf. Ostapkowicz et al. 2012, 2013), but this was only possible on one piece in this study [MFK1; wood and vegetable fibre]. In another instance [NMWC1], both resin and a small sample of plant binding used to secure the two halves of the trumpet were dated, showing almost identical results, most likely coeval with the manufacture of the trumpet. Nevertheless, all non-wood dates reported here should be considered as *termini ante quem,* the latest possible dates for each carving. There is also the possibility that, given the long histories of some of these pieces in museums, interventions may have included conservation treatments or "enhancements" for the display of the artefacts, to make them look complete. Indeed, such was the case with the bifurcated snuff tube [REM3] (Fig. 5c): Zerries (1965:190; Abb.4) clearly noted both eye inlays missing in 1965, so the inlays now present in the piece must have been added at some point in the last few decades. In this case, the resins from the base of the carving, deemed original to the piece, were sampled. Four wood samples were



Fig. 4. Ceremonial staff/sceptres, axe, and bow finial, not to scale. **a.** two views of a bow finial fragment [MFK1], "Brazil," "Guyana," calAD 1495–1640 (95.4 %; on wood), calAD 1526–1797 (95.4 %; on cotton), full length: 45.7 cm, height of figural carving only: 4.7 cm; *Swartzia* cf. *recurva*, vegetable fibres, resin; © Museum Fünf Kontinente, Munich, I-102. **b.** Two views of ceremonial staff, or sceptre [MFK2] with a finial depicting a raptorial bird over a feline, "Brazil," calAD 1656–1805 (95.4 %, of which the greatest likelihood at 75.1 % is calAD 1731–1805); full length: 112 cm, W: 6.7 cm; height of figural carving only: 15.4 cm; wood, resin, pigments, © Museum Fünf Kontinente, Munich, Erl-35. **c.** Ceremonial staff/sceptre with feline finial [MQB1], "Pachacamac, Peru," calAD 1437–1625 (95.4 %; of which the greatest likelihood at 70.4 % is calAD 1437–1515); full length: 132 cm, W: 5.3 cm; height of figural carving only: 11.9 cm; wood, pigments, resin, shell inlay, Musée du Quai Branly, 71.1878.5.36. **d.** Two views of ceremonial axe [BM3], "Brazil," calAD 1510–1653 (95.4 %; of which the greatest likelihood at 57.7 % is calAD 1510–1585); full length: 79 cm; W: 4 cm; D: 11.5 cm; *Brosimum* cf. *rubescens*, *Mauritia flexuosa*, human hair, shell, resin, stone, British Museum, Am 1949.22.178. Photos: Ostapkowicz, courtesy institutions listed.



Fig. 5. Snuff tubes and finial, roughly to scale, three views (on the vertical) of each. **a.** Snuff tube (?) in the form of a raptorial bird over a feline [BM1], "Brazil," calAD 1291–1395 (95.4 %); H: 7.5 cm; W: 5.6 cm; D: 7.9 cm; wood, resin, pigments, shell inlay; British Museum, Am.4103. **b.** Finial (or composite snuff tube?) featuring raptorial bird over feline [REM2], "Northern Brazil," calAD 1465–1624 (95.4 %, of which the greatest likelihood at 60.3 % is calAD 1581–1624); H: 11.1 cm; W: 6.5 cm; D: 8.2 cm; *Brosimum* cf. *guianense*, pigments, resin, shell inlay; Reiss-Engelhorn-Museen, Mannheim, V Am 1987. **c.** Bifurcated snuff tube in the form of a bird [REM3], "Northern Brazil," calAD 1636–1799 (95.4 %, of which the greatest likelihood at 78.7 % is calAD 1636–1674); H: 10 cm; W: 3.8 cm; D: 7 cm; *Swartzia* cf. *laxiflora*, pigments, resin, shell inlay (recent intervention); Reiss-Engelhorn-Museen, Mannheim, V Am 1894. Photos: Ostapkowicz, courtesy institutions listed.

taken for dating [MFK1; MQB1-2; REM1], as the originally proposed target area of resin in the sceptre [MQB1] was considered too invasive, while the other pieces [MFK1, MQB2, REM1] had no accessible resin. For these, sampling focused on already damaged surfaces or to the undersides of the artefacts in order to minimise visual impact. Wherever possible, the outermost wood growth rings present in the carving were targeted, an approach successfully developed for previous projects focusing on dating ancient Caribbean wood sculptures (e.g., Ostapkowicz et al. 2012; 2013). Given the small size of some of the carvings, sampling was kept to an absolute minimum, with the radiocarbon samples ranging from ~ 7 mg to 66 mg (mainly reflecting resin and wood, respectively). Most sampling was undertaken by in-house conservation colleagues, ensuring institutional oversight of the process and alignment with their respective conservation standards/policies.

Comparable protocols were used by the three radiocarbon labs involved in the project (see SI2.1–2.3 for details); the calibration and modelling of the radiocarbon dates is provided in SI2.4. Wood identifications of specimens were performed as detailed in SI3 (see also

Table 2
Wood identifications.

Wood ID	Code	Figure	Artefact (Code/Coll/Acc. no/description)
Hymenaea cf. *parvifolia* (jatobá, jatai)	NMD1	9a. a	• Gc.18 side-blown trumpet
Platymiscium sp. (jacarandá do brejo, macacaúba)	NMWC1	9a. e	• Rv-360–8157 side-blown trumpet
Brosimum cf. *guianense* (snakewood, letterwood, leopardwood)	REM2	9a. c	• V Am 1987 finial
Brosimum cf. *rubescens* (bloodwood, cacique)	BM3	9a. j	• Am.1949,22.178 ceremonial axe
	MQB2	9a. h	• 71.1930.54.1785D vessel
	PRM1	9a. g	• 2000.43.1 side-blown trumpet
Swartzia cf. *panacoco* (pirquichy, anacoco)	NMD2	9b. a	• Ia.4 rattle
Swartzia cf. *recurva* (wamara)	MFK1	9b. c	• I-102 bow
Swartzia cf. *laxiflora* (goncalare, pau roxo)	BM2	9b. e	• Am.7204 double-headed vessel
	REM1	9b. f	• V Am 1988 jaguar vessel
	REM3	9b. g	• V Am 1894 bifurcated snuff tube

Table 3
Strontium isotope results on wood samples, from highest to lowest values.

Code	Artefact (Coll/Acc. no/description)	$^{87}Sr/^{86}Sr$ (pre-treated)	Geographical assignment (SI4.1)
REM1	V Am 1988 jaguar vessel	0.736163	Figure SI4.2
REM2	V Am 1987 finial	0.735946	Figure SI4.3
REM3	V Am 1894 bifurcated snuff tube	0.734326	Figure SI4.4
NMD1	Gc.18 side-blown trumpet	0.721727	Figure SI4.5
MQB2	71.1930.54.1785D double-headed vessel	0.718130	Figure SI4.6
NMD2	Ia.4 rattle	0.716831	Figure SI4.7
PRM1	2000.43.1 Side blown trumpet	0.713971	Figure SI4.8
MFK1	I-102 bow finial	0.712833	Figure SI4.9

Ostapkowicz et al. 2018). The strontium isotope methodology is outlined in SI4, and those for the isoscapes in SI4.1. The analyses undertaken on the pigment samples are provided in SI5.

4. Results

4.1. Radiocarbon results

The 18 radiocarbon dates obtained on 14 objects were calibrated in OxCal v.4.4.4 (Bronk Ramsey 2009, 2025) using a mixed curve (Bronk Ramsey and Lee 2013) for the northern (IntCal20; Reimer et al. 2020) and southern (SHCal20; Hogg et al. 2020) hemispheres, as recommended by Marsh et al. (2018) for equatorial regions (see SI4). They are reported at 95.4 % confidence unless otherwise noted (Table 1). Most calibrated dates exhibit a bimodal distribution with two distinct time ranges. This is due to the shape of the calibration curve during the period covered. *A priori*, it is not possible to determine the true age of the sample within this range, though Bayesian modelling excludes the earlier and later parts of these bimodal distributions for the earliest and two latest dates, respectively (SI2.4).

The results range from calAD 1291–1395 (95.4 %; BM1 unmodelled) to calAD 1517–1667 (95.4 %; PRM1 unmodelled), with the exception of four distributions that extend into the 18th century [REM3, MQB2, MFK1-2]. However, these are of lower probability, and their distributions end before 1700 when Bayesian modelled (Table SI2.2, Fig. 6).

The earliest date obtained is calAD 1291–1395 [BM1] (Fig. 5a, Fig. 6) for the central, figural component of a composite snuff tube (cf. Zerries 1965:185), featuring the characteristic comma-shaped eyes and volute joints of the Trombetas style. A substantially later date of calAD 1465–1629 was obtained on another composite carving [REM2] (Fig. 5b), possibly a finial or snuff tube (cf. "device for snuffing", Zerries 1965:185), also featuring a compact depiction of a feline/raptorial bird combination and comma-shaped eyes. Both dates are on resin and so are not subject to any in-built age, though there is the possibility that the objects were refurbished during the course of their use lives. In any case, this gives us a clear indication of the last period of use and suggests that these small carvings, featuring the same iconography and carved in the same style, and likely used in the same way, potentially spanned at least some three centuries, ca. AD 1300–1630.

The dates for the two figural vessels [BM2, REM1] (Fig. 1) are very similar with bimodal probabilities between calAD 1457–1625. The third vessel in this form [MQB2] dates somewhat later, to calAD 1525–1806 (greatest probability falling at 1628–1806; 92.2 %, though the late part of this range is excluded when Bayesian modelled); this more recent vessel is much more substantial in size, and somewhat simpler in features and carving. However, the style and iconography of the three are very similar, all featuring a single or double-headed feline, their backs seemingly bent under the weight of the centrally positioned bowl. The two earlier vessels feature bands of engraved scrollwork, emphasised in the Reiss-Engelhorn Museen [REM1] example with the infill of yellow pigment against the dark surface of the wood, and both feature comma-shaped eyes, whereas the later vessel [MQB2] features circular eyes.

