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**PRE-COLUMBIAN EARTHWORK SITES IN THE FRONTIER REGION BETWEEN
BRAZIL AND BOLIVIA, SOUTHWESTERN AMAZON**

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ACADEMIC DISSERTATION

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Abstract

Amazonian earthworks have a variety of forms and sizes, and are found in different geographical and ecological locations, indicating separate time periods, distinct cultural affiliations, and diverse functions. Because research on pre-Columbian earthworks has only recently begun, a number of basic questions concerning the function and chronology of these structures, and the ethno-cultural and socio-political relationships of the societies who created them still remain unanswered. The main aim of this dissertation, consisting of four peer-reviewed articles and a synthesis paper, is to build new knowledge and expand on the existing, but still noticeably sparse, data on the region's pre-Columbian earthworking cultures. It proposes a hypothesis of the existence of relatively early sedentary interfluvial populations with rather organized and peculiar societal and ideological systems in southwestern Amazonia. This suggestion challenges the conventional view of ancient Amazonian peoples being non-sedentary, with an egalitarian social organization and an inability to alter and manage the environment in which they lived.

This dissertation presents and discusses the results of archaeological fieldwork undertaken at earthwork sites in two neighboring frontier regions in southwestern Amazonia: the region of Riberalta in Bolivia and the eastern state of Acre in Brasil. The Bolivian sites are interpreted as permanent settlements, while the Acrean earthworks were constructed principally for ceremonial purposes. The earthworks documented in the Riberalta region are structurally simpler than the ones studied in Acre and are found in slightly different locations, e.g., on high river bluffs or inland only a few kilometers from the main rivers. In Acre, the sites are located on high interfluvial plateaus near minor watercourses. The earthwork building practice prevailed in the Riberalta region from around 200 B.C. until the period of European contact, whereas the geometric earthwork tradition began earlier in Acre, around 1200 B.C., if not before. By the tenth century A.D., the regional confederation that created the geometric enclosures was already disintegrating. Even so, some sites apparently remained in use until the fourteenth century A.D. Chronologically and culturally, these earthworking peoples were formative-stage societies demonstrating emerging sedentism and evolving socio-organizational structures, and in Acre in

particular, a society united by a highly developed ideological system materialized in the geometric enclosure architecture.

Acknowledgments

My interest and life-long passion for Amazonia were awakened during the year I spent as an exchange student in Colombia at the beginning of the 1990s. During this time I got to know a group of Colombian archaeologists working in Amazonia, including Ines Cavalier, Louisa Herrera, Gaspar Morcote, and Camilo Rodrigues. Impressed by the quality of their research, I returned to Colombia in 1993 to participate in a season of fieldwork they carried out at the Peña Roja site in Colombian Amazonia and to gather material for my master's thesis in archeology. I revisited Amazonia in 1997, when I participated in a field survey in Bolivian Amazonia as part of the "Prehistory of the Chiriguanos and Tacanos" project, directed by Ari Siiriäinen, late professor of archeology at the University of Helsinki. It was then that I became convinced that I wanted to continue my studies in Amazonian archeology. This earnest wish came true in 2001–2003 under the auspices of the Finnish–Bolivian "The Amazonian Interests the Incas" project, also led by Siiriäinen. The fieldwork in Bolivia lasted six months, and I began collecting material for my dissertation. Fieldwork and data collection in Amazonia continued in 2005 and 2007–2008, this time for the Finnish-Brazilian "Man and Nature in Western Amazonian History" project, in Bolivian and Brazilian Amazonia. The project directors were professors Martti Pärssinen, of the University of Helsinki, and Denise Schaan, of the Universidade Federal do Pará. The Kone Foundation has provided me with research and travel grants in 2010–2013, and the University of Helsinki with travel grants for participating in international congresses in Manaus, Belém, and Quito. Since 2007 I have, in a sense, "gone native", commuting between the coniferous boreal forest environment of Mäntsälä and the tropical lowlands of Acre. As a result of writing this dissertation, Amazonia has definitely become my second home.

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And finally, with the poetry of my favorite sambista, Nelson Cavaquinho, my warmest thanks to the one I love, Rubens Barros, who has been by my side in spite of all obstacles.

O sol... há de brilhar mais uma vez
A luz... há de chegar aos corações
O mal... será queimada a semente
O amor... será eterno novamente

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List of Original Publications

This thesis consists of the following peer-reviewed articles which are referred to the synthesis paper by their Roman numerals.

I Saunaluoma, S. 2010. Pre-Columbian Earthworks in the Riberalta Region of the Bolivian Amazon. *Amazônica* 2(1):86–115.

II Schaan, D., M. Pärssinen, S. Saunaluoma, A. Ranzi, M. Bueno, and A. Barbosa. 2012. New Radiometric Dates for Pre-Columbian (2000–700 B.P.) Earthworks in Western Amazonia, Brazil. *Journal of Field Archaeology* 37(2):132–142.

III Saunaluoma, S. and D. Schaan. 2012. Monumentality in Western Amazonian Formative Societies: Geometric Ditched Enclosures in the Brazilian State of Acre. *Antiqua* 2(1):1–11.

IV Saunaluoma, S. 2012. Geometric Earthworks in the State of Acre, Brazil: Excavations at the Fazenda Atlântica and Quinauá Sites. *Latin American Antiquity* 23(4):565–583.

Introduction: Advancing Amazonian Archaeology

Pre-Columbian Amazonia is still, surprisingly, every so often explained as a largely pristine environment undisturbed by human impacts (McMichael et al. 2012). This conventional vision derives from the Standard Model (Viveiros de Castro 1996), formulated in the 1940s (Lowie 1948; Steward 1948) and characterized by environmental determinism and diffusionism, which described Amazonian pre-Columbian societies, categorized as the Tropical Forest Culture by Julian Steward and Robert Lowie, as sparse non-sedentary populations with an egalitarian social organization. While mobile marginal tribes occupied vast interfluvial areas surrounding the Amazon Basin, the Tropical Forest Culture populace inhabited areas near the main water routes (Steward 1948). Consequently, the Standard Model led to the formation of the renowned *terra firme* (upland) – *varzea* (floodplain) dichotomy, which divides Amazonia into two widely divergent environments. The basic elements of the Tropical Forest Culture include root crop cultivation, effective river transportation, pottery manufacture, absence of permanent villages, leadership restricted to a headman with some degree of power tied to kinship rule, and, especially interesting from the perspective of this dissertation, a lack of elaborate religious systems (Lowie 1948).

