Nature as kin: reconsidering evidence of agriculture in Southwest Amazonia in the Early Holocene

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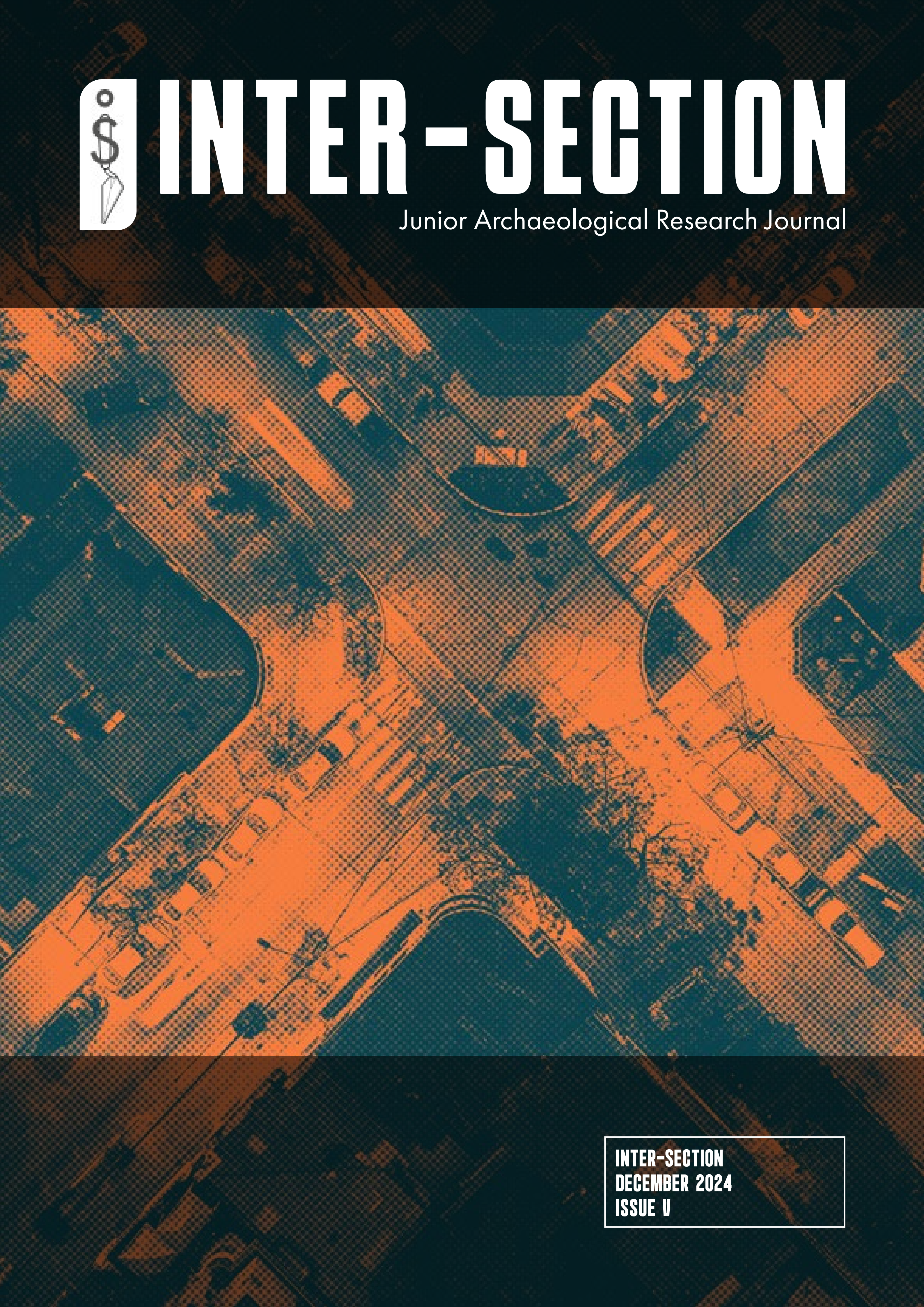

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NATURE AS KIN
RECONSIDERING EVIDENCE OF AGRICULTURE IN SOUTHWEST AMAZONIA IN THE EARLY HOLOCENE

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ABSTRACT:
Palaeoecological evidence for southwest Amazonia reveals subtle but complex botanic management stretching back 10,000 years. In situ cultivation of root crops in managed tree groves comprised a pattern of polyculture agroforestry that left a marked footprint on modern floral biodiversity. This evidence rejects traditional archaeological definitions of 'agricultural societies' and indicates the need to rethink how we approach archaeobotanical remains in tropical forest environments. This forms the basis of a proposed new paradigm for approaching the archaeobotanical record: familiarisation. Familiarisation draws on Amazonian anthropological theory and ethnography to conceptualise human-nonhuman relationships as fluid, reciprocal, and laden with ontological significance. Applied here to the early and middle Holocene in Amazonia (c. 10,000-4,000 calBP), it is a productive milieu for examining horticulture systems in the deep past.