Some of the carvings discussed above feature the shell-inlaid comma-shaped eyes identified by Gerbrands as stylistically diagnostic, with five [BM2-3, NMD2, REM1-2] falling within the period ca. calAD 1450–1630. All the distributions are bimodal as a result of the shape of the calibration curve here, with a slightly greater weighting towards the earlier part of their range. This weighting increases when this group of carvings is Bayesian modelled (Fig. 7), but not sufficiently so to discount the possibility that they do fall within the later part of the range extending into the early 17th century. The sixth carving [BM1] (on resin) is a significantly earlier outlier dating to the 14th century. This stylistic group includes two vessels, two possible composite snuff tubes, one rattle fragment and one ceremonial axe. It should be noted that some of these carvings, when featuring plural beings, distinguish the two by featuring one with comma-shaped eyes, one with circular eyes [BM1, NMD2, REM2]. This suggests that the two eye forms were partly contemporary, while circular eyes also occur in later examples, suggesting that this eye form had a longer chronological span [MQB2, PRM1, REM3, see below].

The results on the side-blown trumpets have a broadly comparable temporal range. The earliest [NMD1], depicting a female jaguar, dates to calAD 1393–1421 (two combined resin dates at 87.5 %, unchanged when Bayesian modelled – Table 1). There was sufficient sample to run two dates on the resin, one undergoing pre-treatment, the other processed without treatment: both dates align (see SI2.3 for discussion), indicating little difference between the approaches. The NMWC1 trumpet falls approximately a century later based on two almost identical dates (Table 1), one on resin and the other on plant-based cordage used to secure the two pieces of the trumpet. They can be combined (using the R_combine function in OxCal v4.4; χ^2, df = 1, T = 0.5 [5 %, 3.8]) to 388 ± 13 BP, which gives two possibilities: calAD 1458–1509 (63.1 %) or calAD 1590–1620 (32.3 %). This suggests that the two trumpets were not manufactured at the same time, which is consistent with the selection of different woods used to carve them. This is interesting in the light of the fact that Zerries (1977:82-83) considered the Copenhagen [NMD1] and Leiden [NMWC1] trumpets a pair – one featuring a female jaguar, the other a male (Fig. 8). Zerries (1977:83) also considered the PRM1 trumpet as the youngest in the group, and indeed, its date of calAD 1517–1667 supports this. We can therefore shift Zerries' (1977:82-83) initial estimate of calAD 1600–1800 (based

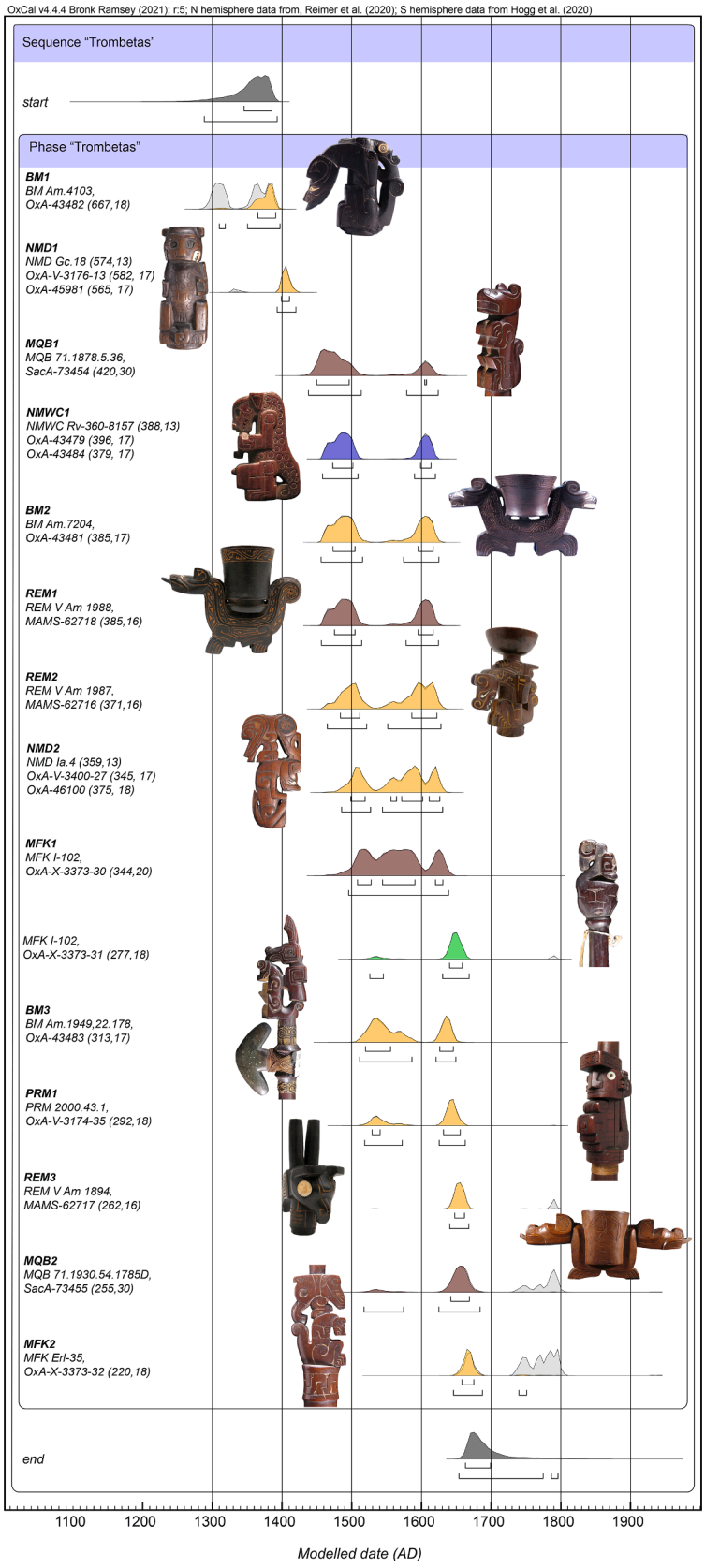


Fig. 6. Graph showing the modelled radiocarbon results on the 14 wood carvings analysed as part of jagWARS, colour coded to indicate material sampled – amber: resins; dark brown: wood; green: plant material (including cotton), blue: combined date on resin and veg fibres (NMWC1).

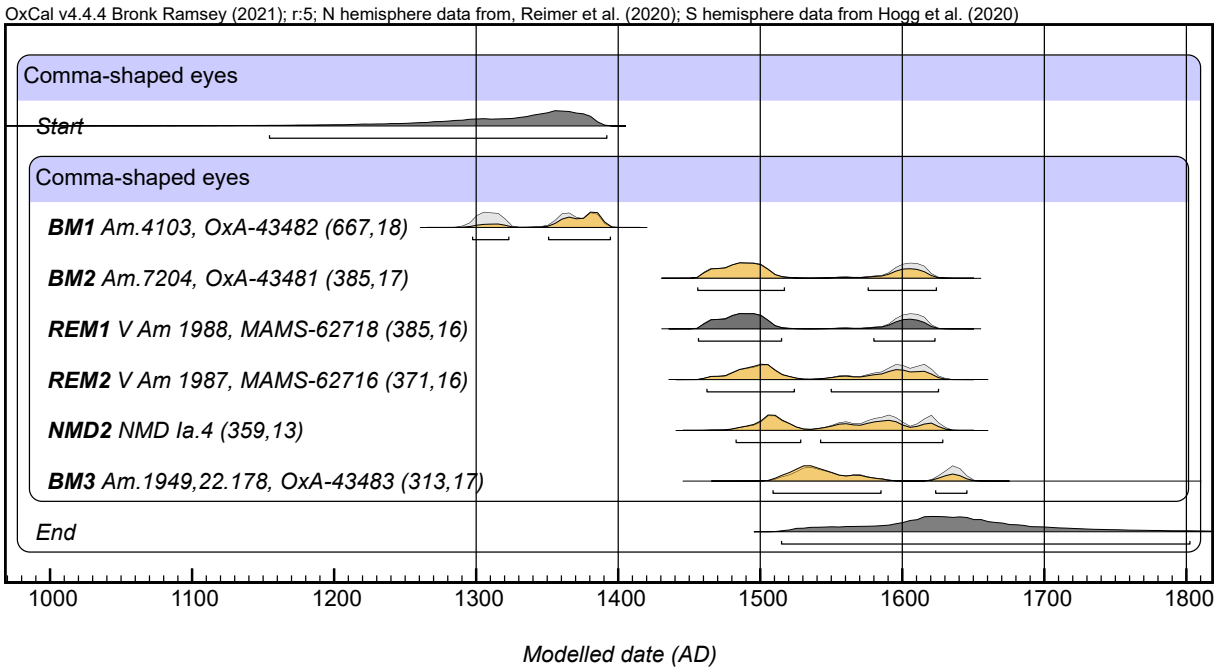


Fig. 7. Bayesian modelling (single phase with uniform boundaries) of six carvings featuring the diagnostic "comma-shaped" eyes. Dates on resin (amber) and wood (brown).

on accession histories) back to ca. AD 1300–1650.

The two staffs/sceptres [MQB1 and MFK2] do not overlap chronologically: MQB1 (Fig. 4c) is earlier, at calAD 1437–1625 (greatest probability at calAD 1437–1515, 70.4 %), while MFK2 (Fig. 4b) is later, at calAD 1656–1805 (greatest probability at calAD 1731–1805, 75.1 %). With the caveat that the results on MQB1 are on wood and therefore have the potential of being skewed slightly older, this would suggest that this category of artefact was in use from the 15th to 18th centuries.

