Pre-Columbian geometric earthworks in the upper Purús: a complex society in western Amazonia

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It's an ill wind that blows nobody any good. The combination of land cleared of its rainforest for grazing and satellite survey have revealed a sophisticated pre-Columbian monument-building society in the upper Amazon Basin on the east side of the Andes. This hitherto unknown people constructed earthworks of precise geometric plan connected by straight orthogonal roads. Introducing us to this new civilisation, the authors show that the 'geoglyph culture' stretches over a region more than 250km across, and exploits both the floodplains and the uplands. They also suggest that we have so far seen no more than a tenth of it.

Keywords: Amazonia, pre-Columbian, Acre River, Purús River, Andes, monumentality, earthworks, geoglyphs

Introduction

According to mid-twentieth-century neo-evolutionist interpretations of cultural development in the South American lowlands, pre-European Amazonian societies were mainly considered to be primitive egalitarian tribes living in small, impermanent villages in a hostile environment, unable to develop complex socio-political institutions (Steward 1948; Meggers 1954). Although historical accounts mentioned that floodplain river banks and islands were heavily populated by chiefdoms with village leaders and superior lords, some students of Amazonian archaeology and ethnology emphasised important differences between floodplain (*varzea*) and upland (*terra firme*) ecosystems. According to Lathrap's model, for example, the *varzea* constantly attracted peoples due to its bountiful resources, especially aquatic fauna and good alluvial soils; but, as population pressure over limited land took its toll, they were forced to flee to the hinterland *terra firme*, where their cultural level decreased (Lathrap 1968, 1970). In her own way, Meggers (1991, 1995) also acknowledged higher levels of cultural complexity for *varzea* peoples, where some level of social hierarchy and elaborate material culture could develop, thanks to better soils. In her account, *terra firme* peoples remained demographically smaller and less complex, and were forced to live as hunters, collectors and semi-sedentary slash-and-burn cultivators.

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Taking a different avenue to explain the differences between *varzea* and *terra firme*, Carneiro (1970) proposed that ecological pressure, caused by too many people desiring limited productive land, was responsible for dragging people into war and eventually gave rise to social stratification. But Carneiro (1960) did not dismiss the *terra firme* as a place suitable for supporting dense populations, demonstrating, in his upper Xingu example, that a manioc subsistence economy could provide the necessary caloric intake to support large and sedentary populations. Roosevelt (1980), for her part, also had an important role in defending the *varzea/terra firme* dichotomy, emphasising the fact that the alluvial soils of the *varzea* were critical for supporting the indigenous development of chiefdoms, an idea not backed up by neo-evolutionist determinism, which always gave priority to outside cultural developments. However, in her 1991 work, she already recognised that some of the *terra firme* soils were geologically different, citing the ceremonial earthwork monuments of Ecuadorian Amazon (Porras 1987), as an example of social complexity back in the hinterland (Roosevelt 1991).

As we can see, although scholars had different ideas on how to account for the differences between the two main Amazonian environments, the basic dichotomy between *varzea* (floodplain) and *terra firme* (interfluvial hinterland) remained valid for some time. In fact, given the scarcity of archaeological data for hinterland areas, researchers concentrated their efforts in trying to figure out how social complexity arose among floodplain societies (Carneiro 1970, 1987; Roosevelt 1993), accepting, even if not explicitly, that *terra firme* peoples had remained smaller and simpler.

In the flooded areas of the Amazon periphery – the Baures region of Bolivia, and on Marajó island, located at the estuary of the Amazon river (Figure 1) – Steward and Meggers supposed the undeniable signs of social complexity to have resulted from migration from the Andean highlands. Subsequent research has shown rather that social complexity developed indigenously, with the use of sophisticated landscape management techniques such as elevated terraces for agriculture and living, as well as dams and fishponds to manage aquatic fauna in order to guarantee the necessary protein intake (Denevan 1966; Erickson 1980, 2000; Roosevelt 1991; Schaan 2004, 2008). Since the late 1980s, researchers have found evidence of complex pre-European societies in Amazonian upland areas, such as in the Ecuadorian Amazon, where Porras (1987) and Salazar (1998) have found earthworks such as mounds and sunken plazas, and in the upper Xingu, where Heckenberger and his colleagues have described regional integrated systems, identified by villages with central plazas, as well as extensive landscape modifications with moats, roads and bridges (Heckenberger *et al.* 2003, 2008).