KEYWORDS:
Archaeobotany; Anthropology; Landscape archaeology; Domestication; Tropical archaeology

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INTRODUCTION:

Domestication has long been perceived as the foremost indicator of agriculture (Ford, 1985; Rindos, 1984; Smith, 2001; Zvelebil, 1986), with archaeobotanical evidence of domestication used to determine when past societies 'crossed the threshold' into farming (Smith, 2001, p. 14). This assumption, based on evolutionary schemas developed for the Neolithic Near East (e.g., Childe, 1936), associates agriculture with cereal farming in temperate ecozones. Methodologies for detecting agriculture are often biased towards this ecological context, relying on morphogenetic change in plants to establish whether cultivation occurred.[1]

Relying on morphogenetic change as a marker of domestication (and therefore agriculture) is flawed. Domestication traits develop slowly and inconsistently, only becoming observable once a species moves outside its natural range (Pearsall, 1995, p. 159). Further, factors including genetic disposition, reproductive strategy, environment, and manner of exploitation affect if and how a given species will exhibit adaptations to domestication (Denham et al., 2010, pp. 2-4, 39; Piperno, 2011). Throughout time, complex patterns of plant selection, management, and translocation have given rise to new varieties or hybrids, with convoluted effects on the genetic architecture of plant families and the species composition of landscapes (Barton & Denham, 2011, pp. 21-22; Clement et al., 2010; Kantar et al., 2017, p. 975; Larson et al., 2014, pp. 6142-3). Consequently, relying on identifiable morphogenetic signals for domestication can result in an incomplete reconstruction of past societies' botanic management practices.

This issue is compounded in understudied environments in archaeologies of agriculture, such as tropical forests. Tropical forest cultivation practices are often subtle, diverse, and difficult to trace in the archaeological record (Denham et al., 2007; Neves & Heckenberger, 2019; Piperno, 2011). This article considers evidence from archaeobotany, ecology, anthropology, and ethnography to

1 Morphogenetic change is change in a plant's form and/or structure according to environmental conditions and genetic predisposition.

reconsider traces of early Holocene horticulture in southwest Amazonia.[2] The resulting transdisciplinary synthesis probes the way human-landscape relationships are traditionally (mis)represented in archaeology.

STUDY AREA

The interfluvial hinterland of southwest Amazonia (Fig. 1) has often been portrayed as 'untouched' by human activity prior to European colonisation (e.g., Bush et al., 2015; Lathrap, 1968; McMichael et al., 2012; Meggers, 1954, 1991; Steward, 1948). Since the 1980s, palaeoenvironmental and ethnographic research has increasingly challenged this claim, suggesting local communities shaped this landscape for 10,000 years pre-colonisation – albeit without domesticated field-crops (e.g., Balée, 2002; Denevan, 1992; Erickson, 2006; Heckenberger et al., 2003; Iriarte et al., 2020). Important sites of archaeobotanical analyses include the habitation site Teotonio (archaeological contexts beginning c. 9,000calBP), the anthropogenic 'forest-islands' of Llanos de Moxos (archaeological contexts beginning c. 10,850calBP), and geoglyph sites in Acre (archaeological contexts beginning c. 4,400calBP).[3] Southwest Amazonia has also been the subject of region-wide analyses into forest composition and plant phylogenetics (e.g., Levis et al., 2017; Schaal et al., 2006). This combination of evidence reveals southwest Amazonia as one of the earliest centers for horticultural experimentation globally (Watling et al., 2018).

METHODOLOGY

This article adopts a multidisciplinary approach to summarise evidence of anthropogenic land-management in southwest Amazonia from c. 10,000-4,000calBP.[4] It integrates archaeobotanical and ecological data with anthropological frameworks, namely *multispecies perspectivism* (Viveiros de Castro, 1998) and *interspecies consubstantiality* (Vilaça, 2002). Discussed ethnographic data is not intended to be projected onto early and mid-Holocene communities; rather, it demonstrates that Euro-American definitions of agriculture, landscape, and personhood are not universal. This multidisciplinary approach elucidates the potential of considering alternative ways of thinking when interpreting evidence of past horticultural activity.