In Amazonian archaeology, Betty Meggers was probably the most influential defender of the Standard Model, arguing that cultures inhabiting the white-water river floodplain environment managed to develop by means of diverse adaptive processes, while *terra firme*, mainly due to nutrient-poor and leached soils, could only offer a setting for cultural degeneration (Meggers 1971). Donald Lathrap (1970) also supported this dichotomy concept, but in contrast to Meggers (Meggers and Evans 1957), he considered Amazonia to be a founding region for various independent cultural innovations (Lathrap 1973). Daniel Gross (1975) later introduced to this concept the insufficiency of exploitable animal protein in tropical lowlands as an inhibiting factor in the cultural progress of Amazonian societies, particularly of those societies occupying interfluvial areas. Meggers continued to expand the theory of the importance of environmental factors for Amazonian prehistory in the form of the Refugia Model (Meggers 1979) and the effects of El Niño events (Meggers 1994), explaining the detrimental impact of climatic fluctuations on demographic distribution

and diversity. According to Meggers, periods of environmental instability caused lowered population density, increased mobility, increased migration, and even extinction – aspects that readily correlate to Amazonian cultures of the post-Contact Period.

Intriguingly, the early chronicles picture Amazonian pre-Columbian cultures in a totally different way than the adherents of the Standard Model. Thus one of the focal issues in Amazonian archaeology is the impact of European conquest on native societies and how profoundly it affected and changed the demographic, economic, and socio-cultural processes during and after the Contact Period. The most recognized historical reference in archaeological literature is the chronicle written by the Dominican friar Gaspar de Carvajal, who narrated the first Amazon River expedition commanded by the conquistador Francisco de Orellana in 1541–1542. Carvajal ([1541–1543] 1894) described the river banks in central Amazonia as densely populated by adjoining permanent settlements that extended a long way inland and were controlled by paramount leaders. The account of the Jesuit father Cristóbal de Acuña (1641) also illustrated the riverine Amazonia as a scene of substantial indigenous occupations during the expedition of Pedro Teixeira from Quito to Belém along the Amazon River in 1638–1639. The accounts of explorers and travelers in the nineteenth and early twentieth century portrayed a different reality of decaying cultures, largely due to the introduction of European diseases and the far-reaching exploitation of natural and human resources. Nevertheless, many of these early ethnohistoric and ethnographic references provide information that can be interpreted as remnants of considerably organized and populous societies that once prevailed in pre-Columbian Amazonia (e.g., Keller 1875; Nordenskiöld 1913; Roquette-Pinto 1919; Wallace 1889).

In recent decades, a new concept that replaces the Standard Model has been established for the cultural development of Amazonia. This change of paradigm began in the late 1980s, and demonstrated extensive anthropogenic transformations and management of the natural environment, along with independent advances of cultural innovations in the tropical lowlands, a sedentary way of life, high population densities, and the emergence of late pre-Columbian complex societies along the Amazon River and its main tributaries (Balée 1995; Denevan 1992; Posey and Balée

1989; Roosevelt 1991,1994a; Stahl 2002). This new paradigm for Amazonian archaeology is also eco-centered, which is logical because we are dealing with the world's most biologically diverse area. However, instead of stressing the fatalistic adaptive position of ancient Amazonian peoples in relation to varying ecological situations, the new concept sees humans as capable of maintaining an interactive dialogue with the environment that they occupy. The new standard for Amazonian archaeology has its roots in historical ecology (Crumley 1994), and it is shifting the focus of research perspectives away from the traditional culture – nature dichotomy and towards the dynamic relations between the environmental systems and humans (Balée 2010; Balée and Erickson 2006; Erickson 2008, 2010; Heckenberger 2010; Schaan 2010, 2012; Stahl 2009). The concept of historical ecology underlines the outcomes of past historical circumstances. Rather than prevailing ecological conditions alone, varied historical processes may have irreversible effects on the cultural developmental sequence.

Large-scale conscious environmental alterations took place in Amazonia centuries before the European contact period. One of the most convincing indications of agriculture-related long-term sedentism in tropical lowlands is the high incidence of dark anthropogenic¹ soil layers, Amazonian Dark Earths (ADE), often found at pre-Columbian riverine sites of Amazonia. Studies concentrating on the subject of ADE commenced in the 1980s (Eden et al. 1984; Smith 1980). Since then, research focused on ADE has enhanced considerably our understanding of these human-induced soils and their implications for Amazonian archaeology (see, for example, Glaser and Woods 2004; Lehmann et al. 2003; Teixeira et al. 2009; Woods et al. 2009). There are two types of ADE: *terra preta* and *terra mulata*. Genuine *terra preta* is a black soil, packed with cultural debris, and associated with permanent settlements, while *terra mulata* is brownish in color, more wide-ranging, lacking in archaeological ceramics, and the result of enduring agricultural activities outlying residential areas. Both soil types are much more fertile than natural, non-anthropogenic Amazonian soils, perhaps due to their high pyrogenic carbon content (Woods and Denevan 2009).

Further testimony to extensive anthropogenic environmental modifications includes earthworks, many of which are still perceptible in the contemporary landscape

(Figure 1). Earthwork engineering seems to have been a widespread cultural tradition throughout Amazonia, from the Andean piedmont (Salazar 2008) to the coast of the Guianas (Rostain 2010) and Marajó Island in the Amazon estuary (e.g., Roosevelt 1991; Meggers and Evans 1957; Schaan and Veiga 2004), extending north to the Venezuelan Llanos (Spencer and Redmond 1992) and south to the Upper Xingu region (Heckenberger et al. 1999) and the Bolivian Llanos de Mojos (Denevan 1966; Erickson 1995, 2001, 2006a; Prümers et al. 2006; Walker 2008a, 2008b). The extent and significance of the archaeological earthwork phenomenon have been the topics of many recent studies, demonstrating that Amazonian earthworks have a variety of forms and sizes and are found in different geographical and ecological locations, indicating separate time periods, distinct cultural affiliations, and diverse functions. Additionally, in some cases, their significance is much more complex than their being mere representations of functional architectural compounds (Papers III–IV).



Figure 1. Aerial photo of the Baixa Verde site, taken in 2010. The rectangular ditch, situated approximately 30 km east of the city of Rio Branco, has endured some 2,000 years of human land-use.

The third central concern of Amazonian archaeology, in addition to the critique of ecological determinism and the issue of the consequences of the European conquest among Amerindian populations, is the question of ethno-linguistic groups and their connection to certain ceramic traditions (Brochado 1984; Heckenberger 2008; Lathrap 1970; Neves 2008). This debate, despite providing an alternative insight into ancient migrations and cultural interchange (as an example, see Eriksen 2011), is problematic, and archaeologists are generally reluctant to apply linguistic studies. Ethnohistoric evidence for understanding extensive post-contact population

relocations is insufficient, which complicates the comparison of prehistoric and contemporary linguistic frameworks, and moreover, the geographical patterning of Amazonian linguistic families needs supplementary evaluation (Roosevelt 1994b:17). Furthermore, cultural traditions and ethnicity are not necessarily related; the characteristics of material culture are easily transferred from one ethnic group to another (e.g., Jones 1997; Lucy 2005).