Adding to this debate, geometrically patterned anthropogenic earthworks, discovered since 1999 in both upland and *varzea* areas of western Amazonia, are among the most concrete proofs of versatile Amazonian cultures. Up to now, around 200 such sites have been found over an area that extends from northern Bolivia to the southern Amazonas state, encompassing the eastern part of the state of Acre (Pärssinen *et al.* 2003; Ranzi 2003; Schaan *et al.* 2007) (Figure 2). The earthworks are shaped as perfect circles, rectangles and composite figures sculpted in the clay rich soils of Amazonia, and appear to be defensive and/or ceremonial enclosures, formed by excavated ditches and adjacent earthen walls. Located for the most part on a 200m-high plateau, clusters of these monumental earthworks

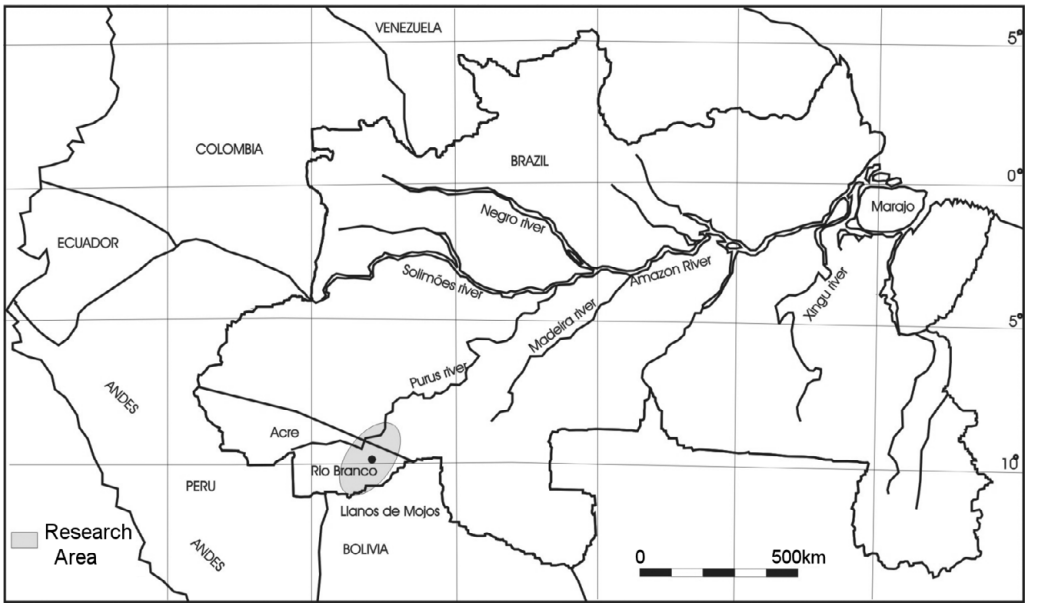

Figure 1. Map of the Amazon Basin showing the research area and places mentioned in the text (map by Denise Schaan).