POLYCULTURE AGROFORESTRY IN SOUTHWEST AMAZONIA IN THE EARLY TO MID-HOLOCENE: (PALAEO)ECOLOGICAL AND ARCHAEOBOTANICAL EVIDENCE

Archaeobotany and (palaeo)ecology offer useful contributions towards reconstructing past landscape management in southwest Amazonia. Table 1 summarises plant micro- and macrofossil evidence for three key archaeological site complexes (Teotonio, Llanos de Moxos, and Acre), alongside forest composition analyses and phylogenetic investigations from the broader region. Synthesising these lines of evidence suggests early to mid-Holocene

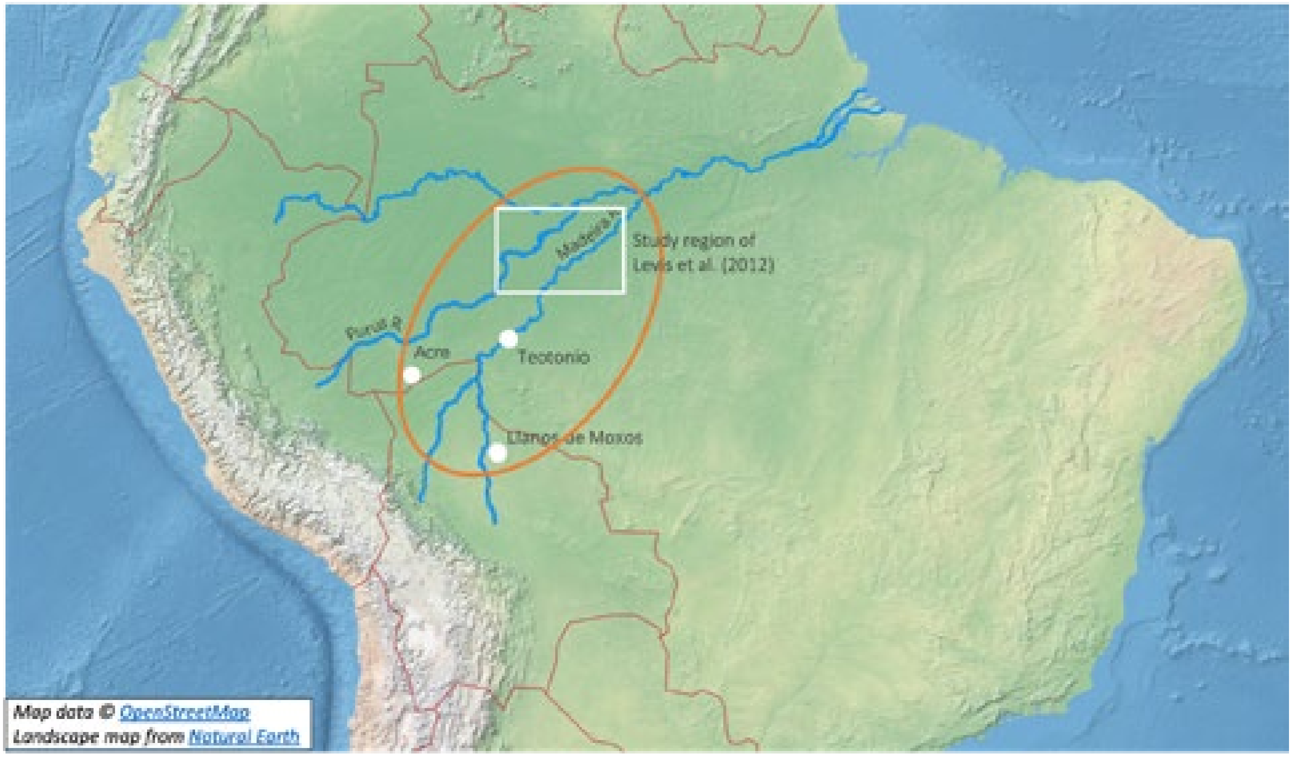

Figure 1: Map of study area, circled in orange: southwest Amazonia (SW). Major rivers and sites mentioned in this paper are marked (map data from OpenStreetMap).

2 Horticulture is defined here as the subdivision of agriculture related to the cultivation of plants.
3 For dating of sites, see Watling et al. (2018) for Teotonio, Lombardo et al. (2020) for Llanos de Moxos, and Watling et al. (2017) for Acre.
4 These dates represent the early and middle Holocene in this region as defined in Capriles et al. (2019) and Lombardo et al. (2020).

communities in southwest Amazonia practiced cultivation systems centered on small-scale polyculture and agroforestry.

Various arboreal and herbaceous resources are attested in the archaeobotanical record of the early Holocene (c. 10,000-6,000calBP), including palms, tree nuts and fruits (e.g., Brazil nut, guava), cucurbits (e.g., gourd), and roots and tubers (e.g., leren, manioc). Pollen and phytoliths found in the Llanos de Moxos indicate that after c. 6,000calBP more cultigens were integrated into food procurement systems, including maize and a variety of rice (Brugger et al., 2016; Hilbert et al., 2017; Lombardo et al., 2020).[5] At Teotonio, this time period is marked by the appearance of an exotic bean (likely *Phaseolus* sp.), implying the translocation of this cultigen into southwest Amazonia prior to c. 6,000calBP (Watling et al., 2018). Bean plants are phosphorus-demanding, suggesting soil enrichment would likely have been necessary to grow them at Teotonio (Watling et al., 2018, p. 21). Alongside other macrofossil and phytolith evidence (Table 1), this evidence suggests communities in southwest Amazonia were practicing low-intensity polyculture incorporating root crops, cereals, and/or legumes by the mid-Holocene. Supporting this interpretation, phylogenetic investigations indicate plants like manioc (*Manihot esculenta*) and peach palm (*Bactris gasipaes*) were being actively manipulated in southwest Amazonia from c. 9,000-8,000calBP (see Table 1).