The current trend in Amazonian archaeology draws even more attention to the dynamism, variability, and uniqueness of Amazonian cultural achievements than the initial historical ecology-based model of the 1990s (Arroyo-Kalin 2012; Dickau et al. 2012; Heckenberger and Neves 2009; Heckenberger et al. 2008; Lombardo 2010; Lombardo and Prümers 2010; Lombardo et al. 2011; Neves 2011; Papers I–IV; Pärssinen et al. 2009; Pereira and Guapindaia 2010; Prümers 2009; Walker 2011a, 2011b). Amazonia is not only indisputably unique in its biodiversity, but it is also incredibly variable culturally, as the research in progress is demonstrating through a comprehensive recognition of ecological complexity and regional variations.

Research Environment

The areas of study, i.e., the region of Riberalta in northern Bolivian Amazonia and the eastern part of the Brazilian state of Acre, are located in southwestern Amazonia, in a region defined by the tributary areas of the Ucayali, Juruá, and Purus rivers and the white-water tributaries of the Madeira River (Figure 2). These rivers have their headwaters in the eastern Andean slopes and deposit vast amounts of silt in the Amazon plain. The geomorphological relief is almost entirely formed by undulating non-flooded ground composed of late Tertiary alluvium and younger alluvial terraces and plains (Räsänen et al. 2007). The soils are mainly Acrisols, with some areas of Ferralsols (Macías 1984; Oliveira and Alvarenga 1985). The soils of western Amazonia have been studied scantily, but they seem to differ from other Amazonian regional soils in, for example, their high contents of exchangeable aluminum (Marques et al. 2002), which is considered one of the main limiting factors of agricultural productivity, especially in acidic tropical soils (Abreu Jr. et al. 2003). Yet, not all upland soils in Acre are regarded as impoverished (William Woods, personal

communication 2013). However, to date, no true ADE soils have been recorded in the study area.

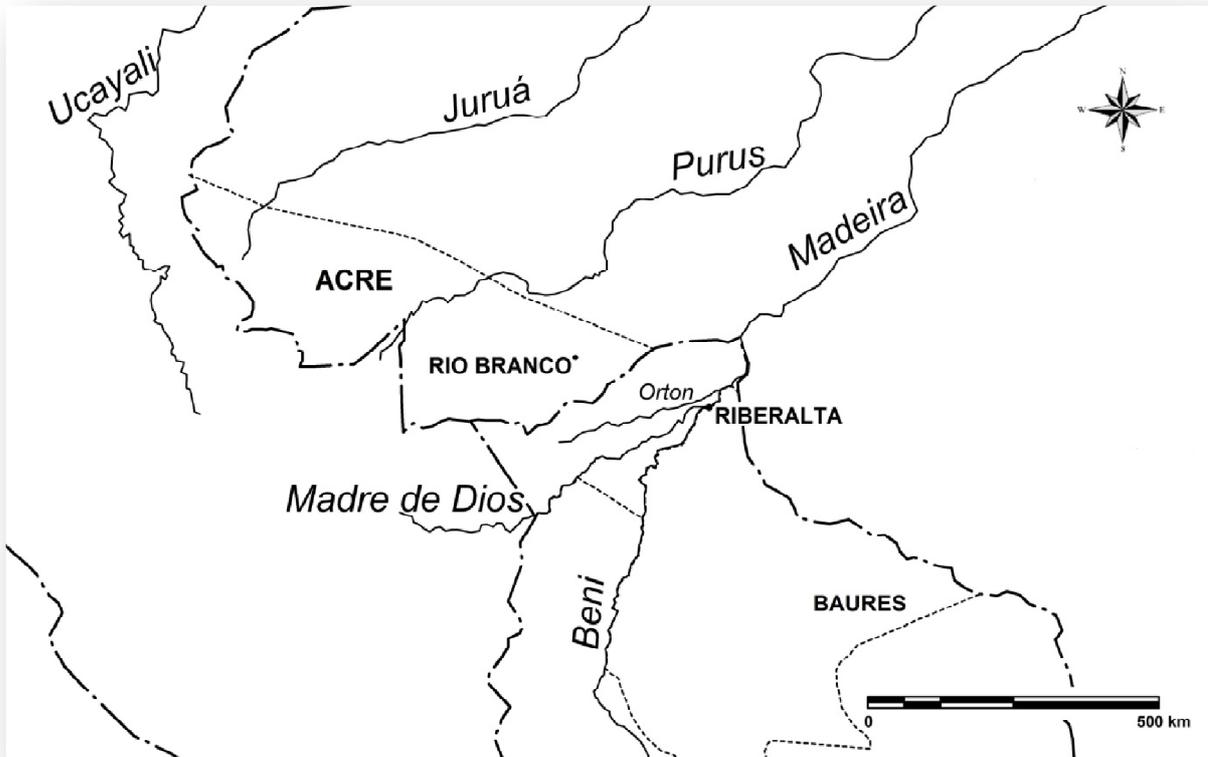


Figure 2. Southwestern Amazonia; locations of main rivers and regions mentioned in the text.

In contrast to its rather deprived soils, the western Amazonian rainforest is considered the most biodiverse part of the Amazon Basin due to geo-historical and more recent environmental disturbance dynamics, including anthropogenic intrusions (Dirzo and Raven 2003; Dumont 1996; Malhi and Phillips 2005; Salo et al. 1986). On the Bolivian side, in the Department of Pando, the well-drained *terra firme* is still covered by nearly intact lowland rainforest, while approximately 50 percent of the area of eastern state of Acre is deforested (Pinheiro et al. 2011; Figure 3). Needless to say, deforestation has contributed greatly to earthwork research, since satellite remote sensing is one of the primary methods for locating new earthwork sites (Lombardo and Prümers 2010; Schaan et al. 2010).



Figure 3. Satellite imagery showing the contrast between the still-preserved Bolivian rainforest and the deforested sectors on the Brazilian side of the border (Google Earth Imagery © Google Inc., Europa Technologies; © 2012).