The bow finial [MFK1] (Fig. 4a) has two dates, the result on wood falling slightly earlier (calAD 1495–1640) than that on the fibre cordage (calAD 1526–1797); they cannot be combined in OxCal. There are three possible interpretations for this discrepancy: 1) the bow had some years of use and the cord wrapping was replaced, which is a reasonable assumption for objects in frequent use; 2) the wood may have had a couple of decades of in-built age when it was carved and bound with the cordage; 3) the cordage had some historic conservation treatment to secure the binding (the surface appearance appears quite waxy), which may have skewed the date younger. As this is the only example with paired dates on wood and short-lived materials, it is difficult to determine whether it may be part of a wider pattern of refurbishment over time, though given their long histories of use, this would not be unexpected.

The ceremonial axe [BM3] (Fig. 4d), featuring a raptorial bird (possibly a harpy eagle, *Harpia harpyja*) surmounting a jaguar, dates to calAD 1510–1653, while the bifurcated snuff tube [REM3] (Fig. 5c) dates to calAD 1636–1799 (greatest probability calAD 1636–1674, 78.7 %). The latter has two nostril tubes emerging from its body, aligning it clearly with the paricá snuff tubes documented in later centuries, which typically were set with two harpy eagle bones or quills (e.g., Augustat 2012:130). Most of these later examples feature circular eyes.

4.2. Wood identification

Wood identification samples were taken from 11 of the 14 pieces in the analytical study (Table 2); BM1, MQB1 and MFK2 did not have any areas of damage that could be discreetly sampled. The results indicate a comparatively frequent use of *Brosimum* sp. (four carvings) and *Swartzia* sp. (five carvings) to less common *Hymenaea* cf. *parvifolia* and *Platymiscium* sp., each represented by a single carving.

Of the four carvings identified to the genus Brosimum, one piece was carved from *Brosimum* cf. *guianense* [REM2] (Fig. 9a. c) and three from *Brosimum* cf. *rubescens* [BM3, PRM1, MQB2] (Fig. 9a. j; 9a. g; 9a. h, respectively). *Brosimum* cf. *guianense* grows extensively within the wet tropical Americas, including northeastern South America – Brazil, Colombia, Venezuela and the Guianas. It is commonly known as "snakewood" or "leopardwood" due to its distinctive patterning, appearing as darker brown or black patches against a typically deep reddish brown of the wood. When freshly cut, the wood appears blood-red and patterning is quite intense, darkening with age and exposure. It is a very dense wood and is similar in some respects to *Guaiacum* sp., among the heaviest of woods, and the choice for ceremonial carvings in the insular pre-Columbian Caribbean, for example (Ostapkowicz et al. 2012). It has a straight grain and fine texture, with a high lustre. However, it is quite brittle and very difficult to work even today with metal tools, and no doubt was particularly challenging in the past with a stone and osseous toolkit (Comvalius 2001:116-117). But there were clear preferences for this wood in the construction of carvings for both ritual and war: in the wider project, a number of double-handed clubs have been identified as carved from *B. guianense* (e.g., see also Ostapkowicz et al. 2018; 2023). *Brosimum* cf. *rubescens*, also known as "bloodwood" or "bloodwood cacique" has similar properties to those outlined above for *B. guianense* – hard, durable, resistant to decay and difficult to work.

The rattle [NMD2] (Fig. 9b. a) is carved from *Swartzia* cf. *panacoco* and the bow finial [MFK1] (Fig. 9b. c) is carved from *Swartzia* cf. *recurva*. The *Swartzia* genus is widespread in the Amazon basin and Guiana Shield (Torke and Mansano 2009:922; Record and Hess 1943:328). The heartwood is typically dark brown, reddish-brown or nearly black, clearly distinct from its yellow to white sapwood. It is highly resistant to decay and again is a very dense, difficult to work wood (Record and Hess 1943:329). Other carvings in the wider jagWARS project, all clubs, have returned a *Swartzia* sp. identifications which will be explored in a separate publication (for comparative example, see also Ostapkowicz et al. 2023).

Two trumpets [NMD1; NMWC1] (Fig. 9a. a; 9a. e, respectively) are carved from woods thus-far unique in the wider project corpus:



Fig. 8. Jaguar carvings depicted on side-blown trumpets. Note the presence of circular designs on the pelt, suggestive of the spot patterns of the jaguar. **a.** three views of female jaguar carving [NMD1]; figure only: H: 11.3 cm; W: 4.7 cm, National Museum of Denmark, Copenhagen, Gc.18. **b.** three views of male jaguar carving [NMWC1]; figure only: H: 12.4 cm; W: 8.2 cm, National Museum of World Cultures, Leiden, RV-360–815. Photos: Ostapkowicz, courtesy institutions listed.



Fig. 9a. Transmitted light micrographs of wood. Scale bar in **a.** represents 200 μm and applies to all images. Photos: A. C. Wiedenhoeft. **a.** Tangential section of NMD1 showing a large ray (arrow) and intervessel pits. **b.** Tangential section of *Hymenaea parvifolia* SJRw 45798, showing a large ray (arrow) and intervessel pits. **c.** Radial section of REM2, showing sclerotic tyloses (arrow) and thick-walled fibres. **d.** Radial section of *Brosimum guianense* SJRw 4947 showing sclerotic tyloses (arrow), thick-walled fibres, and upright ray cells with crystals. **e.** Tangential section of NMWC1 showing storied uni- to biseriate rays. **f.** Tangential section of *Platymsicium yucatanensis* MADw 25,272 showing storied uni- to biseriate rays. **g.** Tangential section of PRM1 showing a latificer (arrow) in a ray. Note an another latificer in the partly excluded ray on the lower right. **h.** Tangential section of MQB2 showing latificer (arrow) in a ray; there is another latificer in the same ray, and two more visible in other rays. **i.** Tangential section of *Brosimum rubescens* SJRw 31,723 showing laticifers in rays (two of which are indicated with arrows). Three additional laticifers are visible in the image. **j.** Radial section of BM3 showing sclerotic tyloses (arrow) and thick-walled fibres. **k.** Radial section of *Brosimum rubescens* MADw 11,453 showing sclerotic tyloses (arrow) and thick-walled fibres. Photos: Wiedenhoeft.

Hymenaea cf. *parvifolia* and *Platymiscium* sp. *H.* cf. *parvifolia,* is an evergreen tree, the wood of which is today used for carving and the gum used medicinally in South America (Boniface et al. 2017). Its use stretches back millennia in the Amazon region (e.g., charred *Hymenaea* cf. *parvifolia* seed/fruits have been recovered from the site of Caverna da Pedra, Pintada, Brazil, dating to 12,000–10,000 BP; Shock 2019: Tab. 9.1). The tree grows to a height of 20–25 m; its heartwood varies from purple-, orange- to red-brown, in sharp contrast to the lighter sapwood. The wood is very hard and heavy and resistant to decay even when in contact with the soil. Again, it is difficult to work and blunts metal tools. More has been published on the use of its sister species – *H. courbaril* L. – than *H.* cf. *parvifolia,* though their properties are largely similar (Record and Hess 1943:281). *H. courbaril* L. is used extensively in the region, particularly medicinally. Resins exuding from the bark are used for a variety of ailments as well as for treating fresh wounds (DeFilipps, Maina and Crepin 2004:70; Timyan 1996:215) while the hard lumps of gum resin found buried at the base of the tree are considered the best for incense and for coating ceramics. Trunk diameter of *H. courbaril* L. can