Archaeobotanical remains in this region are often accompanied by palaeoecological traces of soil preparation. In the Llanos de Moxos, the deposition of organic waste including shell, animal bone, burnt earth, and charcoal increased soil fertility and created up to 4700 'islands' of anthropogenic soils (raised patches above the wet-season water level) (Lombardo et al., 2020, pp. 192-4). These sediments contain phytoliths from squash, manioc, jackbean, chilli pepper, and peach palm dating as early as c. 10,350calBP (Table 1). The *Cucurbita* rind phytoliths are larger than phytoliths from wild varieties, indicating the possibility of consistent low-intensity cultivation in these early Holocene 'gardens' (Lombardo et al., 2020, pp. 190-1).[6] This data is corroborated by pedological findings elsewhere in Amazonia indicating that anthropogenic soils are closely associated with cultivation activity including scraping or turning soils, burning, and localised forest disturbance (Arroyo-Kalin, 2010; Iriarte et al., 2020; Robinson et al., 2021). Such practices create an environment conducive to small-scale growing of cultigens like manioc, squash, and maize (Watling et al., 2018, pp. 21-22).

This 'gardening' likely took place in tandem with agroforestry: the management and manipulation of tree groves to encourage useful species, increase yields, and attract fauna for hunting (Latinis, 2000; Terrell et al., 2003, p. 335). Agroforestry practices – including seed dispersal, weeding, localised disturbance, and systematic harvesting[7] – rarely result in morphological change to tree macrofossils (seeds, nuts, and fruit parenchyma) (Fuller et al., 2023, p. 643). Yet tree resources were central to early Holocene communities in southwest Amazonia; combining archaeobotanical evidence with ecological data suggests these communities shaped the structure and composition of the forest landscape. Brazil nut, for example, is consistently attested in archaeobotanical assemblages from at least 9,500calBP and appears to have been anthropogenically dispersed throughout Amazonia from the southwest during the early Holocene (see Table 1).

Combining microfossil and forest composition data indicates intentional forest disturbance was a central component of past subsistence strategies. Localized burning and clearance help stimulate the growth of useful species like Brazil nut and guava: key arboreal resources attested in the archaeobotanical record (Levis et al., 2012; Watling et al., 2017, 2018). Such practices likely contributed to modern forest composition, creating patches dominated by useful species including peach palm, Brazil nut, bamboo, and fruit trees (Levis et al., 2012, p. 1; Stahl, 2015, p. 1600).[8] Across the Amazon, these useful species are '*five times more likely [...] to be hyperdominant*' than tree species with no history of anthropogenic management (Levis et al., 2017, p. 925). Statistical analyses indicate their abundance and richness in southwest Amazonia is most influenced by anthropogenic factors (see Levis et al., 2017, p. 925), and their distributions correlate strongly with the location of archaeological 'anthrosols' (anthropogenically-fertilised soils associated with habitation sites) (Thomas et al., 2015). Similarly, phytolith assemblages from the Acre site complex show a positive correlation between increased human-driven burning events and an increase in useful palm species (Table 1). Further, nine of the ten most abundant tree species in the forests around these sites today are useful species.

A comparison of modern and archaeological phytolith samples suggests this forest composition has remained broadly similar since the mid-Holocene, raising the possibility of a palm-dominated agroforestry system in the region by this time (Watling et al., 2017).

5 Also see Iriarte et al. (2020) for contemporaneous evidence of maize cultivation at other Amazonian sites.

6 The *Cucurbita* rind phytoliths described here, likely representing a type of squash, fall within the range of some domesticated *Cucurbita* species; however, similar phytoliths found in later layers do not show evidence of change in size, suggesting a lack of domestication pressure (Lombardo et al., 2020). Consequently, it is still unclear if these microfossils represent a domesticated species.

7 For discussion of palaeoecological evidence for agroforestry practices in southwest Amazonia, see: Clement (1999, pp. 189-92), Clement et al. (2015), Kern et al. (2015), Levis et al. (2017), Lombardo et al. (2020), Miller and Nair (2006), Oliver (2008, pp. 202- 203), Stahl (2015, p. 1600), and Watling et al. (2018, pp. 18, 23).