The introduction of scientific exploration in southwestern Amazonia took place in 1780–1795, when military engineer Francisco Requena e Herrera carried out a cartographic demarcation of the Spanish – Portuguese boundaries in the Amazon Basin, producing maps and enlightening watercolor paintings that illustrated the natural and cultural environments at that time (Beerman 1996). In 1864–1865, geographer William Chandless (1866a, 1866b) conducted a cartographic survey of the courses of the Purus and Acre rivers. He mentioned various native tribes encountered during the journey and divided them into the general categories of "Indians of the land and Indians of the water" (Chandless 1866a:96). Obviously, Chandless did not venture far inland, so his observations concern only to the areas near the region's main waterways. Some 20 years later, when the rubber boom had already altered the region's native demography, causing massive ethnic dislocations (Vallvé 2010), explorer Antonio Labre (1889) traveled by foot from the confluence of the Beni and Madre de Dios rivers to the Acre River to open up a tentative commercial terrestrial connection between these regions. Labre made some interesting notes on the interfluvial indigenous occupations, mentioning, for example, many abandoned villages, some of which still had "a small temple with clean

courtyard in circular form" and "roads crossing each other in all directions, and small cultivated fields" (Labre 1889:498, 500). These villages were situated in what is currently the Bolivian department of Pando, on the northern side of the Orton River. Chandless and Labre, as well as the Spanish missionary Nicolás Armentia, who traveled around the river courses of the Beni and Madre de Dios in the 1880s, described a variety of ethnic groups, but the ones pertaining to the Arawak, Pano and Tacana linguistic families seem to have been the most numerous (Armentia [1883] 1976; Chandless 1866a; Labre 1889; Metraux 1948).

Southwestern Amazonia still has remarkable variation in indigenous ethnicity, including a few remaining uncontacted/isolated peoples. According to ethnohistoric sources, the area of the Bolivian tropical lowlands is "peculiar in possessing an unusually large number of linguistic stocks" (Metraux 1942:1). The contemporary ethnic groups in the region of Riberalta pertain to the Panoan – Tacanan language family (Teijeiro et al. 2001). These peoples are largely assimilated and have adopted the lifestyle of the Bolivian main-stream rural population. In Acre, the position of the indigenous population is somewhat different. The indigenous territories cover 14 percent of the state of Acre, and the indigenous peoples, representing the Pano, Arawak, and Arawá linguistic stocks, are politically organized and prepared to answer for the production, environmental management, cultural revitalization, and vigilance of their lands (Rodrigues 2010). After the devastating effects of the late nineteenth-century rubber boom on the indigenous demography (Vallvé 2010), direct cultural continuity between the region's ethnicities of past and present is uncertain. Nevertheless, ethnographic analogies are useful in enhancing our understanding of ancient societies' traditions and manner of living in the tropical lowland environment of southwestern Amazonia.

Study Background: Upsurge of Regional Archaeology

This dissertation was prepared under the auspices of two archaeological research projects directed by Ari Siiriäinen, late professor of archaeology at the University of Helsinki, Martti Pärssinen, professor of Latin American studies at the University of Helsinki, and Denise Schaan, the director of the Graduate Program in Anthropology

at the Universidade Federal do Pará. In 2001–2003, the Finnish–Bolivian project titled "The Amazonian Interests of the Incas" explored the geographical extent of the Inca state (A.D. 1400–1532) in Bolivian Amazonia. The research focus was La Fortaleza de las Piedras, an Inca fortress site at the confluence of the Beni and Madre de Dios rivers near the town of Riberalta. Earthwork sites were surveyed concurrently to obtain a more comprehensive view of the region's archaeology. The Finnish–Brazilian "Man and Nature in Western Amazonian History" project, carried out in Bolivian and Brazilian Amazonia in 2005–2008, emphasized the demographic and cultural development in the western Amazon before the European contact period. In addition to the Riberalta region's earthwork sites, the peculiar and poorly known geometric earthworks located in the Brazilian state of Acre, a few hundred kilometers to northwest of Riberalta, were chosen as a topic of study because only few examples of monumental archaeological sites of this type had been surveyed before in Amazonia.

The earliest archaeological studies in the Riberalta region were restricted to short accounts and field reports that referred mainly to La Fortaleza de las Piedras. The first to mention this site was Marius Del Castillo (1929), who explored the Beni River in the late 1920s and made also notes of archaeological vestiges encountered during this journey. Said Zeitum Lopez (1991:151–152) visited the "Fuerte Incásico" in the 1950s and provided details of its walled structures. William Denevan (1966:23) also mentioned the archaeological features he perceived at the site in 1961. In 1977, Víctor Bustos and Kenneth Lee visited La Fortaleza de las Piedras, describing it as a defensive and ceremonial site, and also noting the existence of the El Anillo (i.e., El Círculo) site (Bustos 1978). More recent archaeological investigations include a survey of the Tumichucua site (Arnold and Prettol 1988), situated approximately 18 km southwest of Riberalta, and a reconnaissance carried out along the lower Orton River (Arellano 2002). The preliminary results of the "Amazonian Interests of the Incas" project were published in the early 2000s (Siiriäinen and Korpisaari 2002, 2003; Siiriäinen and Pärssinen 2003).

In Acre, the record of archaeological research is also quite scant and fairly recent, compared with that of many other parts of the Brazilian Amazonia.² Ondemar Dias carried out the first archaeological studies in Acre, under the auspices of the

Programa Nacional de Pesquisas Arqueológicas na Bacia Amazônica (PRONAPABA) project in the late 1970s (Dias 1977, 1978, 1979, 1980). PRONAPABA was coordinated by Betty Meggers and Clifford Evans of the Smithsonian Institution and Mario Simões of the Museu Paraense Emílio Goeldi, with the objective of determining the settlement patterns, routes of migration, and cultural characteristics of prehistoric populations in Amazonia (Dias 1977). During PRONAPABA, various pre-Columbian sites in the Upper Purus and Juruá river valleys, including ceramic-bearing settlement sites, campsites, urn burial sites, and some circular earthwork sites, were surveyed and registered. Dias (Dias and Carvalho 1988) later proposed a tentative hypothesis concerning the defensive function of the circular earthworks. Dias returned to Acre with his students in 1992–1999 to investigate the ceramic material of the earthwork sites (Latini 1998; Nícoli 2000) and established two ceramic traditions for the region: Acuriá for the Juruá river valley and Quinari for the upper Purus basin (Dias 2006). The data pertaining to the former tradition remain unpublished.