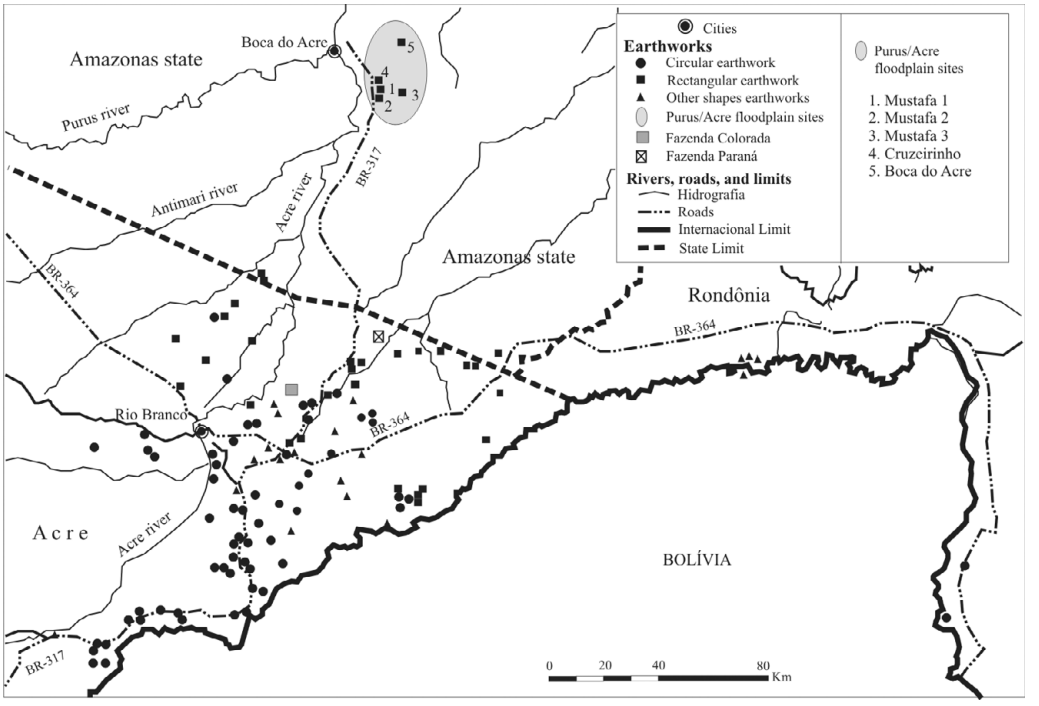

Figure 2. Distribution of earthworks in western Brazil (NB: not all sites are shown; map by Rafael Nascimento).

indicate a quite substantial population living in an area that scholars once believed to be an inadequate environment for sedentary settlement. Such sites indicate both the presence of complex societies capable of managing the environment, and the occurrence of larger populations in the uplands. Moreover, a recent discovery of the same type of sites in the Purús River floodplain, in the state of Amazonas, suggests that a floodplain *versus* upland dichotomy might no longer work as a variable for evaluating human adaptive behaviour in the lowland South American tropics.

Geometric earthworks in the uplands

The earthworks found in western Amazonia were named *geoglyphs* by Alceu Ranzi, the scholar who first saw them from an aircraft and realised they were built by pre-Columbian societies. Geoglyphs can be defined as marks on the surface of the earth, whose dimensions make them better seen from above. Indeed, regardless of the function that the excavated ditches and associated walls had in the past, their perfect geometry speaks of their symbolic significance.

The fact that the Amazonian geoglyphs have only been noticed and publicised in the last few years deserves an explanation. After their abandonment, which we believed happened at least 500 years ago, they were heavily covered by vegetation. In the last 30 years, however, areas once believed to be pristine forest began to be cleared for the cattle industry. In their new treeless, savanna-like landscape, the ancient earthen structures became visible, especially from the sky. If they were initially visible from aeroplanes, researchers can now search for them using satellite imagery freely available in Google Earth. Aerial remote sensing has in fact been more efficient than ground survey, since some structures are filled in by recent sedimentation, and thus hard to see at ground level. In fact, their enormous size makes it easier to distinguish their shape and configuration from an aerial perspective. Preliminary surveys in a number of sites have been done in several short field seasons.

In general, the geometric figures are formed by a ditch approximately 11m wide, currently 1-3m deep, with adjacent 0.5-1m high earthen banks, formed by deposition of the excavated soil. Ring ditches have diameters that vary from 90 to 300m. The circular structures are more common in the south, while composite and rectangular structures become more frequent as one moves north (see Figure 2). When there are two or more structures, they are usually connected by embanked roads. Some of the single rectangular structures may have short roads coming out of their mid-sides or corners. Composite figures include a rectangle inside a circle or *vice versa*.

The Fazenda Colorada site (Figures 2 and 3) is comprised of three ditched structures with outside embankments: one circle, a quadrangle and a double ditch structure which forms a three-sided square. The three-sided square double ditch is connected to a trapezoidal structure comprised by linear walls without ditches. Its south-western corner is open and connects to a *c*. 55m broad, avenue-like, road; on both sides of the entrance one can still see two high mounds, standing like towers. The road has embankments which border both sides, and, as it extends away from the entrance, it narrows, vanishing 600m further. Yet another walled road exists in the northern part of the site, crossing the circular and rectangular geoglyphs. Small excavations done in 2008 suggested that the three-sided square