8 Modern ethnobotanical research has observed higher species diversity and richness in anthropogenic soil sites (both current and historical) than in adjacent areas of primary forest, including a higher proportion of useful species (Balée, 1993; Erickson & Balée, 2006; Junqueira et al., 2010, 2011).

Table 1: Data on early and mid-Holocene cultivation practices in southwest Amazonia, grouped by discipline (archaeobotanical lines of evidence in pink; ecological lines of evidence in green). Focal sites discussed in this article are marked in bold.

	Category of evidence	Chronology	Evidence of cultivation
Archaeobotany	*Microfossil record (pollen, starch, phytoliths[1])*	c. 10,400-8,000calBP	**Llanos de Moxos:** Phytolith evidence for regular and consistent co-exploitation of a range of useful species including: arrowroots (Marantaceae sp.), sedge tubers (Cyperaceae sp.) and Heliconia sp. rhizomes from c. 10,400calBP; manioc (*Manihot* sp.) by c. 10,350calBP; squash (Cucurbita sp.) by c. 10,250calBP; leren (*Calathea* sp.) by c. 8000calBP (Lombardo et al., 2020).
		c. 9,500-6,500calBP	**Teotonio**: Phytoliths evidence for the cultigen leren (*Calathea* cf. *allouia*) (Watling et al., 2018).
		c. 6,800-4,000calBP	**Llanos de Moxos**: Phytolith evidence for regular and consistent co-exploitation of cereals: maize from c. 6850calBP; and wild rice by c. 5300calBP, with evidence of selection pressure for larger grains by c. 4000calBP (Hilbert et al., 2017; Lombardo et al., 2020).
		c. 6,495–6,400calBP	**Teotonio:** Phytolith evidence for extensive exploitation and processing of manioc (*Manihot esculenta*) (Watling et al., 2018).
		c. 6,000calBP	**Llanos de Moxos:** Palynological profiles indicates maize cultivation, and possibly that of edible species in the Annonaceae and Cucurbitae families (Brugger et al., 2016; Burbridge et al., 2004).
		c. 6,500-5,500calBP	**Teotonio:** Residue analysis of lithic artefacts has yielded starch grains of a useful local palm species (*Attalea maripa)* and an exotic bean species (*Phaseolus* sp.) (Watling et al., 2018).
	Macrofossil record	c. 9,500-6,000calBP	**Teotonio:** Carbonised parenchyma tissue of tubers and/or roots, alongside charred remains of Brazil nut (*Bertholletia excelsa*) and fruit including *pequiá* (*Caryocar* sp.), guava (*Psidium* sp.), and fruits from palm species, found in an early to mid-Holocene context. A single fragment of bean, possibly belonging to a *Phaseolus* sp., was also recovered in this context (Watling et al., 2018).
		c. 1,600-600calBP	**Llanos de Moxos:** Evidence of well-established and systematic reliance on a range of cultivated plants including palms, fruit trees, and Brazil nut trees, cereals such as maize, and parenchymous storage organs including manioc (Bruno, 2010). Though macrofossils have not been recovered from earlier contexts, these finds correlate with the early and mid-Holocene microfossil record (see Lombardo et al., 2020).
	Charcoal *record*	c. 6,000calBP	**Llanos de Moxos:** Macroscopic charcoal peak suggests local biomass burning in association with palynological evidence of maize cultivation (Brugger et al., 2016; Burbridge et al., 2004; Iriarte et al., 2020).
		c. 4,400-3,600calBP	**Acre:** Charcoal peaks indicative of anthropogenic burning events, succeeded immediately by a 20-30% increase in phytolith count for useful palm species (in spite of wet climatic conditions non-conducive to palm colonisation) (Watling et al., 2017).