In the late 1990s, paleontologist Alceu Ranzi re-discovered the Acrean geometric earthworks from the air when approaching Rio Branco by plane. Afterward, Ranzi arranged flights for aerial photography. By 2001, he had registered 25 geometric earthworks, referred to as *geoglifos*, in the vicinity of Rio Branco (Ranzi 2003). Convinced of this finding's value, Ranzi made contact with various scholars, including Martti Pärssinen of the University of Helsinki and Denise Schaan (at that time of the Museu Paraense Emílio Goeldi), who was carrying out rescue excavations in Acre in 2005 at sites affected by the establishment of power lines by the Electronorte company. This collaboration was the start of the "Man and Nature in Western Amazonian History" project. Since then, archaeological research in Acre has intensified considerably. Both scholarly research projects and rescue archaeology assignments have increased our knowledge of the region's archaeology. However, to develop a comprehensive understanding of pre-Columbian Acre, many subjects still need to be studied. While the prehistory of both regions under study has been until recently inadequately explored, this dissertation contributes to the comprehension of southwestern Amazonia's regional archaeology and provides new data concerning evolving Amazonian archaeology in general.

Research Questions: Building New Knowledge

Because research on pre-Columbian earthworks in southwestern Amazonia has only recently begun, a number of basic questions concerning the function and chronology of these structures and the ethno-cultural relationships and socio-political issues of the societies who created them remain unanswered. The main aim of this dissertation was to build new knowledge and expand on the existing, and still noticeably sparse, data on the region's pre-Columbian earthworking cultures. This dissertation proposes a hypothesis of the existence of relatively early sedentary interfluvial populations with rather organized and peculiar societal and ideological systems in southwestern Amazonia. This hypothesis challenges the conventional view of ancient Amazonian peoples being reactive toward environmental processes and unable to organize their modes of conduct to interact and cope with the ecological conditions of the tropical lowlands.

To test the hypothesis, information was acquired taking into consideration certain research topics. The identification and interpretation of the sites' ditches, embankments, mounds, and roads were crucial to comprehending their magnitude, functions, and spatial arrangements, as well as the physical setting in which the earthworks were constructed. Another issue of utmost importance was using the radiocarbon method to date the individual sites to assess their chronological disposition, reveal the possible temporal development of their sizes and forms, and understand the regional typology, the comprehensive extent of the occurrence of the earthwork sites, and their relationship to the cultural sequence of the Amazon in general. To obtain knowledge of specific material cultural variables associated with the earthwork sites, ceramic form and ornament styles in particular were studied for regional comparison to detect the relationships between the communities and the exchange routes of information, values, and commodities. In summary, the earthwork sites of the two neighboring regions were compared, and parallels and differences are discussed in this synthesis paper to further augment knowledge of southwestern Amazonian archaeology.

The first article (Paper I) presents the results of a survey and trial excavations undertaken in the region of Riberalta, in the departments of Beni and Pando in

northern Bolivia, in an area with few formerly documented archaeological sites. Because the main objectives of these investigations were to identify, study the variation among, clarify the functions of, and date the region's earthworks, this paper concentrates on five earthwork sites, providing a description of the cultural features and materials, as well as the radiometric dates of these sites. Southwestern Amazonia's ceramic traditions are explored seeking parallels (or dissimilarities) in local ceramic assemblages. The layouts and functions of the studied earthworks, interpreted here principally as settlement sites, are analyzed and compared on a regional scale. Finally, the potential ethno-cultural affiliation of the peoples who constructed and occupied these earthwork sites is briefly discussed.

Paper II introduces new radiometric dates and fieldwork data on the geometric earthworks, i.e., ditched enclosures, of the Brazilian state of Acre and provides some ethnographic examples for the feasible functions of these constructions. The paper addresses three complex geometric earthwork sites, interpreting the sites' ceramics and other cultural on-site features, and displays the Amazonian interfluvial area as a setting for large-scale anthropogenic landscape modifications and considerable population densities, contrary to the traditional view of pre-Columbian Amazonia. The question of the possible ethno-cultural background of the builders of the geometric ditched earthworks is explored, and the construction of these public spaces as a regionally shared tradition extending beyond ethnic boundaries is proposed. Ethnohistoric sources are applied to strengthen the argument of the collective and possibly religious use of the ditched enclosures.

Paper III deals with the implication of monumentality for Acrean earthworking societies, presenting cross-cultural examples from central European causewayed enclosures and central Andean civic-ceremonial sites. The emergence of monumental public architecture is considered an indicator of transition and increasing complexity among the formative-stage societies of Acre. The paper depicts the route of flows of information, cultural practices, and ideologies between western Amazonia and the central Andean area, analyzing, in addition to the architectural elements of early ceremonial centers, certain attributes of ceramic materials. The nine geometric ditched enclosure sites under study display close cultural connections, regardless of

slight temporal, geographical, and morphological differences, which reinforces the idea of communities integrated by a regional ideological or socio-political coalition.

Paper IV presents a case study of two composite ditched enclosure sites, providing further evidence of the primarily ceremonial and/or ritual use of the geometric earthwork sites in eastern Acre. Emphasis is placed on a detailed analysis of the sites' earthwork structures and minor on-site cultural features, as well as the distribution of archaeological deposits and the characteristics of ceramic collections. The significance of different earthwork forms and structural features in archaeological and ethnographic contexts is discussed. The idea of these sites serving solely defensive and/or residential functions is abandoned, given that the fieldwork data support the interpretation of the geometric ditched enclosures as communal spaces used predominantly for ceremonial activities.

Materials and Methods

Field archaeology in Amazonia and at the earthwork sites differs from archaeology in many other regions and settings. Fieldwork in Amazonia is arduous indeed. The accessibility of the sites is generally low, due to long distances and the lack of proper infrastructure and logistics. Sometimes, entry to the sites and permission for surveys and excavations are denied by land-owners, typically because excavations are considered disadvantageous for cultivation and cattle raising. As a result of sumptuous vegetation, visibility at the sites is often reduced, which complicates mapping and excavating. The preservation of archaeological material in moist tropical contexts is very poor. At most southwestern Amazonian sites, eroded ceramics constitute the bulk of the material culture available for analysis because lithics are rare, metal artifacts are practically non-existent, and artifacts manufactured of organic material obviously decayed long ago. Excavating large (1–10 ha) earthwork sites is extremely slow. Digging is feasible only during the dry season, which in southwestern Amazonia extends from May to October, and usually after a rainless period of a couple of weeks, the soil becomes compacted and thus hard to dig. Although the density of cultural remains is low at the earthwork sites, the depth of excavations is normally 60–100 cm, and the cultural layers can reach depths of

300 cm at the ditch bases. Furthermore, intense heat and insect bites can slow down archaeological fieldwork and even make such an effort insupportable for researchers in the tropical rainforest.

The following fieldwork procedures were applied to obtain the information needed to answer the above-mentioned research questions. The locations of the sites under study were documented with a hand-held GPS device, and the earthwork structures mapped. We excavated 1 x 1 m test units in artificial 10-cm levels at each site to reveal the distribution, density, and characteristics of cultural deposits in different sections of the sites, and we collected ceramic, soil, and radiocarbon samples (wood charcoal).