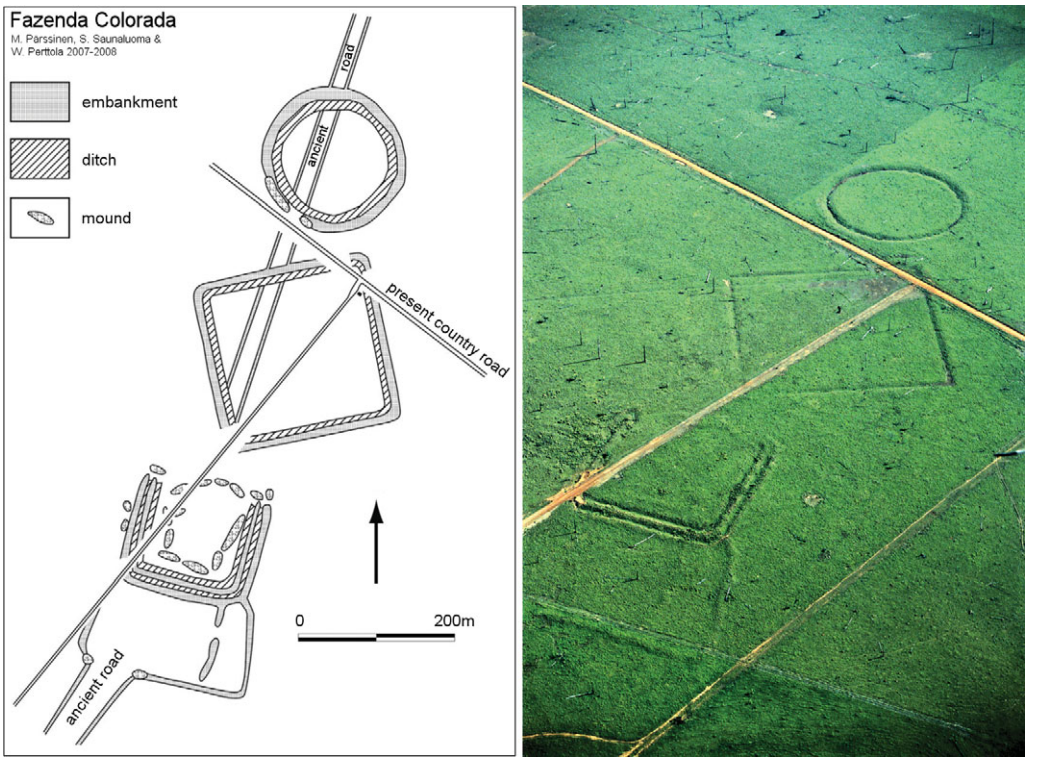

Figure 3. Aerial photograph and plan of the Fazenda Colorada site (photograph by Sanna Saunaluoma).

structure was the habitation centre of the site, where many low mounds containing domestic ceramics and other evidence of permanent habitation were found. Such evidence includes charcoal, dust and grinding stone fragments. The original depth of the two ditches in this structure was *c*. 4-5m.

Function

The function, or functions, of the geoglyphs remain a mystery. A nineteenth-century historical account gives a dubious clue, since it is not clear whether the explorer is talking about these geoglyphs, although he mentions the existence of a ditch in an Indian village in the area where geoglyphs are found today. Chandless (1866: 3) describes how, descending the Aquiry (today Acre) River, he observed that the Indians fled, leaving their belongings behind in fear, before they could reach them:

> *'All that was portable they had taken . . . This village [maloca] seems to be the main one, and, so to speak, the capital of the nation. It has 3 or 4 houses, or, better stated, huts with open sides; of good size and well made; another, quite apart, all closed, and with an entrance of only three open hands tall, which is the storage room for things for festivities, some very curious as we discovered when we returned. Between the storage room and the houses there is a trench [sketched], the extremities leaving only a small*

entrance, next to the forest. This we thought to be a defensive work; but the Indians later told us that was no more than an arrangement for parties'.

As laconic as this passage may seen, it is a reference to a possible reason for the earthwork's construction – e.g. related to feasts and possibly ceremonies – although it has to be considered that the region had already gone through profound demographic transformations when Chandless travelled up the river in the 1860s. The people who then occupied the land had not necessarily built the geoglyphs.