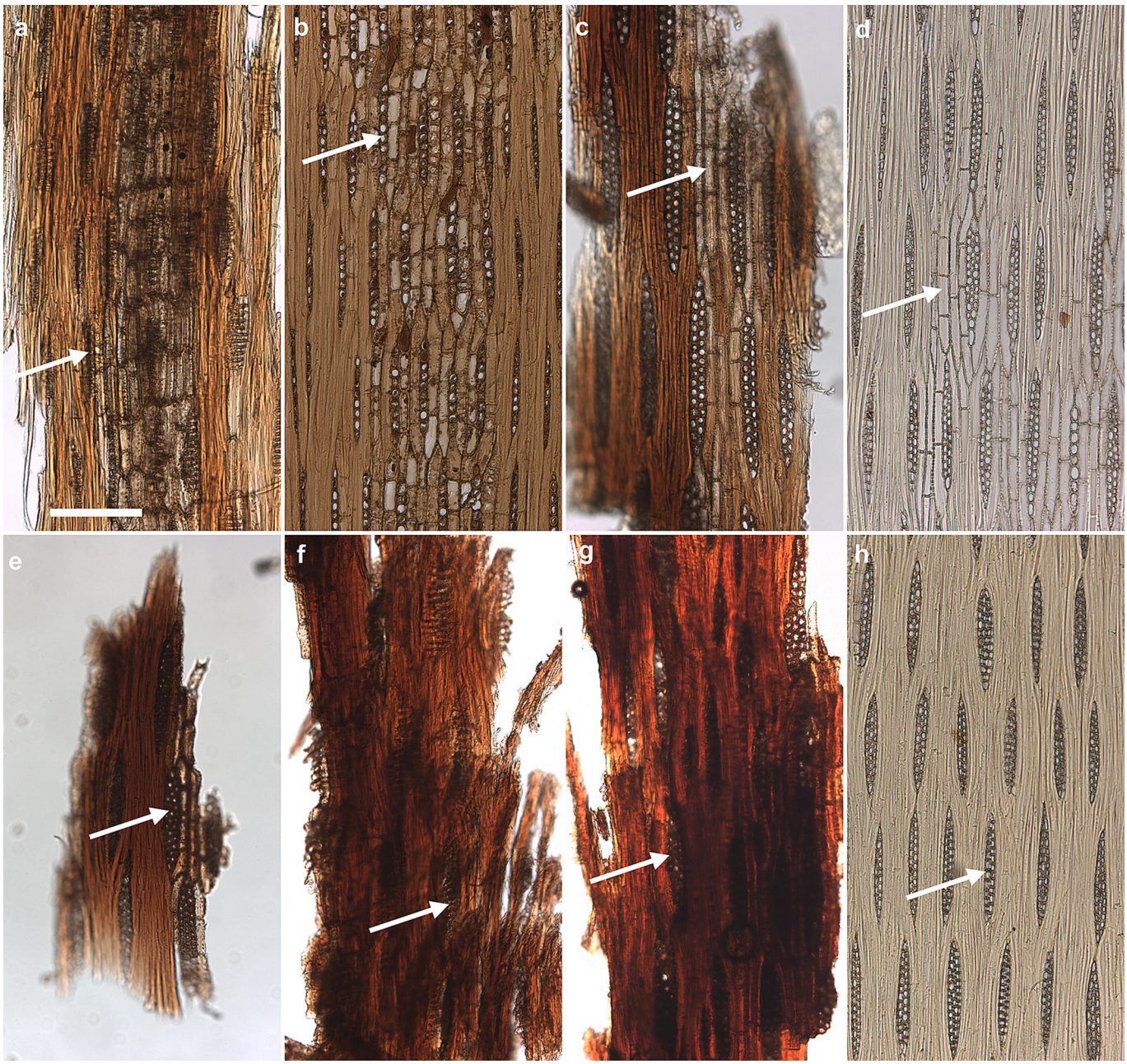


Fig. 9b. Transmitted light micrographs of tangential sections of wood. Some specimens were of a size and geometry that precluded "perfect" sections. Scale bar in **a.** represents 200 μm and applies to all images. **a.** NMD2 showing uniseriate, comparatively short, storied rays (arrow), slightly out-of-pure-tangential orientation. **b.** *Swartzia panacoco* SJRw 12,749 showing short, uniseriate storied rays (arrow). **c.** MFK1 showing biseriate storied rays and four-celled axial parenchyma strands (arrow). **d.** *Swartzia recurva* MADw 12,590 showing biseriate storied rays and four-celled axial parenchyma strands (arrow). **e.** Small section of BM2 showing storied bi-to-triseriate storied rays (arrow) and thick-walled fibres. **f.** Slightly-out-of-plane section of REM1 showing bi-to-triseriate storied rays (arrow) and thick-walled fibres. **g.** REM3 showing bi-to-triseriate storied rays (arrow) and thick-walled fibres. **h.** *Swartzia laxiflora* MADw 31,320 showing bi-to-triseriate storied rays (arrow) and thick-walled fibres. Photos: Wiedenhoeft.

reach more than 1.8 m, and the wood is heavy and very hard with an interlocking grain, which is not easily worked, but finishes smoothly (Record and Hess 1943:282): "it is very strong, tough, durable, very resistant" (Little and Wadsworth 1964:178; see Timyan 1996:195; Record and Hess 1943:281). Its bark has been made into canoes by several Indigenous Amazonian groups (e.g., Nimuendajú 1948a:288; 1948b:315).

There are ca. 30 closely related species of *Platymiscium* sp., with *P. pinnatum* perhaps the best known, its distribution spanning northern South America and Trinidad. It is a dense, heavy, reddish wood with attractive markings (Record and Hess 1943:311). The two principal Brazilian species are *Platymiscium ulei* and *P. triniatis*, which grow to large size (up to 24 m and up to 1 m in diameter) and are known locally as macacaúba (Record and Hess 1943:311). *P. ulei* is a moderately hard, but easily worked, wood, while that of *P. triniatis* is considerably heavier and darker. Colour ranges from red with occasional purple striations to brick red with black markings (Record and Hess 1943:311).

4.3. Pigments, resins, fibres, hair

Nine samples of surface materials (pigments, fibres) were extracted from seven objects [BM2, BM3, MFK1, NMWC1, REM1-3] in efforts to



Fig. 10. Hair and vegetable binding on shaft of ceremonial axe [BM3], directly above and below the anchor axe **a.** Detailed views of relevant stylistic features and various materials brought together in the creation of the ceremonial axe, including stone, vegetable fibre, shell, wood and resin. Dotted lines indicate feature on the reverse side. **b.** Variable pressure scanning electron microscope (VP SEM) image of one of many strands of human hair within the ornamental binding of the ceremonial axe. **c.** a longitudinal section of one of the *Mauritia flexuosa* fibres. Images: **a.** Ostapkowicz; **b-c.** C.R. Cartwright; © The Trustees of the British Museum, Am1949,22.178.

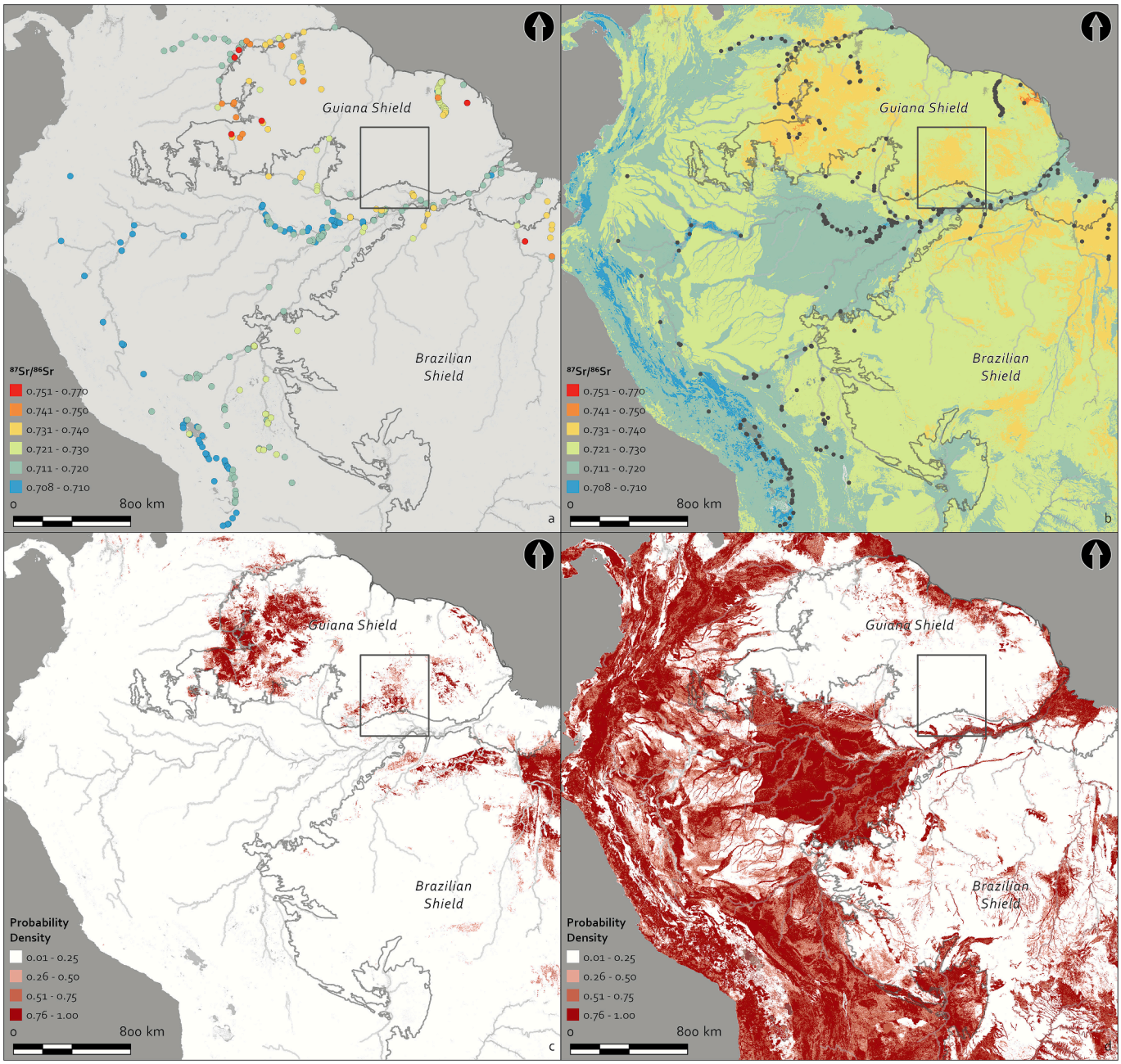


Fig. 11. Strontium baseline for the Amazon and Orinoco watersheds and geographic assignments for carvings from the Trombetas region: a) measured $^{87}Sr/^{86}Sr$ ratios from modern plants, water samples and teeth from small mammals; b) predicted $^{87}Sr/^{86}Sr$ ratios (Out of Bag Errors 100 trees, Mean Squared Error 0.000, % variation explained 70.935%); c) maximum posterior probability densities for carvings REM1, REM2 and REM3; d) maximum posterior probability densities for carvings NMD1, MQB2, NMD2, MFK1 and PRM1. See SI4.1 for further details. Map: John Pouncett.

identify the materials used in their decoration. Among the most intriguing results of this study is the first identification of human hair woven into the ornamental binding of a ceremonial axe [BM3] (Fig. 10; for detailed discussion see SI3.2); numerous strands of hair are interwoven with *Mauritia flexuosa* fibres to either side of the hafted anchor axe, creating a vibrant plaited pattern with the tan fibres on the vertical, the black hair on the horizontal. While beyond the scope of the current project, a DNA study of the hair may be considered in future.

SEM-EDS analysis of the pigments from REM1-3 identified them as predominantly composed of silicon dioxide (silica) with traces of iron (Figures SI5.1–3) and, in some cases, carbon. Silicon dioxide is widespread, most commonly as quartz and sand, but also exists in hydrated, amorphous form as opal (there are significant opal deposits in eastern Brazil). The pigment samples for all three objects had surface coatings dominated by iron and oxygen with low levels of carbon, aluminium and silicon. Iron oxide exists in several forms with different colours, including red, yellow, brown and black.

The pigment on BM2 (Figure SI5.4) was chemically distinct from that on REM1-3, containing aluminium, carbon, iron, oxygen and silicon, most likely reflecting one or more clay mineral(s). SEM-EDS analysis confirmed that the material from NMWC1 (Figure SI5.5) was carbon-based, assumed to be resin. Small amounts of surface material on the resin containing predominantly aluminium, silicon and oxygen, as well as trace levels of potassium, sulphur and other elements may indicate the presence of clay minerals, although chemically distinct to the pigment on BM2. However, due to the low quantities observed it cannot

be ruled out that this may be contamination and not part of the original object.