In Bolivia, the Tumichucua, Estancia Girasol, Las Palmeras, Estancia Giese, and El Círculo sites, featuring different types of earthworks, were mapped and tested in trial excavations. Due to the presence of dense vegetation, mapping was carried out using a hand compass. Although the Tumichucua earthwork complex had been previously studied by Dean Arnold and Kenneth Prettol (1988), we wanted to return there to collect radiocarbon samples, because Arnold and Prettol had not dated the site. At the Chacra Telería and Candelaria sites, ceramic and radiocarbon samples were collected from test units to compare these sites, lacking visible earthen structures, to the earthwork sites. Furthermore, four sites (Estancia Mendez, Chacra Carbajal, Dos Palmas, and Estancia Velasco) were briefly visited to verify the type of occupation, primarily the presence or absence of earthworks. The ceramic and lithic materials recovered during the fieldwork periods 2001–2003 and 2005 were deposited in a communal lodge situated in the community of Las Piedras, in the department of Pando.

Macrofossil analysis was applied as a part of the archaeological investigations at the Tumichucua, Las Palmeras, Estancia Giese, and El Círculo sites. The primary objective of this analysis was to gain additional information on certain aspects of the region's ancient societies, such as their economy, land use activities, and environmental management. While paleobotanical analyses are not commonly used in Amazonian archaeology, perhaps because plant remains are often very poorly preserved in tropical climates (Pearsall 1995), the secondary objective was to

evaluate the utility of this method in the Riberalta region's archaeological contexts. We collected two-liter sediment samples from 2–4 excavation units' vertical profiles at 20-cm intervals at each site mentioned. The macrofossil material was extracted from the sediment by manual water flotation and analyzed by Tanja Aalto at the University of Turku. Only charred macroremains were considered to correspond to the ancient periods of plant use. The results were not very encouraging. In total, the samples contained only 6 percent charred plant remains, the majority of which came from El Círculo samples. In the other sites' samples, the quantities of charred macrofossil material were minimal. The few identified species were charred palm (*Attalea* sp.) fruits and grass (Family *Poaceae*) seeds (Aalto 2005). It is possible that the water flotation method shatters macrofossil remains (Pearsall 1995), which could have been one of the factors affecting the small amount of identifiable charred macrofossil material in our samples. Furthermore, if a more comprehensive comparative collection of tropical plants had been available during the analysis, more species could probably have been identified in the samples.

In Brazil, the Severino Calazans, Fazenda Colorada, Jacó Sá, Fazenda Atlântica, Quinauá (also known as Balneário Quinauá), Ramal do Capatará, and JK sites were surveyed using a Geodimeter 600 total station. On average, 1,320 measurements were made at each site, concentrating on the earthwork features, while the areas with flat topography were measured more sparsely. The Fazenda São Paulo site was mapped with a hand-held GPS device. At the Prohevea site, only the location of the test excavation units was recorded, due to the completely demolished state of the site's circular earthwork at the time of the rescue excavation in 2010. The archaeological material recovered during the fieldwork periods is stored in the Departamento de Patrimônio Histórico da Fundação Elias Mansour in Rio Branco.

Soil samples for phosphorus analysis were collected at the Severino Calazans (83 samples) and Jacó Sá (107 samples) sites. The objectives of this geochemical application were to test the suitability of phosphorus analysis at the geometric earthwork sites of Acre and to try to locate areas of activity, such as waste disposal, burial, and fertilized cultivation sections. The 10-gram soil samples were collected during the 2007 field season in a grid at 30-m intervals, at a depth of 30 cm. In addition, three vertical profiles comprising ten samples each, collected at depths

between 10 cm and 100 cm, were analyzed to determine whether phosphorus had leached deeper into the soil. The samples were analyzed by Paula Kouki (November 2009) at the University of Helsinki. No anthropogenic enrichment of soil phosphorus could be perceived in any of the analyzed samples. The explanation for this may be that the occupation at the sites was neither sufficiently long-term, nor sufficiently intensive to cause a lasting phosphorus anomaly in the soil under the prevailing environmental conditions. The nature of the occupation may also have been such that it did not cause significant accumulation and subsequent decomposition of organic matter. Another possible explanation is that phosphorus in the soil samples was fixed in compounds not extracted in the process used to treat the samples. To test this assumption, the treatment of the samples should be modified to release more of the phosphorus fractions into solution (Kouki 2009).

Geophysical surveying using a GPR (ground-penetrating radar) was carried out at Fazenda Atlântica by Marcio Rocha (May 2008) of the Universidade Federal Rural do Rio de Janeiro and at JK by José Gouvea Luiz (July 2010) of the Departamento do Geofísica da Universidade Federal do Pará. Some excavation units were placed at points where the GPR supposedly detected anomalies. The results of this analysis were not promising either, because they did not reveal any notable archaeological anomalies in the soil of the surveyed areas.

Although the applied fieldwork methods (i.e., macrofossil and phosphorus analysis, and GPR survey) did not yield positive results, these and certain other geophysical methods, such as magnetometry and electromagnetic induction, would be worth applying again in future research. Geophysical surveying in particular has been proven successful at other Amazonian archaeological sites (Bevan and Roosevelt 2003; Roosevelt 1991, 2007). Geophysical methods are non-destructive and relatively rapid, which could be quite useful in preliminary surveys at earthwork sites that usually cover sizable areas.

Discussion

This chapter discusses the results of the research presented in Papers I–IV through a comparative regional perspective. The data collected from the studied earthwork sites in the two neighboring frontier regions were evaluated to determine whether the sites belong to a widespread common regional system or whether we are considering separate, more locally restricted cultural traditions.

Location of the Earthworks

In the Riberalta region, we found diverse earthwork sites at 137–146 m asl on the high bluffs of the main rivers and also a bit further inland (3–5 km from the floodplain) near minor watercourses. Due to the active meandering of the Beni and Madre de Dios rivers, some of the most ancient sites are today most likely located at some distance from the river margins, and others may have been destroyed by channel migrations. Changes in the course of the rivers, by lateral channel migration or sudden avulsion, may have been among the factors leading to the abandonment of sites in western Amazonia (Lathrap 1968; Pärssinen et al. 1996).

The Acrean geometric earthworks, conversely, are situated on the stable *terra firme* plateaus of the Acre, Iquiri and Abunã rivers, tributaries of the Purus and Madeira rivers, at approximately 160–230 m asl, near rivulets. The earthworks are located on elevated yet level terrains, with a good view of the surrounding landscape. Apparently, the earthworks were constructed not only as places to have complete visible control of the surroundings, but also as monuments to be seen and recognized from a considerable distance. Another factor that supports the idea of their monumentality is that the earthworks were built to last for generations; the proof is that many earthworks are still clearly distinguishable in the modern-day landscape.