In general, the geoglyphs are located some 2-5km or more from permanent rivers, but most of them have nearby spring water sources. Their location is strategically chosen: at the headwaters on the edges of the plateaux above the river valleys. Once there, one has a magnificent view of the whole valley and, if the region was once at least partially deforested, it would have allowed a privileged view of people coming up river. Therefore, a defensive function for the earthworks is definitely not out of the question. Although different in shape and structure, earthen ditches and walls around villages have been found in other parts of Amazonia and central Brazil, where they have been interpreted as fortified settlements (e.g. Wüst & Barreto 1999; Heckenberger 2005). Circular settlements surrounded by palisades were also described for other parts of Amazonia by the first European travellers (e.g. Schmidl [1554] 1962; Staden [1557] 1962). Pärssinen *et al.* (2003) consider that defensive settlements occur as a response to conflict and slave raids, a situation that is likely to have happened in some parts of Amazonia at that time (AD 1200-1300). For example, there is evidence of fortifications in the Beni River (Bolivia) in the same time period (Saunaluoma & Korhonen 2003). Nevertheless, the fact that in these geoglyph-type structures the ditches are usually situated *inside* the embankments may call for a different explanation since the opposite would be more effective for defence. Seeking an alternative explanation, Pärssinen *et al.* (2003) suggested that the ditches could have been used to store water and aquatic fauna, such as turtles, inside fortified villages. The fact that during the rainy season some ditches become filled with rainwater would support such a hypothesis.

Date

Up to now, a single radiocarbon date is available for the Fazenda Colorada site in the Rio Branco area. It has been determined from a charcoal sample collected from an exposed profile of the three-sided square structure which had just been cut off by the rancher's bulldozer when opening a dirt road. The sample was processed at the University of Helsinki, producing a date of 750±35 BP or AD 1244-1378 (*c*. AD 1283) in calibrated years (2σ, sample Hela-616; Pärssinen *et al.* 2003). We believe that this date is somehow representative of a number of sites, since this particular site exhibits much of the variability seen for the region. The date of AD 1283 implies a late occupation for such a site, only around 300 years before the Europeans' arrival, but is consistent with the development of complex societies in other areas of the Amazon between AD 900 and 1400.

Resource implications

It is estimated that, in order to build one geoglyph of 200m diameter, *c*. 8000m^3 of soil had to be removed. If one agrees that one man or woman could move 1m^3 per day, 8000

individuals per day or a workforce of 80 individuals for 100 days would be necessary to do the job. Considering that there is also a necessity for people to do domestic work and provide food and shelter for the workers, we could be talking about a population of at least 300. It is clear that more people could do the same job in less time, and that fewer people could do it in more time. Even though, considering a population of 300 people per geoglyph, it would be possible to envision a regional population of 60 000 people, which indicates a fairly dense population living in a *terra firme* area. Since most of the sites have been found due to deforestation, it is possible that many more are still to be found inside the forest. The accumulated data has forced archaeologists to review their current assumptions about the superiority of a floodplain environment for the support of large populations. Although available empirical evidence is still preliminary, research in western Amazonia will certainly contribute significantly to the re-writing of the history of cultural development in the tropical lowlands.

Geoglyphs in the floodplain

Since geoglyphs were usually found in the uplands, it came as a surprise when the first geoglyphs in the floodplain were discovered in 2006, while the third author was browsing Google Earth satellite imagery (Ranzi *et al.* 2007). Geometric earthworks, linked by roads, were located near the confluence of the Acre and Purús rivers, in the state of Amazonas. This stretched the area of occurrence of geoglyph-type sites by more than 200km, demonstrating that people living on the floodplains of the middle Purús and lower Acre rivers (on the inner beach of an ancient oxbow lake) shared similar cosmology to peoples living in *terra firme* in the eastern state of Acre.