4.4. Strontium isotope ($^{87}Sr/^{86}Sr$) analysis

Strontium isotope analysis was undertaken on eight objects (Table 3) with the results ranging from 0.7128 to 0.7362. Five carvings have lower $^{87}Sr/^{86}Sr$ values ranging from 0.7128 to 0.7217, while the other three – all from the collections of the REM – have markedly more radiogenic values between 0.7340 and 0.7360. Published $^{87}Sr/^{86}Sr$ values for modern plants, water samples and teeth from small mammals were used to generate a strontium baseline for the Amazon and Orinoco that was in turn used to determine the possible geographic origins of two groups of objects with higher and lower values (Fig. 11, SI4.1).

5. Discussion

5.1. Chronology, historic context and provenience

While the study sample is limited to only 14 carvings, and represents a potentially biased corpus that preferences more durable woods, it nonetheless provides a firmer foundation upon which to explore this unique carving style and assess its chronological range and possible provenience. The unmodelled radiocarbon dates suggest a range for the Trombetas carvings from ca. AD 1300 to 1800. Bayesian modelling further constrains this to ca. AD 1350 to 1700 for the individual objects. The modelled start and end dates for Trombetas wood carvings are AD *1290–1395* to *1655–1795* (95.4 %), or AD *1345–1385* to *1665–1700* (68.3 % probability), considering the possibility of additional examples not represented here (e.g., Augustat 2012:130; Zerries 1981:340, 341). Because the modelled start and end date ranges include long tails, the 68.3 % probability range may be more indicative. It is perhaps surprising that no Trombetas carvings can be more convincingly placed in the 18th and early 19th centuries. Given the colonial histories at this time – expanding Brazilian settler populations, vast regions under survey, increasing development, and an emerging antiquarian interest in collecting both contemporary and past Indigenous arts – this strongly implies that this style of carving was no longer being made.

Based on radiocarbon analysis and Bayesian modelling, the carvings under study range broadly in date from ca. AD 1350 to 1700, with a concentration ca. AD 1500–1650. This was a time of dense populations in the wider Trombetas region, with established polities at the core of far-reaching networks circulating elaborate ceramics (many with complex transformative animal-human iconography and plural beings) and highly valued green stone ornaments (*muiraquitãs*) (e.g., Alves 2016; Boomert 1987; Schaan 2016; Gomes 2023; Palmatary 1960). Some of the largest Indigenous archaeological sites in Amazonia dating to this time have been found in the area (Aldeia and Porto, Santarem; Alves 2018:172; Gomes 2001; Gomes et al. 2023). The period also coincided with increasing European exploration of northeastern South America and Brazil's coast. Forays into the region were initiated by the Spanish from 1500, and by the 1600s the Spanish, Portuguese, English, French and Dutch had had a century of extracting gold and other natural resources (brazilwood, tobacco) – as well as conducting slaving expeditions – with numerous attempted settlements (though many more failures than successes). There is a complex history of vying colonial interests in the region (e.g., Boucher 2007; Dodge 2018; Domingues 1992; Hemming 1978; Parry and Keith 1984; Whitehead 1993; 2012) and it is against this backdrop that most of the objects studied here were collected, and which likely explains their wide dispersal in European institutions. To give but one example of the desire for, and ultimately the wide dispersal of, Indigenous "curiosities" at this time of exploration: in Dutch Brazil (ca. 1630–1650) collecting ethnographic material was an integral part of the Colonial endeavour. These collections were not haphazard but formed part of a larger program of mapping and understanding these new territories (Françozo 2023). Johan Maurits van Nassau-Siegen, first governor of Brazil's "Nieuw Holland" colonies, acquired a substantial collection which returned with him to the Netherlands in 1643, some of which he utilised as diplomatic gifts to foreign dignitaries, including the King of Denmark, Frederik III, Friedrich Wilhelm I of Brandenburg, Germany, and Louis XIV of France (Spenlé 2011:8).

Strontium isotopes offer another way to investigate provenience, though the method is better at excluding possible locations than confirming them, since similar $^{87}Sr/^{86}Sr$ values are typically found across many different locations with the same geology. While the Amazon and Negro Rivers are reasonably well characterised in terms of their $^{87}Sr/^{86}Sr$ values (Mereles et al. 2025), the same cannot be said for their tributaries, with only one measurement from near the mouth of the Trombetas River (Figs. 11a, b). This greatly limits the power of the strontium isoscape to determine likely origins for the objects (or rather, the trees from which they were made). What is most noteworthy here is that the results clearly fall into two groups: one more radiogenic ($\bar{x} = 0.7253 \pm 0.0098$, $n = 3$) and the other less so ($\bar{x} = 0.7189 \pm 0.0025$, $n = 5$). At a continental scale, there are a relatively limited number of areas consistent with the higher values, which characterise rivers draining the more radiogenic Precambrian geology of the Guiana Shield to the north, and that of the Brazilian Shield to the south. Notably, the former includes the upper and middle reaches of the Trombetas watershed (Fig. 11c). The Amazon itself, flowing between the two Shields, has substantially lower values that could accommodate the second group of carvings (Fig. 11d). Interestingly, the carvings with the three highest values were all accessioned in the 19th century into the same collection [REM1-3], suggesting that they share a history, and likely originated from the same area. Their pigments also yield similar SEM-EDS results, and they overlap in date between 1450 and 1650, though REM3 does extend somewhat later. Finally, they show stylistic similarities that further support a shared origin.

Given the issue of equifinality (i.e., other geographical assignments are equally probable based on the $^{87}Sr/^{86}Sr$ values alone), an important consideration here is the iconographically comparable "stone idols" found along the middle and lower Trombetas and Lago Grade de Curuai (Fig. 2). Another way to approach the $^{87}Sr/^{86}Sr$ results is to consider whether they could be consistent with this location. While the high and low clusters of values differ significantly, they can both be found within a short distance of one another, where the rivers draining the more radiogenic Shields meet the Amazon, with its lower $^{87}Sr/^{86}Sr$ values (Allègre et al. 1996; Gaillardet et al. 1997; Mereles et al. 2025). Other sources are also possible: one of the stone carvings was reportedly found further up the Trombetas, close to the Guiana border (Palmatary 1960:88), where comparably high $^{87}Sr/^{86}Sr$ values occur (Négrel and Lachassagne 2000; Poszwa et al. 2009). However, the current evidence – archaeological, stylistic, historic – favours a Trombetas source for these carvings. Further refinement of the region's strontium isoscape is required to hone their assignments.

The issue of cultural provenience is complex, and space limitations prevent a fuller discussion here. There remain numerous questions regarding the movement of people and the influence of various cultures within the region, as well as the rich artistic heritage that may form the ancient foundations of this style (e.g., Pocó-Açutuba, ca. 1000 BC-AD 600; Neves et al. 2014). Any attempts to attribute the carvings to specific cultural entities is obfuscated by the sheer number of Indigenous cultures in this region during the style's artistic horizon (broadly, AD 1300–1700) and the complexities of – and gaps in – the archaeological and historical records at this time. The Trombetas carvings fall within a dynamic period that saw the rise of important polities (Konduri, Topajó) in an area that was core to what Alves (2019) calls the "Lower Amazon Interaction Sphere", which during its apogee ca. AD 1000–1600 connected diverse cultures, providing a fertile ground for the sharing of ceremonial practices and artistic styles (Gomes 2021; Schaan 2016). Which of the many cultures connected through this regional complex may have influenced the emergence of the Trombetas carving style

discussed here is difficult to define at this stage.

Among the "many nations" living along the river in the 17th century (Heriarte in Palmatary 1960:65) were the Konduri/Conduri who, with their transformational, multi-figural ("alter-ego") ceramic designs may have influenced the Trombetas style (Alves and Barretto 2025, pers. comm.). Supporting this is the recent discovery of Konduri ceramics in association with a stone "idol" (Alves and Prous 2016:184-5), an association that echoes previous accounts of such finds: Rodrigues (in Figueiredo 1982:46) notes that ca. 1850, some stone figures were recovered in association with "fragmentos de louça" (ceramics) and *muiraquitãs*. Dedicated studies of their artforms are only just emerging (e.g. Alves 2020; Gomes 2021). Other cultural groups include the Sateré-Mawé (Tupi speakers), some of whom occupied the south bank of the Amazon in the 17th century, opposite the Trombetas River (Nimuendajú 1948:245). Their dispersed descendants, and those of the Kaxuyana (Carib speakers), continued to use ornately carved ritual paraphernalia, including snuff trays and sceptres featuring paired figures, the latter well into the 20th century (Zerries 1981:341; Frikel 1961:7-8; Polykrates 2021). This region was a fluid cultural entrepôt. Based on archaeological, historical and ethnographic records, including information supplied by local Indigenous elders, Jácome and Waiwai (2020:11; Jácome 2017:209, trans. Ostapkowicz) suggest that "the vast region between the lower Amazon [where the Rio Negro joins the Amazon] and the Trombetas should not be thought of as closed and with precise boundaries. Nor can we conceive of a "pure" culture, be it Tapajonian, Konduri, Katxuyana or Wai Wai… Rather, it is a territory of transit for people, relationships, objects and powers (physical and spiritual)… in which knowledge, styles and powers circulated in all directions…".

It is not surprising, then, that in broad terms material culture was widely shared, though it could differ in detail. While ascribing rattle NMD2 to the Trombetas region, Zerries (1981:336) noted that rattle staffs were generally not used there; rather, these distinctive instruments were common among 20th century Desana (Tukano speakers living along the Vaupés River, within both Columbia and Brazil, some 1800 km distant to the east), though here they do not feature zoo/anthropomorphic carvings. Trumpets, which were so common in the region that the Trombetas was named the "River of Trumpets" (Heriarte in Palmatary 1960:65), were also found among many Indigenous peoples in the Amazon (Fausto 2020:73-122; Izikowitz 1935:2020–21; 245; see also Zerries 1981:336). That such linguistically diverse groups share similar material culture deepens the difficulties of identifying an "origin" and the dispersal of stylistic influences.