In the core area of the geometric earthworks, the distances between the separate earthwork sites vary, but other sites are generally located within a radius of 2–10 km. The northernmost geometric earthworks have been recorded in Boca do Acre, in the state of Amazonas (Pärssinen et al. 2009), some 140 km from Rio Branco, and the

westernmost in the state of Rondônia (Schaan et al. 2010:Figure 2). The number of registered geometric earthworks in Brazil is currently approximately 300.³ Circular enclosure forms seem to predominate in the southern part of the area in which geometric earthworks are found, while quadrangular forms are more common in the north. In the south, the area of occurrence of geometric earthworks most likely extends to the department of Pando, but as the rainforest is still well preserved on the Bolivian side of the border, it is currently impossible to assess the full extent and elements of the earthworks in Bolivian Amazonia. Some of the ring ditch sites in the Baures region in northeastern Bolivian Amazonia (Erickson 2010; Erickson et al. 2008), approximately 600 km southeast of Rio Branco, are technically similar to the Acrean geometric earthworks, more so than the ones studied in Riberalta.

Characteristics of the Earthworks and Their Cultural Deposits

The earthwork sites investigated in the region of Riberalta display more type variation but are structurally less complex than the sites in Acre (Paper I). Tumichucua occupies an area of approximately 125 hectares, while the other documented Riberalta sites are only one-third of that size. The Tumichucua site features circular and semicircular ditches adjacent to an oxbow lake, and a canal connecting the lake and the floodplain of the River Beni. Although these earthworks were already eroded and were distinguished in places with difficulty, evidently the ditch backfill was piled on both sides of the ditches. The cultural deposits, which reach depths of 60 cm, are concentrated in the area enclosed by the circular ditch, while the ditch itself contains less archaeological material. At the Las Palmeras site, a 40-cm-thick cultural layer covers the area surrounded by a badly eroded roughly circular ditch. Nevertheless, the most profuse archaeological deposits were found at the base of the ditch and in the small mound/depression features inside the circle. At the Girasol site, we documented four earthworks: two partly parallel, already eroded ditches connected to the old riverbank of the Beni River, a canal connecting a smaller stream to the Beni, and a section of a 15-m-wide road structure. At this site also, the greater part of the cultural material present had accumulated in the ditches. Less substantial deposits were encountered in an embankment between and outside the double-ditch system. At the Estancia Giese site, moderate, 20 to 40-cm-thick archaeological deposits were

dispersed inside and outside of the mapped semicircular embankment. The El Círculo site consists of a circular embankment with an entrance facing toward the old riverbank of the Beni River and a canal situated some 150 m to the east. Deposits that indicated residential activities were found concentrated in the embankment and, in particular, in the small mounds attached to the inner side of the embankment. The area enclosed by the circular embankment is void of cultural layers.

In Acre, a uniform standard of earthwork engineering and a rather consistent pattern of deposit distribution clearly existed within the geometric earthworks (Papers II–IV). The geometric earthwork sites contain contiguous ditch and embankment structures, also called ditched enclosures, of varying forms, such as circles, squares, rectangles, ellipses, octagons, and U- and D-shapes; circles and squares being the most frequent outlines. The best-preserved ditches are still several meters deep. The individual enclosures vary in diameter from dozens of meters to almost 400 m, and the sites generally comprise 1–5 distinct earthworks, ranging in size and shape. Some of the sites contain remains of rectangular-shaped embankments that are situated between or inside the ditched enclosures. The areas enclosed by the earthworks at different sites are approximately 1–10 hectares in size. Roads, delineated by low banks, frequently connect separate enclosures and link them to a network of nearby headwater streams. The overall density of cultural material is low at the geometric earthwork sites, and the distribution of cultural deposits indicates that the flat area enclosed by ditches and/or embankments was kept clean, perhaps functioning as a plaza meant for communal gatherings or ceremonies. Ceramics were found accumulated at the bases of the ditches, in embankments, and in special features, such as a small artificial mound documented at the Fazenda Atlântica site. This feature was apparently related to ritual activities performed at the site (Paper IV).

The cultural layers in the Acrean ditches are much thicker than in Riberalta, suggesting that these ditches were originally 2–3 m deeper than they are today. Some of the finer ceramic material was deposited in those parts of the ditch closest to the entrance of the enclosure, suggesting a votive function (Paper III). Ceramics were also located on the slopes of the ditches, as if thrown there during the maintenance and cleaning of the enclosed space. Obviously, archaeological material

also ended up in the ditches as a consequence of natural soil creep processes, considering the primary depositional location of certain ceramics on the adjacent embankments. Ceramics were usually also found in the embankments, particularly in their most elevated parts near the enclosure entrances, as if they formed part of the construction material of these structures or were deposited there gradually in the course of the site's active utilization.

The extents and characteristics of the individual sites and earthwork structures are quite varied in Riberalta, but they do not exhibit the precise geometric shapes of the Acrean earthen enclosures. Furthermore, certain structures, such as the distinctive external embankments along the ditches, and the roads connecting separate earthworks, are absent. Because we could survey only a section of the road discovered at Estancia Girasol, it is difficult to define its context of use; it may belong to the same complex as the ditches, or it may be a remnant of an earlier or later occupation. The differences in the earthwork type and layout, as well as in the distribution of cultural deposits at the sites, seem to reflect diverse functional objectives, as discussed later in this synthesis paper.

Chronology

In Amazonia, earthworking seems to have been a dynamic and enduring cultural practice not restricted to a certain region or period of time. The monumental mound complexes with road networks and rectangular platforms delineating square-shaped plazas in the Ecuadorian Upano Valley in the Andean piedmont, utilized mainly as settlement sites, span the period of approximately 700 B.C.–A.D. 1200 (Salazar 2008). The massive earthworks related to agricultural activities in the eastern lowlands of Bolivia were in active use by 400 B.C., but many settlement and burial sites surrounded by ditches in the central Llanos de Mojos date to the late pre-Columbian period (Erickson 2006a; Prümers et al. 2006), as is also the case of the Upper Xingu region's village sites in the southern Amazon (Heckenberger et al. 1999).