Having the geographic coordinates at hand, we visited one of the sites, later named Cruzeirinho (S 08 50' 38", W 67 15' 11"), located about 6km east from Boca do Acre city airport, in one of Mr José Lopes' cattle ranches (Figures 2 and 4). The western quadrangular structure (structure 1) was easily located on the ground, since the ditches are still 1-3m deep. In the south-north axis, the enclosure walls of structure 1 extend for 210m, while structure 2 is somewhat larger, its sides measuring approximately 310m. Structure 1 ends on a small oxbow lake which was full of water, located under dense vegetation. Just like in the Rio Branco region further south, the walls were built with the soil taken out of the excavated ditches and carefully placed alongside and outside them. Structures 1 and 2 are interconnected by a 30-35m wide and 400m long road, bordered by short embankments along both sides, crossing over a dry oxbow lake. The road then continues for 250m off the structure 2 plaza in the eastern direction, until vanishing near the other end of the former lake. A second road crosses the plaza square in the south-north direction, also vanishing in the lake. A third rectangular structure is partially formed by the east and south roads that come out of structure 2, lying south-east from it. It is completed by two other straight ditch/bank structures, which are 360m long in the north-south axis, and 380m long in the west-east direction.

Four other geoglyphs were identified in this vicinity, situated about 3.3km in a south-eastern direction (Figures 2 and 5). The site Mustafa 1 (S 08 52' 32", W 67 14' 42") is a 250m wide quadrangular structure, crossed by a 12m wide NE-SW oriented road, leading

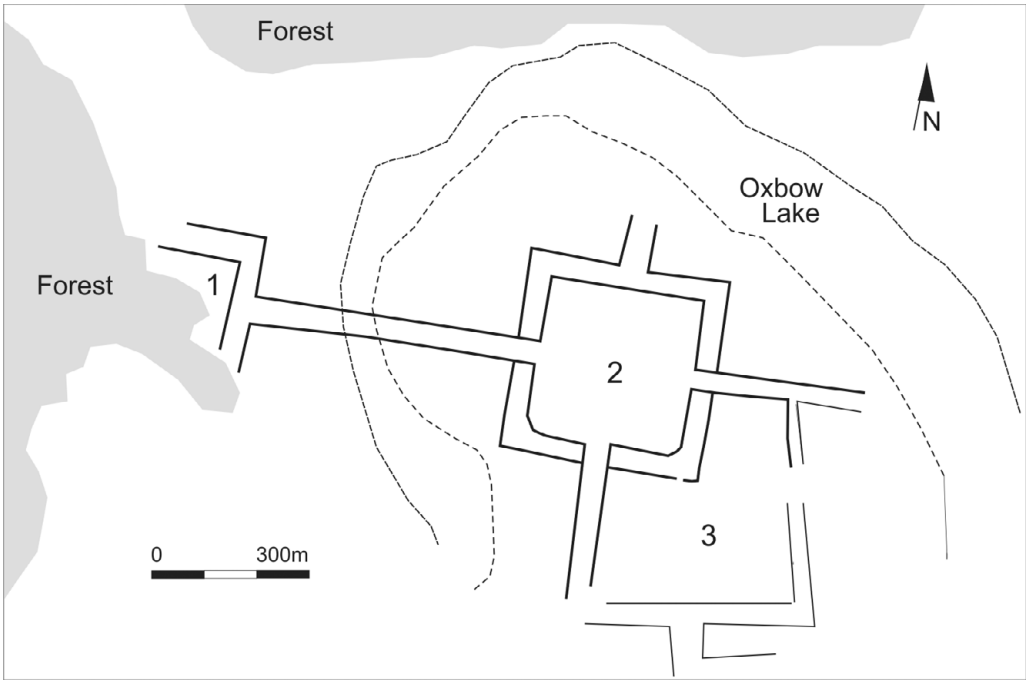

Figure 4. Plan of the Cruzeirinho site (drawing by Martti Pärssinen and Denise Schaan).

after 1300m to the geoglyph site Mustafa 2 (S 08 53' 15", W 67 14' 42"), which is comprised of a rectangular structure with rounded corners, measuring 200 × 260m. From Mustafa 2, a road comes out in the SW direction for some 500m before vanishing into the vegetation. Another rectangular structure lays 10km east of Cruzeirinho, which was called Mustafa 3 (S 08° 53' 11", W 67° 10' 19"). It is a 100m wide square, with a road leaving it in the south direction, vanishing after 120m. The fourth example, Boca do Acre 1 (S 8° 43' 13", W 67° 10' 34") located 16km north-east of the Cruzeirinho site, is a double ditched square, with roads leaving from the centre of its north, east and south sides, entering the vegetation in a south-eastern direction after 785m.