[1]*Phytoliths: fossilised silica-based features in plant tissues.*

	Category of evidence	Chronology	Evidence of cultivation
Ecology	*Forest composition analyses*	c. 4,400-3,600calBP	**Acre:** Useful tree species including Brazil nut and several fruit trees dominate the forest surrounding archaeological sites today. Modern phytolith sampling in these forests is comparable to the archaeological phytolith samples, suggesting a broadly similar forest composition in the mid-Holocene (Watling et al., 2017).
		Early Holocene	**Region-wide:** There is a statistical correlation between the distribution of Brazil nut stands and the presence of anthropogenic sites, as well as consistently greater density and trunk diameter of trees in stands within 30km of sites (Shepard & Ramirez, 2011; Thomas et al., 2015). Combining these results with ecological data on Brazil nut growth and dispersal and palaeoenvironmental reconstructions of Late Pleistocene habitats (Thomas et al., 2014), alongside studies of Brazil nut genetic diversity (Sujii et al., 2015), suggest a high likelihood of human influence in the dispersal of Brazil nut from southwest Amazonia into central and eastern parts of the Basin (i.e. through trade or incidental translocation).
		Present day	**Region-wide:** Greater distribution, abundance, and richness of tree species with a history of human management and/or cultivation. Such species (including Brazil nut, cacao, and tree grape) are five times more likely to be hyperdominant across Amazonian forests than species with no history of human cultivation, and their spatial distribution in southwest Amazonia particularly appears to be strongly correlated with the presence of human occupation sites (Levis et al., 2017).[2]
	Plant phylo-genetics	c. 9,000-7,000calBP	**Region-wide**: Genetic domestication of the cultigen *Manihot esculenta* (manioc) before c. 7,000 years ago based on archaeobotanical evidence from Peru (Elias et al., 2004; Léotard et al., 2009; Olsen & Schaal, 1999; Rival & McKey, 2008; Schaal et al., 2006) and of *Bactris gasipaes* (peach palm), likely also in the early Holocene (Clement, 1988; Clement et al., 2010; de Cristo-Araújo et al., 2013; Galluzzi et al. 2015; Hernández-Ugalde et al., 2010).[3]
		c. 6,000calBP	**Madeira basin**: Genetic domestication of chilli pepper (both *Capsicum baccatum* and *C. pubescens*), peanut (*Arachis hypogaea)*, guaraná (*Paullinia cupana sorbilis*), and coca (*Erythroxylum coca),* likely by the mid-Holocene based on archaeobotanical evidence for these cultigens (Clement et al., 2010, 2016; Grabiele et al., 2012; Scaldaferro et al., 2018; White et al., 2020).
		Present day	**Region-wide:** High genetic diversity in staple cultigens in the region, such as manioc, suggestive of deep-time cultivation and selection strategies that incorporated both sexual and asexual reproduction to maintain diverse species varietals (Clement et al., 2010; Rival & McKey, 2008).

[2]The tree species studied in Levis et al. (2017) include species with genetic, ecological, geographic, and/or historical evidence for anthropogenic influence on their phenotypic or genetic traits. This list includes 85 species, of which 20 have been shown to be hyperdominant. This research builds on that by Levis et al. (2012) in the upper Madeira basin, which showed that useful tree species such as Brazil nut and cacao appear in anomalously high concentrations and high-diversity clustering than ecological conditions imply they should (Levis et al., 2012).

[3]The earliest archaeobotanical evidence of M. esculenta to date is the c. 7,000-year-old sample from coastal Peru, implying the domestication of this species took place prior to this date (with enough time to then be translocated from southwest Amazonia to the Peruvian coast) (Piperno & Pearsall, 1998, pp. 207-2). Timing for peach palm domestication is speculative, based on observed intensification in palm use starting from c. 9,000 years ago (Morcote-Ríos & Bernal, 2001) as well as the high degree of morphological modification seen in domesticated populations vs. wild populations in the area today (Clement, 1988).

Overall, combined archaeobotanical, (palaeo)ecological, and phylogenetic evidence suggests agroforestry and small-scale polyculture were well-developed food procurement strategies in southwest Amazonia by the mid-Holocene. This form of lower-intensity cultivation can be challenging to interpret from the archaeobotanical record due to the lack of morphologically-distinct macrofossils of domesticated crops. Uniting archaeobotanical, palaeoenvironmental, and ecological evidence can elucidate early land-management practices. This interpretation is strengthened by considering anthropological theory and ethnographic data. The next section discusses anthropological perspectives on human-nature interaction in Amazonia with the aim to integrate them into archaeobotanical interpretations of early cultivation systems.

INTRODUCING ANTHROPOLOGICAL PERSPECTIVES: INTERSPECIES MUTUALISM AND KINSHIP

Across the Amazon, 'personhood' is a flexible and dynamic identity category applied to animals, plants, objects, spirits, and natural features (Fausto & Rodgers, 1999; Vilaça, 2002; Viveiros de Castro, 1993, 1998). All beings share a common spirit ('culture') that manifests in different corporeal forms ('natures'); this worldview, termed *multinatural perspectivism* by Viveiros de Castro (1998), governs all human-nonhuman relationships and stimulates complex inter-species dynamics. The concept of *consubstantiality*, meanwhile, describes how all beings in the fluid universe of multinaturalism can be 'incorporated' as kin (Vilaça, 2002). A well documented example is 'pet-keeping', where young wild animals are captured and adopted into a community as kin (see Costa, 2017). Pet-keeping demonstrates the ontological 'universal affinity' that allows all beings to be(come) consanguine (Vilaça, 2002, pp. 349-50). Across different Amazonian languages, the term for 'pets' has a reciprocal term meaning 'owner' or 'master'; yet the same terminological pair is also used to refer to chiefs/followers, adoptive parents/children, and shamans/guiding spirits (Fausto, 2008, pp. 330-4). This suggests human-nonhuman relationships can be comprised of a complex blend of mastery and familial care.