Compounding this already complex cultural landscape is the impact of increasing colonial demands on the local populations, which by the 17th century resulted in dramatic shifts in Indigenous economies and cultural practices, and often the movement of whole communities in efforts to escape European expansion; this, together with the "rearrangement of interethnic entities," caused massive disruption to once long-term settlements and still hinders our understanding of the identities of ethnic groups and their distributions (e.g., Castro 2018:208; Harris 2018:635). Provenience, therefore – whether regional or cultural – will here remain loosely ascribed to the Trombetas region, given that it is currently not possible to assign a more detailed attribution for such early ethnographic collections.

5.2. Curation

While most of the study pieces (apart from NMD1) first appear in museum collections in the 19th century (see Table SI1), the radiocarbon dates demonstrate a much deeper history spanning ca. calAD 1300–1700; this is when all the carvings in this style were crafted and used. The carvings thus reflect a long stylistic horizon that is more often documented for ceramics than for wood sculpture (though only because the latter do not typically survive in the archaeological record). A particular wood carving style can be in use for some time before it falls out of favour or transforms into something else.

There are several examples in the study corpus that suggest some centuries of use prior to collection and eventual deposit in museum collections. The earliest piece of this style to be documented in a European collection is the trumpet [NMD1] which first appears in the Bernhard Paludanus collection inventory of 1617; yet its radiocarbon date suggests that it was at least two centuries old by this time (calAD 1393–1421). An even earlier piece [BM1], a finial depicting a jaguar and bird, dates to calAD 1291–1395, suggesting a deep history of use prior to being collected and some five centuries prior to being accessioned into the British Museum in the 1860s. The preservation of these objects is a testament to the care that went into safeguarding them – both in Indigenous and, later, European hands – over the centuries.

Aside from the temporal currency of a specific style, it should not be surprising that objects that have a relevance to continuing traditions can and do last. They may be carefully curated for generations and brought out only on special occasions. For example, the Kágaba/Kogi (Venezuela) used 15th century masks in 20th century ceremonies (Oyuela-Caycedo and Fischer 2006:154). Among the Tukano, heirloom objects have well-documented histories, with the names of previous owners known and recounted (Hugh-Jones 2009:50). Munduruku belts, particularly those featuring human teeth, were transmitted intergenerationally (Fausto 2020:Tab. 1). The Kaxuyana are known to have curated legacy ritual paraphernalia, such as a ceremonial staff (*jiwaraua*) featuring two animals (a vulture and boa constrictor) and a snuff tray with a twinned jaguar handle, in use for at least three generations, some 80 years (Zerries 1960:617, Wassen 1967:279; 1965:32). Among the Sateré-Mawé, Nimuendajú (1948a:249) recounts a *porantin* (ceremonial "paddle," over 1 m in length and very similar in appearance to highly decorated clubs often attributed to the "Guianas" – see Ostapkowicz et al. 2018) that was "carefully preserved in the choir of the chapel" in the village of Terra Preta, and "made by the third predecessor of the present chief," placing it in the late 19th century.

5.3. Materials

From the overwhelming variety of woods to which Indigenous carvers had access, it is clear that specific choices were being made favouring woods of a deep reddish colour with strong, black striations – ones which perhaps mimicked the patterning of reptile skin and thus harkened back to myths, or channelled the agency of the tree and the animate forests from which it came (Rival 1998). Across much of South America, the colours red and black had, and continue to have, a deep resonance, being traditionally used in body painting, ceramics, and basketry. The wood of newly felled tree trunks in some species would be vibrantly red against their black outer bark, perhaps recalling blood seeping from a wound. In addition to the relevance of colour, highly durable woods may have been specifically selected to ensure that these spiritually charged objects, investments of artistic creativity and labour, lived long 'lives'. These choices of woods were not accidental – they were deliberate, in part based on the quality of the woods, but also connections to ritual and belief, now difficult to access. Europeans were quick to recognise the value of red woods for their own purposes: *pau-brasil* or brazilwood (*Caesalpinia echinata*) was one of the defining materials of Brazil's early Colonial period, becoming a major export to Europe, where it was used in the production of a valuable and highly prized red dye (Dodge 2018).

The hair bound around the haft of the ceremonial axe is an unprecedented finding on what was clearly an object of deep significance and meaning. If the hair derived from a respected member of the society, it may have imbued this anchor axe with ancestral force or, alternatively, it may have referenced a historic encounter with a powerful enemy, who was vanquished and "bound" to the weapon, either scenario reflecting on the connections, and ultimately the status, of its custodian(s). The interweaving of human hair into belts and various body ornaments (hairpieces and wrist, arm and leg bands) was a widespread practice across the Amazon (e.g., the Guarani Mbyá, and Bororo da Campanha of

southern Brazil, Métraux 1948:83; Feest 2012:87; the Aguano of Eastern Peru, Steward and Métraux 1948:587), where it is often the prerogative of certain community members (e.g., a Bororo hunter who kills a jaguar to avenge the death of a relative – Feest 2012:87). But, to our knowledge, this is the first investigated example of human hair being incorporated into the binding of a South American weapon. The ornately carved axe straddles the ambivalent categories of war and ceremonial weapon; it is also a status marker modelled on a weapon, or rather a weapon evolved into a status object. Although such hafted axes are generally not classified as "weapons" in more recent writings, anchor axes were documented as such in the 17th century ethnographic accounts (Cristiani et al. 2008:277); certainly, some of them functioned in this capacity, at least symbolically or ceremonially (see Rydén 1937).

6. Conclusions

Single, multiple or plural beings – including felines, raptors and other predators (humans, snakes) carved with joint volutes and incurling noses, ears and tails and occasionally featuring comma-shaped eyes – largely define the Trombetas carvings. The distinctive, shell inlaid comma-shaped eyes, which Gerbrands (1955:267-268) considered diagnostic, only occur in six of the 14 carvings studied here [BM1-3; NMD2, REM1-2], and their chronology spans ca. AD 1300–1630. The comma-shaped eye carvings may perhaps represent a sub-style of the broader multi-figural animal carvings, unique to a particular community within the regional complex or restricted to a specific period of production. The carvings that depict animals and humans with round eyes, while largely overlapping in time with those with comma-shaped eyes, have a longer span, likely extending into the 18th century. In this corpus, the last "spark" of this carving tradition – coinciding with strengthening European colonization efforts which resulted in the collapse of communities in their path – are seen in the snuffer [REM3], the sceptre [MFK2] and the largest, most simply carved of the vessels [MQB2], with their highest probability spanning date range ~ calAD 1630–1800 (unmodelled, AD *1630–1750* modelled). Whether we can trace echoes of this artistic form in the variations that have survived into 20th century – such as among the Kuxayuna – is one of many questions going forward.

Just as there appears to be (at least superficially) a limited repertoire of depicted "beings," so too were the woods selected to carve these figures restricted to only a handful of species – notably *Brosimum* spp. (four carvings), and *Swartzia* spp. (five carvings), and *Hymenaea* cf. *parvifolia* and *Platymiscium sp.*, the last two used for two trumpets previously considered a matched pair. These woods are very dense and difficult to carve, with colours and patterning evocative of powerful animals. There must have been reasons to consistently choose such difficult to work materials to carve small, intricate objects, perhaps linked with deeply held ontological beliefs concerning the mutable and interchangeable nature of animate beings (Viveiros de Castro 2002; Descola 2013). These rare survivors provide but a glimpse of the undoubtedly rich carving traditions of the region; other, less durable woods were also likely used for a variety of purposes, but the carvings studied here suggest that artists clearly selected challenging materials in the manufacture of select ritual and status objects.

In terms of refining the possible provenience of these wooden sculptures: the high $^{87}Sr/^{86}Sr$ values for the three carvings now held in Reiss-Engelhorn-Museen, Mannheim [REM1-3], are consistent with the upper reaches of the Trombetas River, while the remaining less radiogenic values are consistent with the Amazon floodplain. The stylistically similar "stone idols," predominantly recovered from the lower Trombetas region and featuring multiple figures, volute joints and round or comma-shaped eyes – much like the wood carvings – would lend further support, as do the multi-figure ceramic traditions of the area between AD 1000–1600 (Konduri and Tapajó, considered a regional complex). Given these converging lines of evidence, we consider these to be local artforms and hence have retained the designation "Trombetas style," as first suggested by Gerbrands (1955). This is but a starting point; future research will no doubt further refine our understanding of these carvings.

Lastly, this study underscores once again the value of revisiting legacy museum collections, and the utility of scientific analyses in enhancing information on carefully curated and historically significant cultural heritage.

Originality and approval

The work is original, unpublished and approved by all authors. The corresponding author handles the editorial process.

Data statement

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CRediT authorship contribution statement

Joanna Ostapkowicz: Writing – review & editing, Writing – original draft, Visualization, Validation, Resources, Project administration, Investigation, Funding acquisition, Conceptualization. **Alex C. Widenhoeft:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis. **Fiona Brock:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis. **Christophe Snoeck:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis. **Caroline Cartwright:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis. **Jeremy Uden:** Writing – review & editing, Resources. **Claudia Baittinger:** Writing – review & editing, Resources. **Mille Gabriel:** Writing – review & editing, Resources. **Julie Gordon:** Writing – review & editing, Resources. **Pascale Richardin:** Writing – review & editing, Resources. **Catherine Lavier:** Writing – review & editing, Resources. **Thibault Clauzel:** Writing – review & editing, Writing – original draft, Methodology, Investigation. **Ronny Friedrich:** Writing – review & editing, Writing – original draft, Methodology, Investigation. **Doris Döppes:** Writing – review & editing, Resources. **Martin E. Berger:** Writing – review & editing, Writing – original draft. **Marcony Lopes Alves:** Writing – review & editing, Writing – original draft. **John Pouncett:** Writing – original draft, Methodology, Investigation. **Rachel Wood:** Writing – original draft, Resources, Methodology, Investigation. **Rick J. Schulting:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

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Data availability

The research data/code is contained in the manuscript.