Our final example was located at Ranch Paraná (owned by Mr Tomás Rufino), on the east side of the BR-317 road in the state of Acre, not very far away from a tributary of the Iquiri River, but clearly in *terra firme* (S 09° 47' 13.5", W 67° 20' 35.2") (Figures 2 and 6). It is comprised of two perfect squares (200m and 100m wide), connected, in the same fashion as Cruzeirinho, by a 20m wide, 100m long causeway. The two squares are further connected to straight roads leading east and west, north and south.

Discussion

In the pages above we present substantial evidence for a family of geometric earthworks (geoglyphs) that extend over a vast region drained by tributaries of the upper Purús River, one of the main tributaries of the Amazon. Composed of linear ditches that form geometric figures, bordered by walls and linked by walled roads, such earthworks indicate the presence

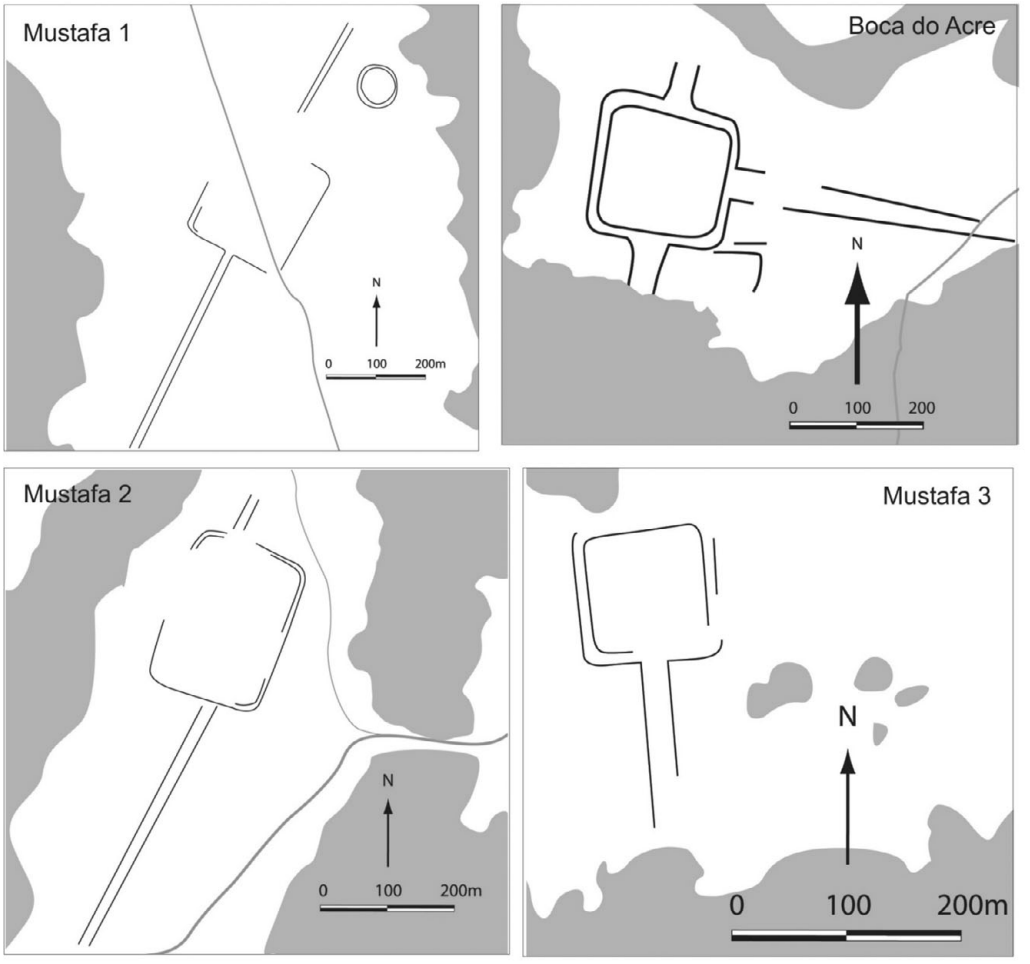

Figure 5. Plans of the sites of Mustafa (1, 2 and 3) and Boca do Acre (drawings by Martti Pärssinen and Denise Schaan).