The same terminological pair is used to describe the relationship between plants and (human) gardeners. Across Amazonian communities, plants are often associated with family, fertility, and regeneration (Fausto & Neves, 2018, pp. 1606-7). Ethnographies frequently report a perception of plants not only as persons, but as *children* of human cultivators (Heckler, 2004; Miller, 2011; Nimuendajú, 1939; Rival, 2001; Seeger, 1981; Taylor, 2001). This parental bond is observed across diverse communities for a range of cultivars, including manioc (Hugh-Jones, 1980, pp. 123-33), maize (Miller, 2011, p. 76), peanuts (Silva, 2009), and sweet potato (Fausto & Neves, 2018, p. 1612). The bond often manifests in practices such as giving plants human names, singing songs to them, and other forms of ceremonial respect such as abstaining from sex after planting (Lagrou, 2007 in Miller, 2011, p. 82; Nimuendajú, 1939, p. 90).

Celibacy in these instances is motivated by the idea that human cultivators are co-producing plants with nature spirits (Fausto & Neves, 2018, p. 1612). The harvest and consumption of 'co-parented' cultigens has diverse ritualistic associations. For the Cashinahua, maize becomes male semen after ingestion and thus plays a role in conceiving future human children (Lagrou, 2007 in Miller, 2011, p. 82). Among the Araweté, where maize is largely consumed as beer, the fermentation process is led by women and discussed as a form of incubation or pregnancy (Viveiros de Castro, 1992, p. 129). In Barasana worldviews, meanwhile, manioc plots are 'the site of human conception and birth' (Hugh-Jones, 1980, p. 115).[9] These examples illustrate that, just as humans parent plants, plants parent humans.

FAMILIARISATION: A PROPOSED NEW FRAMEWORK FOR UNDERSTANDING THE ARCHAEOBOTANICAL RECORD OF SOUTHWEST AMAZONIA

Anthropological theories illuminate how horticulture systems can be enmeshed in other dimensions of meaning, with important implications for approaching the archaeobotanical record. A model for detecting early agriculture founded on ideas of ownership and domination of nature – i.e., a *domestication* model – is ill-fitting to contexts where horticultural practice is integrated into the broader landscape. Indigenous Amazonian worldviews today describe a landscape that cannot be divided, practically nor ontologically, into areas 'in' *vs.* 'outside' the human domain. Early and mid-Holocene forest-gardens encompassed diverse resources and practices in subtle, spatially-diffuse systems of ecological management. Considering anthropological perspectives, we can envisage forest-gardens also as spaces where inter-species kinship was enacted and (re)affirmed. These spaces challenge the assumption that efficiency and homogeneity are always guiding principles of cultivation practice, suggesting that environmental manipulation strategies can be modulated by factors such as familial care, social regeneration, and cultural responsibility.

Shifting what we consider the purpose of cultivation requires us to shift how we seek evidence of it. I propose 'familiarisation' as an alternative paradigm to 'domestication' for interpreting the eco-archaeological record (Table 2).[10]

9 For further examples of beliefs and practices related to the regenerative power of plants in Amazonia, see: da Matta (1973, pp. 284-7), Miller (2011), Nimuendajú (1939, pp. 89-90, 134), and Posey and Plenderleith (2002).

10 'Familiarisation' refers to bringing something into the human sphere on levels beyond the pursuit of immediate functional return; it is a term laden with connotations of reciprocal care and multi-directional effects (Fausto & Rodgers, 1999).

Table 2: A summary of two alternative theoretical approaches to studying agriculture in archaeology: Domestication (traditional paradigm) and Familiarisation (proposed paradigm). Inspired by Fausto & Neves (2018).

	DOMESTICATION	FAMILIARISATION
Scope	Focuses on single species or species families. Prioritises the study of these species' physical and genetic changes.	Shifts the focus to landscape-wide analysis. Prioritises the study of human ecological practices and collaborative interactions with nature.
Conceptualisation of human-nature relationship	Sees humans as dominating nature, and therefore as the (sole) creators of 'civilization'. Neglects the agency of nonhuman beings.	Recognises the multidirectional complexity of human-plant interactions. Decentres humans within the landscape, recognising the important roles of nonhuman beings in co-creating environments.
Philosophy of history	Teleological: agriculture is portrayed as a unilinear development towards increasing human domination over nature. Focuses on agricultural origins and human 'progress' in evolutionary schemas designed to distance modern (Euro-American) civilizations from the 'savagery' of prehistoric and non-European societies.	Acknowledges the variable rate of change and patterns of flux characterising the historical development of human societies. Actively combats the legacy of evolutionary schemas of development, as part of the broader mission of decolonising academia and empowering non-Eurocentric epistemologies.
Perception of human agency	Prioritises the functional, economic motivations behind past peoples' practices and habits.	Recognises the multilayered and entangled patterns of knowledge, belief, and behaviour that constitute past lifeways.
Underlying epistemology	Reflects Euro-American perspectives on nature and on human behaviours.	Integrates 'alternative' understandings of nature and the drivers of human action/thought.