References

Allègre, C.J., Dupré, B., Négrel, P., Gaillardet, J., 1996. Sr Nd Pb isotope systematics in Amazon and Congo River systems: constraints about erosion processes. Chem. Geol. 131 (1), 93–112.

Alves, M.L., 2025. *No ritmo do rio: sazonalidade, mobilidade e cosmologia na Amazônia Antiga*. Museum of Archaeology and Ethnology. University of São Paulo. Unpublished PhD dissertation.

Alves, Marcony Lopes, 2020. Revistando os alter egos: figuras sobrepostas na iconografia Konduri e sua relação com o xamanismo, *Boletim do Museu Paraense Emílio Goeldi, Ciências Humanas* (15), https://doi.org/10.1590/2178-2547-BGOELDI-2019-0105.

Alves, Marcony Lopes, 2019. Objetos distribuídos do Baixo Amazonas: um estudo da cerâmica Konduri, MA thesis, Universidade de São Paulo, São Paulo, SP, Brasil.

Alves, M.L., 2018. Os vasos de gargalo na bacia do rio Trombetas. Boletim Do Museu Paraense Emílio Goeldi, Ciências Humanas 13 (1), 1–15. https://doi.org/10.1590/1981.81222018000100002.

Alves, Marcony and Cristiana Barreto, 2025. Shamanism, Transformation of the Body, and Predation in Ancient Amazonia, *Transforming Spirit Bodies: Materialization and Embodied Dependencies in South America*, edited by Sinah Theres Kloß, Lena Muders and Taynã Tagliati, Berlin, Boston: De Gruyter, 2025, pp. 151-176. https://doi.org/10.1515/9783111662251-008.

Alves, M., Prous, A., 2016. Esculturas líticas inéditas da Amazônia oriental: estatuetas de quadrúpedes e "ídolo" em forma de boto. Arquivos 25 (1–2), 172–193.

Augustat, Claudia, ed., 2012. Snuff tablets. In *Beyond Brazil: Johann Natterer and the Ethnographic Collections from the Austrian Expedition to Brazil (1817-1835),* Claudia Augustat, ed., p. 130, Museum für Völkerkunde, Vienna.

Barbosa Rodrigues, J., 1899. *O Muyrakytã e os idolos symbolicos: estudo da origem asiática da civilização do Amazonas nos tempos prehistoricos*. Imprensa Nacional, Rio Janeiro.

Boomert, A., 1987. Gifts of the Amazons: 'green stone' pendants and beads as items of ceremonial exchange in Amazonia and the Caribbean. Antropológica 67, 33–54.

Boucher, Philip, 2007. French proprietary colonies in the Greater Caribbean, 1620-1670s. In *Constructing Early Modern Empires*, Olivier Caporossi, ed., pp. 163-188, Brill, https://doi.org/10.1163/ej.9789004156760.i-425.20.

Bronk Ramsey, C., 2025. https://c14.arch.ox.ac.uk/oxcal/OxCal.html#.

Bronk Ramsey, C., 2009. Bayesian analysis of radiocarbon dates. Radiocarbon 51 (1), 337–360.

Bronk Ramsey, C., Lee, S., 2013. Recent and planned developments of the program OxCal. Radiocarbon 55 (2–3), 720–730.

Castro, Luis Paulo dos Santos de, 2018. Índios Conduri: Sob o Olhar de Viajantes e Missionários na Amazônia Colonial. Revista Temporis 18 (1), 196269–197216.

Comvalius, L.B., 2001. Surinamese timber species: Characteristics and utilization. Djinipi, N.V. https://edepot.wur.nl/378604.

Cristiani, E., Lemorini, C., Saviola, D., Domingues, S.A., Cesaro, S.N., 2008. Anchor axes: a case-study of wear traces analysis on ethno-archaeological stone tools from Brazil: an anthropological reflection on functional meaning. In: Longo, L., Skakun, N. (Eds.), Prehistoric Technology 40 Years Later. BAR Interntional Series 1783, Oxford, pp. 275–284.

DeFilipps, Robert A., Shirley L. Maina and Juliette Crepin, 2004. Medicinal plants of the Guianas (Guyana, Surinam, French Guiana), Medicinal Plants of the World Series, No. 7. https://naturalhistory.si.edu/sites/default/files/media/file/medicinalplants master1.pdf.

Descola, P., 2013. *Beyond Nature and Culture*. The University of Chicago Press, Chicago.

Dias, Jill R., ed., 1992. Brasil, Comissão Nacional para as Comemorações dos Descobrimentos Portugueses, Lisbon.

Dodge, C.J.G., 2018. A forgotten century of brazilwood: the brazilwood trade from the mid-sixteenth to mid-seventeenth century. e-JPH 16 (1), 1–27.

Domingues, Â., 1992. As sociedades e as culturas indígenas face à expansão territorial *Luso-Brasileira* na segunda metade do século XVIII. In: *Brasil: Nas Vésperas Do Mundo Moderno*. Comissão Nacional para as comemorações does descobrimentos Portugueses, Lisbon, pp. 183–207.

Fausto, C., 2020. *Art Effects: Image, Agency, and Ritual in Amazonia*. University of Nebraska.

Feest, C., 2012. Bororo "Crown Jewel of Anthropology. In: Augustat, C. (Ed.), *Beyond Brazil: Johann Natterer and the Ethnographic Collections from the Austrian Expedition to Brazil (1817-1835)*. Museum für Völkerkunde, Vienna, pp. 81–103.

Figueiredo, N., 1982. Algumas notas sobre a estatueta lítica coletada no rio Paru (Estado do Pará, Brasil) e pertencente às coleções da Universidade Federal do Pará. Clio 5, 45–54.

Fonseca Jr., João Aires da, 2010. As estatuetas líticas do Baixo Amazonas. In *Arqueologia Amazônica,* vol 1, Edithe Pereira and Vera Guapindaia, orgs., pp. 235-257, MPEG; IPHAN; SECULT, Belém.

Françozo, M., 2023. *Toward an Intercultural Natural History of Brazil: the Historia Naturalis Brasiliae Reconsidered*. Taylor & Francis.

Frikel, P., 1961. Morí: a festa do rape. Boletim Do Museu Paraense Emílio Goeldi 12, 1–34.

Gaillardet, J., Dupre, B., Allegre, C.J., Négrel, P., 1997. Chemical and physical denudation in the Amazon River basin. Chem. Geol. 142 (3–4), 141–173.

Gerbrands, A.A., 1955. Masterpieces of woodcarving from the Amazon Basin. XXXI Congr. Int. De Americanistas 267–268.

Gomes, D.M.C., 2021. Images of transformation in the lower Amazon and the performativity of Santarém and Konduri pottery. J. Soc. Archaeol. 22 (1), 82–103.

Gomes, D.M.C., 2001. Santarem: Symbolism and power in the tropical forest. In: McEwan, C., Barreto, C., Neves, E. (Eds.), *Unknown Amazon: Culture and Nature in Ancient Brazil*. British Museum Press, London, pp. 134–155.

Gomes, D.M., Cavalcante, A.F., Costa, C.S., Munita, J.P., da Cunha, L., 2023. Archaeological evidence of the development of regional society in Santarém (AD 1000-1600), lower Amazon: a path to understanding social complexity. J. World Prehistory 36, 147–189.

Harris, M., 2018. The making of regional systems: the Tapajós/Madeira and Trombetas/Nhamundá regions in the lower Brazilian Amazon. Seventeenth and Eighteenth Centuries, Ethnohistory 65 (4), 621–645.

Hemming, J., 1978. *Red gold: the conquest of the Brazilian Indians*. Papermac, London.

Hogg, A.G., Heaton, T.J., Hua, Q., Palmer, J.G., Turney, C.S.M., Southon, J., Bayliss, A., Blackwell, P.G., Boswijk, G., Ramsey, C.B., Pearson, C., Petchey, F., Reimer, P., Reimer, R., Wacker, L., 2020. SHCal20 Southern Hemisphere Calibration, 0-55,000 Years cal BP. Radiocarbon 62 (4), 759–778. https://doi.org/10.1017/RDC.2020.59.

Hugh-Jones, S., 2009. The fabricated body: Objects and Ancestors in Northwest Amazonia. In: Santos-Granero, F. (Ed.), *The Occult Life of Things: Native Amazonian Theories of Materiality and Personhood*. The University of Arizona Press, Tucson, pp. 33–59.

Izikowitz, Karl Gustav, 1935. Musical and other sound instruments of the South American Indians. *Göteborgs Kungl. Vetenskap och Vitterhets Samhället Handlingar Femte Följden,* Ser. A, Band 5, No. 1, Gothenburg.

Jácome, C., 2017. Dos Waiwai aos Pooco – fragmentos de história e arqueologia das gentes dos rios Mapuera (Mawtohrî), Cachorro (Katxuru) e Trombetas (Kahu). PhD thesis. Museu de Arqueologia e Etnologia, Universidade de São Paulo, São Paulo, Brasil.

Jácome, C., Waiwai, J.X., 2020. A paisagem e as cerâmicas arqueológicas na bacia Trombetas: uma discussão da Arqueologia Karaiwa e Wai Wai. Bol. Mus. Para. Emílio Goeldi. Cienc. Hum. 15 (3), 1–25, e20190140. https://doi.org/10.1590/2178-2547-BGOELDI-2019-0140.

Little Jr, E.L., Wadsworth, F.H., 1964. *Common Trees of Puerto Rico and the Virgin Islands*, Agriculture Handbook. U.S. Department of Agriculture. Forest Service, Washington, D.C.

Marsh, E.J., Bruno, M.C., Fritz, S.C., Baker, P., Capriles, J.M., Hastorf, C.A., 2018. IntCal, SHCal, or a mixed curve? Choosing a ^{14}C calibration curve for archaeological and paleoenvironmental records from tropical South America. Radiocarbon 60 (3), 925–940. https://doi.org/10.1017/RDC.2018.16.