of regionally organised societies, of the type that are commonly called chiefdoms (after Oberg 1955; see also Carneiro 1981). Although only one radiocarbon date is so far available, placing one of the most complex sites of the region in the first quarter of the second millennium AD, this is likely to be the period to which most of the sites should belong. Massive earthworks are found in other parts of Amazonia in the same time period, where complex societies arose over extensive areas of the Amazon River floodplain, estuary, savannas and a few upland areas, such as the upper Xingu and the Ecuadorian Amazon. The evidence for social complexity in the uplands of the Purús Basin, western Amazonia, not only adds data to this regional picture, but places all the existing data in a new perspective. Now it is more than clear that the *terra firme* was not an environment to preclude social complexity, but, in some settings, it even drew people to it. Besides this, our data shows that *terra firme* and *varzea* are not necessarily used exclusively by one people or another, but could be inhabited by societies displaying the same cosmologies and social organisation. Although, at this point, it

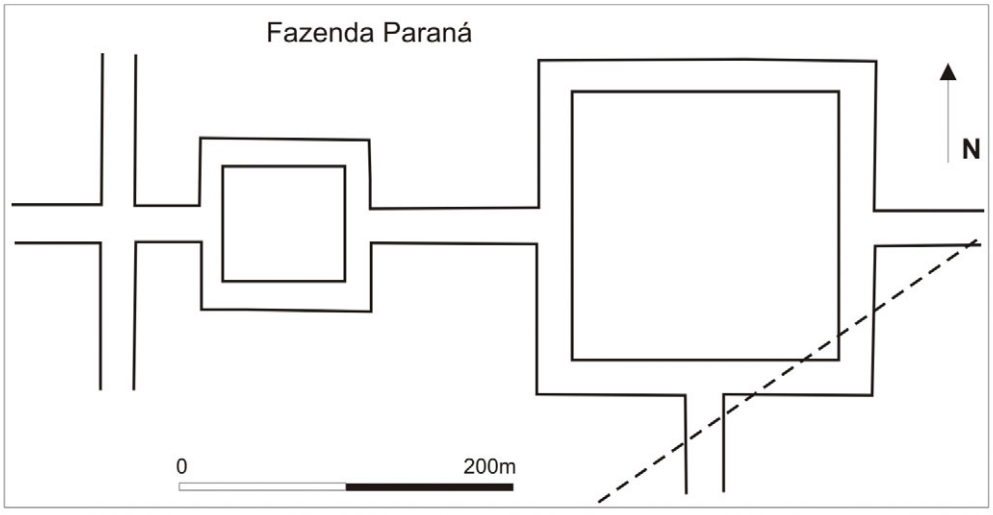

Figure 6. Aerial photograph and plan of the Fazenda Paraná site (photograph by Edison Caetano, drawing by Martti Pärssinen and Denise Schaan).

is still early to define which social organisation that would be, the homogeneity of settlement organisation over the *varzea* and *terra firme* areas for the upper Purús River is certain.

The archaeological evidence so far gathered within the scope of our project indicates that the most pervasive cultural features found within geoglyph sites include small mounds and ceramics. The differential occurrence of ceramics we have observed between sites might

indicate functional differences between habitation and ceremonial sites. The perfection of the geometric shapes indicates that such places had highly symbolic significance for ancient Amazonians. However, similar circular, semi-circular and elliptical ditched structures found elsewhere have generally been interpreted as fortified settlements (e.g. Arnold & Prettol 1988; Heckenberger *et al.* 1999; Roosevelt 1999; Wüst & Barreto 1999) so it is also quite possible that some of the Rio Branco and Boca do Acre earthworks had defensive purposes.

Whether the sites were purely ceremonial or defensive, it is clear that the area was densely populated by relatively sedentary people living both in *varzea* and *terra firme* environments at the eve of European contact. The 200 known sites, with over 210 geometric structures, are so far distributed over an area 250km across, encompassing both floodplain and *terra firme* environments. Given the poor coverage that Google Earth has for non-urban areas, we believe that the sites already found make up only 10 per cent of what is actually there. We can anticipate the exploration of a substantial population purposely modifying, for centuries, environments that we once considered marginal. Although our research is still at an early stage, we feel that the theory of almost stagnant, ecologically determined cultural development as supposed by Steward (1948) and Meggers (1971), and the notion of drastic differences between *varzea* and *terra firme* cultures proposed by Lathrap (1970), can no longer be supported.

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