The familiarisation framework requires archaeobotanists to recognise certain important principles (drawn from Fausto & Neves, 2018; Neves & Heckenberger, 2019; Terrell et al., 2003):

1. Human impact on environment is not limited to morphogenetic alterations; it also involves changing the species composition of landscapes through practices like translocation, regenerative burning, and weeding.
2. There is no guaranteed correlation between the extent of morphogenetic evolution observable in any given species and that species' significance in past livelihoods.
3. Contemporary archaeologists/palaeoecologists are likely to value a species differently to the past peoples who exploited it.
4. Genetic homogeneity was not a universal desire across communities who cultivated plant resources.
5. We must consider the whole "species pool" in which specific domesticates were manipulated (Terrell et al., 2003, p. 325).

The dynamic, mixed-resource cultivation practiced in southwest Amazonia in the early and mid-Holocene appears to have prioritised low-impact ecological interference, in the pursuit of biodiverse local environments replete with useful trees, cereals, and tubers. These 'mixed and diversified cultivation systems' (Neves & Heckenberger, 2019, p. 383) represent polycultural 'agroecosystems' shaped by a mix of intentional and uncontrolled factors (Altieri, 2001, p. 109; Fausto & Neves, 2018, p. 1608). Managed tree groves are one example: the cumulative effect of low-intensity activities like pruning undergrowth, controlled burning, and ad hoc seed dispersal (i.e., along walking trails) likely shaped the patches of 'anthropogenic forests' seen today (Franco-Moraes et al., 2019; Levis et al., 2018; Ribeiro et al., 2014). From an ontological perspective, these managed patches represent an ecological space that is both forest and garden, 'wild' and 'domestic' (Fausto & Neves, 2018, p. 1614).

A similar duality exists in the selection and cultivation of herbaceous plants in forest-garden plots. Many Amazonian communities today do not rigidly control the sexual reproduction of staple cultivars within these plots, but rather allow cross-species pollination (Elias et al., 2000; Silva, 2009; Smith & Fausto, 2016, p. 101; Terrell et al., 2003, p. 341-2). Permitting cultivated plants to intermix with 'wild' plants outside the garden system (e.g., through frequent fallows) results in high germplasm diversity and greater intraspecies genetic variety (Carneiro da Cunha & Morim de Lima, 2017, p. 62; Maezumi et al., 2018, p. 543). Data from plant ecology and phylogenetics suggests cultivators in the past also favoured mixed-reproduction strategies: genetic studies of manioc, for example, indicate that early manioc horticulture involved incorporating new seedlings into managed clonal stocks to encourage beneficial traits and maintain varietal diversity (McKey & Rival, 2008). As well as contributing to healthier plant populations (Denham et al., 2020, p. 586; McKey et al., 2012, p. 381), this diversity is likely culturally-significant. Different cultivated species, varieties, and hybrids hosted in forest-gardens each have specific traits suited to different processing or consumption purposes. Further, different varieties often have specific lore attached (including history, songs, and/or rituals), instilling growers with a cultural responsibility to conserve them all (Miller, 2011, p. 73; Terrell et al., 2003, p. 341-2).

Amazonian ontologies revolve around an underlying openness to 'Otherness.' All living beings are 'mutually constitutive,' tied together in patterns of inter-species transformation and kinship (Vilaça, 2002; Viveiros de Castro, 1993, p. 380-382). In this worldview, life arises from 'the incorporation and preservation of small differences' (Fausto & Neves, 2018, p. 1614). Early cultivation systems centred on genetically-diverse polyculture agroforestry can be interpreted as a material enaction of this ontological inclination towards accepting (and encouraging) alterity.

CONCLUSION

The proposed familiarisation framework incorporates anthropology and ethnography to re-interpret archaeobotanical evidence of early Amazonian cultivation systems. The framework considers how human-plant relationships can form part of broader socio-cultural systems of kinship and reciprocity; it encourages us to consider how prehistoric actions upon landscape may have been guided by a perception of 'plants as people'. In southwest Amazonia, early Holocene forest-gardens were likely both functional and spiritual spaces where floral biodiversity was actively maintained via polyculture and agroforestry strategies. Applying the familiarisation framework to archaeological and (palaeo)ecological datasets from this context suggests that the observed intra- and interspecies diversity was motivated by a complex blend of productivity, sustainability, and cultural responsibility. This case study demonstrates how the familiarisation approach can assist archaeobotanists understand the ways cultural knowledge interweaves with ecological practices and becomes inscribed into landscape.

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