McEwan, C., 2009. *Ancient American Art in Detail*. British Museum Press, London.

Mereles, M.D.A., Sousa, R.G.C., Pouilly, M., Pereira, D.V., Mc Comb, G.L., Filizola, N., Santos, R.V., Freitas, C.E.D.C., 2025. Distribution of strontium isotopes (^{87}Sr/^{86}Sr) in surface waters of the Amazon basin: a basis for studies on provenance. Sci. Total Environ. 965, 178630.

Métraux, A., 1948. The Guaraní. In: Steward, J. (Ed.), *Handbook of South American Indians, Vol 3: the Tropical Forest Tribes,* Bureau of American Ethnology Bulletin 143. United States Government Printing Office, Washington, D.C., pp. 69–94

Négrel, P., Lachassagne, P., 2000. Geochemistry of the Maroni River (French Guyana) during low water stage: implications for water rock interaction and groundwater characteristics. J. Hydrol. 237, 212–233.

Neves, Eduardo G., Vera L. C. Guapindaia, Helena Pinto Lima, Bernardo S. Costa, Jacqueline Gomes, 2014. A tradição Pocó-Açutuba e os primeiros sinais visíveis de modificações de paisagens na calha do Amazonas. In *Amazonía: Memorias de las Conferencias Magistrales del 3er Encuentro Internacional de Arqueología Amazónica*, Stéphen Rostain, ed., pp. 137-158, Ministerio Coordinador de Conocimiento y Talento Humano e IKIAM, Quito.

Nimuendajú, C., 2004. *In pursuit of a past Amazon: archaeological researches in the Brazilian Guyana and in the Amazon region*, Ethnological Studies, 45. Världskulturmuseet, Gothenburg.

Nimuendajú, Curt, 1948a. The Cawahíb, Parintintin, and their Neighbors. In *Handbook of South American Indians*, Bulletin 143, Bureau of American Ethnology of the Smithsonian Institution, Vol 3, pp. 283-297, Washington D. C.

Nimuendajú, C., 1948b. The Cayabi, Tapanyuna, and Apiaca. In: Handbook of South American Indians. Bulletin 143, Bureau of American Ethnology of the Smithsonian, Washington D.C, pp. 307–320.

Ostapkowicz, J., Brock, F., Wiedenhoeft, A.C., Bray, W., 2023. South American Indigenous weapons aboard the *San Pedro* shipwreck of 1596. Bermuda Journal of Archaeology and Maritime History 22, 21–60.

Ostapkowicz, J., Ramsey, C.B., Brock, F., Cartwright, C., Stacey, R., Richards, M., 2013. Birdmen, *cemís* and *duhos*: material studies and AMS ^{14}C dating of Pre-Hispanic Caribbean wood sculptures in the British Museum. J. Archaeol. Sci. 40 (2013), 4675–4687.

Ostapkowicz, J., Ramsey, C.B., Brock, F., Higham, T., Wiedenhoeft, A.C., Ribechini, E., Lucejko, J.J., Wilson, S., 2012. Chronologies in wood and resin: AMS ^{14}C dating of pre-Hispanic Caribbean wood sculpture. J. Archaeol. Sci. 39, 2238–2251.

Ostapkowicz, J., Roberts, A., Thistlewood, J., Brock, F., Wiedenhoeft, A.C., Snoeck, C., Schulting, R., Bray, W., 2018. The origins of Tradescant's 'India occidentali' wooden clubs: ^{14}C dating, material identification and strontium isotope studies. Antiquaries J. 98, 187–218.

Oyuela-Cayced, A., Fischer, M., 2006. Ritual paraphernalia and the foundation of religious temples: the case of the Tairona-Kaaba/Kogi, Sierra Nevada De Santa Maria, Colombia. Baessler Archiv 54, 145–162.

Palmatary, H.C., 1960. The archaeology of the lower Tapajós Valley, Brazil. Trans. Am. Philos. Soc. 50 (3), 1–246.

Parry, J.H., Keith, R.G. (Eds.), 1984. *New Iberian World: A Documentary History of the Discovery and Settlement of Latin America to the Early 17th Century*. Times Books and Hector & Rose, New York.

Polykrates, G., 2021. Alguns trabalhos em madeira dos índios Kashuiéna. Revista Do Museu De Arqueologia e Etnologia 37, 61–65.

Porro, A., 2010. Arte e simbolismo xamânico na Amazônia. Boletim Do Museu Paraense Emílio Goeldi 5 (1), 129–144.

Poszwa, A., Ferry, B., Pollie, B., Grimaldi, C., Charles-Dominique, P., Loubet, M., Dambrine, E., 2009. Variations of plant and soil ^{87}Sr/^{86}Sr along the slope of a tropical inselberg. Ann. For. Sci. 665 (5).

Record, S.J., Hess, R.W., 1943. *Timbers of the New World*. Yale University Press, New Haven.

Reichlen, H., 1961. Objets en bois sculpté du bas-Amazone. Objets et Mondes 1 (2), 17–30.

Reimer, P., Austin, W., Bard, E., Bayliss, A., Blackwell, P., Bronk Ramsey, C., Butzin, M., Cheng, H., Edwards, R., Friedrich, M., Grootes, P., Guilderson, T., Hajdas, I., Heaton, T., Hogg, A., Hughen, K., Kromer, B., Manning, S., Muscheler, R., Palmer, J., Pearson, C., van der Plicht, J., Reimer, R., Richards, D., Scott, E., Southon, J., Turney, C., Wacker, L., Adolphi, F., Büntgen, U., Capano, M., Fahrni, S., Fogtmann-Schulz, A., Friedrich, R., Köhler, P., Kudsk, S., Miyake, F., Olsen, J., Reinig, F., Sakamoto, M., Sookdeo, A., Talamo, S., 2020. The IntCal20 northern hemisphere radiocarbon age calibration curve (0–55 cal kBP). Radiocarbon 62 (4), 725–757.

Rival, L. (Ed.), 1998. The Social Life of Trees: Anthropological Perspectives on Tree Symbolism (materializing Culture). Berg, Oxford.

Rodrigues, J.B., 1899. *O muyrakitã e os ídolos simbólicos*. Imprensa Nacional, Rio de Janeiro.

Russi, Adriana and Denise Fajardo, 2021. No. 37 (2021): Dossier Katxuyana, Kahyana: European perspectives on the peoples (yanas) of the Cachorro and Trombetas rivers, Oriximiná/PA. https://revistas.usp.br/revmae/issue/view/12235.

Sanjad, N., Batista Poça da Silva, J., 2009. Três contribuições de Emílio Goeldi (1859-1917) à arqueologia e etnologia amazônica. Boletim Do Museu Paraense Emílio Goeldi 4 (1), 95–133.

Schaan, D.P., 2016. *Sacred geographies of Ancient Amazonia: Historical ecology of social complexity*. Routledge, London.

Shock, Myrtle P., 2019. As seen through the trees, a lens into Amazonian mobility and its lasting landscape. In *South American Contributions to World Archaeology*, Marian Bonomo and Sonia Archila, eds., pp. 219-248, Springer Nature, https://doi.org/10.1007/978-3-030-73998-0.

Spenlé, Virginie, 2011. "Savagery" and "Civilization": Dutch Brazil in the Kunst- and Wunderkammer. Journal of Historians of Netherlandish Art 3 (2), 1–19. https://doi.org/10.5092/jhna.2011.3.2.3 (summer 2011).

Steward, J.H., Métraux, A., 1948. The Panoan tribes of Eastern Peru. In: Steward, J. (Ed.), *Handbook of South American Indians, Vol 3: the Tropical Forest Tribes,* Bureau of American Ethnology Bulletin 143. United States Government Printing Office, Washington, pp. 555–595.

Timyan, J., 1996. *Bwa Yo: Important Trees of Haiti*. South-East Consortium for International Development, Washington, D.C.

Torke, B.M., de Freitas Mansano, V., 2009. A phylogenetically based sectional classification of Swartzia (Leguminosae-Papilionoideae). Taxon 58 (3), 913–924.

Viveiros de Castro, E., 2002. Imagens da Natureza e da Sociedade. In: *A Inconstância Da Alma Selvagem*. Cosac & Naif, São Paulo, pp. 317–346.

Wassen, S.H., 1967. *Ethnopharmacologic search for psychoactive drugs*. Department of health, education and welfare, San Francisco, U.S.

Wassen, S.H., 1965. The use of some specific kinds of South American Indian snuff and related paraphernalia. Etnografiska Museet. Elanders Boktryckeri aktiebolag, Gothenburg.

Whitehead, Neil L., 2012. Historical writing about Brazil, 1500-1800. In *The Oxford History of Historical Writing: vol 3: 1400-1800,* José Rabasa, et al., ed., pp. 641-661, Oxford Academic, Oxford, https://doi.org/10.1093/acprof:osobl/9780199219179.003.0032.

Whitehead, Neil L., 1993. Ethnic Transformation and Historical Discontinuity in Native Amazonia and Guayana, 1500–1900. L'Homme 33 (126), 285–305.

Zerries, O., 1981. Atributos e instrumentos rituais do Xamã na América do sul não-Andina e o seu significado. In: Contribuições à Antropologia Em Homenagem Ao Professor Egon Schaden. Coleção Museu Paulista, Série Ensaios, pp. 319–360.

Zerries, O., 1977. Drei alte, figürlich verzierte Holztrompeten aus Brasilien in den Museen zu Kopenhagen. Leiden Und Oxford, Ethnologische Zeitschrift Zürich 1, 77–89.

Zerries, O., 1965. Drei unbekannte Holzschnitzarbeiten aus Brasilianisch-Guayana im Museum für Völkerkunde zu Mannheim. Tribus 14, 185–193.

Zerries, O., 1960. Der Zeremonialstab der Erlanger Sammlung aus Brasilien im Staatlichen Museum für Völkerkunde in München. Akten Des 34 Internationalen Amerikanistenkongresses 34, 613–620.



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