Site, provenience	Lab. number	$\delta^{13}\text{C}\text{‰PDB}$	^{14}C Age B.P.	Cal. Age (2 σ)	Reference
Estancia Girasol, outside of enclosed area -42 cm	Ua-24929	-26,8	475 \pm 35	A.D. 1415–1613	Paper I
El Círculo, hearth -85 cm	Hel-4585	-26,7	600 \pm 60	A.D. 1300–1446	Paper I
El Círculo, soot on sherd 120–130 cm	Poz-9429	not given	645 \pm 30	A.D. 1301–1406	Paper I
El Círculo, cultural layer -53 cm	Poz-9524	not given	650 \pm 30	A.D. 1300–1404	Paper I
El Círculo, hearth -80 cm	Poz-9427	not given	660 \pm 30	A.D. 1299–1399	Paper I
El Círculo, cultural layer-20 cm	Poz-9523	not given	680 \pm 30	A.D. 1293–1394	Paper I
El Círculo, charred seed in cultural layer 100–110 cm	Poz-9428	not given	685 \pm 30	A.D. 1292–1393	Paper I
El Círculo, soot on sherd 40–50 cm	Poz-9426	not given	715 \pm 30	A.D. 1277–1390	Paper I
El Círculo, organic sherd temper 50–60 cm	Hela-570	-23,0	1790 \pm 75	A.D. 86–531	Paper I
Jacó Sá, external embankment -47 cm	Ua-37257	-27,8	1195 \pm 30	A.D. 782–984	Paper II
Jacó Sá, square-shaped ditch base 80–90 cm	Ua-37258	-27,6	1205 \pm 30	A.D. 780–977	Paper II
Jacó Sá, soot on sherd (ditch slope) 10–20 cm	Ua-37259	-25,4	1485 \pm 35	A.D. 562–662	Paper II
Balneário Quinauá, square-shaped ditch base -230 cm	Ua-37263	-26,9	1565 \pm 35	A.D. 433–638	Paper IV
Balneário Quinauá, external embankment -42 cm	Ua-37262	-26,9	1570 \pm 35	A.D. 432–623	Paper IV
Balneário Quinauá, circular ditch base 160–170 cm	Ua-37260	-13,1	1585 \pm 30	A.D. 431–602	Paper IV
Balneário Quinauá, inside of circular ditched enclosure -50 cm	Ua-37261	-27,5	1760 \pm 35	A.D. 246–416	Paper IV
Estancia Giese, inside of enclosed area -40 cm	Hela-709	-24,4	1695 \pm 40	A.D. 261–539	Paper I
Estancia Giese, inside of enclosed area -60 cm	Hela-708	-24,4	1815 \pm 45	A.D. 135–390	Paper I
JK, inner ditch base -158 cm	Beta-294309	-26,6	1710 \pm 30	A.D. 260–533	Paper III
JK, inner ditch base -170 cm	Beta-294310	-26,5	1830 \pm 30	A.D. 134–345	Paper III
Las Palmeras, depression feature -96 cm	Ua-24076	-26,1	285 \pm 35	A.D. 1508–1799	Paper I
Las Palmeras, ditch base -60 cm	Ua-24930	-25,8	1850 \pm 40	A.D. 90–377	Paper I
Fazenda Colorada, mound feature -25 cm	Hela-616	-26,6	750 \pm 35	A.D. 1229–1386	Paper II
Fazenda Colorada, interior of U-shaped ditched enclosure -67 cm	Ua-37255	-28,8	1275 \pm 30	A.D. 688–891	Paper II
Fazenda Colorada, interior of U-shaped ditched enclosure 70–80 cm	Ua-37236	-23,2	1340 \pm 35	A.D. 656–858	Paper II
Fazenda Colorada, inner U-shaped ditch base -218 cm	Ua-37567	-26,7	1775 \pm 35	A.D. 238–411	Paper II

Fazenda Colorada, between U- and square-shaped enclosures -90 cm	Ua-37256	-25,5	1820±30	A.D. 139–381	Paper II
Fazenda Colorada, outer U-shaped ditch base 150–160 cm	Ua-37235	-24,1	1865±65	A.D. 69–385	Paper II
Fazenda Atlântica, mound feature -110 cm	Ua-37252	-25,6	1855±30	A.D. 127–335	Paper IV
Fazenda Atlântica, internal embankment -40 cm	Ua-37251	-30,6	1905±35	A.D. 71–251	Paper IV
Fazenda Atlântica, external embankment -55 cm	Ua-37253	-27,2	2110±35	177 B.C–A.D. 48	Paper IV
Tumichucua, inside of circular ditched enclosure -40 cm	Hela-702	-26,5	1905 ± 40	A.D. 65–313	Paper I
Tumichucua, inside of circular ditched enclosure -60 cm	Ua-24932	-27,5	2045 ± 65	185 B.C–A.D. 207	Paper I
Ramal do Capatará, ditch base 130–140cm	Beta-288232	-27,9	1850±40	A.D. 90–377	Paper III
Ramal do Capatará, ditch base -170 cm	Beta-288233	-25,5	1990±30	39 B.C.– A.D. 134	Paper III
Ramal do Capatará, ditch base -79 cm	Beta-288234	-25,9	3310±40	1631–1430 B.C.	Paper III
Severino Calazans, internal embankment 20–30 cm	Ua-37264	-24,2	2050±35	102 B.C. –A.D. 117	Paper II
Severino Calazans, ditch base 50–60 cm	Ua-37265	-27,8	2275±35	389–195 B.C.	Paper II
Severino Calazans, interior of square-shaped ditched enclosure -45 cm	Ua-37238	-25,3	2915±35	1191–912 B.C.	Paper II
Severino Calazans, internal embankment -50 cm	Ua-37237	-28,2	3990±40	2570–2290 B.C.	Paper II

Table 1. Radiocarbon dates from the earthwork sites treated in this study. The dates were calibrated with the OxCal 4.1 program using the ShCal04 curve for the Southern Hemisphere. All, except the date with the laboratory ID Hel-4585, are AMS dates.

Among the earthwork sites surveyed in the region of Riberalta, Tumichucua is the most ancient, having been occupied from approximately 200 B.C. to A.D. 300.⁴ Radiocarbon dates place the Estancia Giese site and the first occupation phase at Las Palmeras between the second and sixth centuries A.D., roughly overlapping the final occupation phase at Tumichucua (Table 1). The El Círculo site is much more recent. The dates for El Círculo range between the end of the thirteenth century A.D. and the mid-fifteenth century A.D. One date (cal A.D. 86–531) is an exception. The material dated was organic temper from a non-diagnostic potsherd. The sample was collected in 2001 from Unit 2 at a depth of 60 cm, which was the last level containing ceramics. I consider this potsherd as an evidence of earlier occupation in the same area, taking into account that the Chacra Telería site, situated 3 km northwest of El Círculo, dates to cal A.D. 27–237 (Paper I). Estancia Girasol, with a sole 14C date, spans cal. A.D. 1415–1613, whereas the re-occupation of Las Palmeras' mound/depression features seems to have taken place as late as the early Colonial period. Thus the 14C measurements suggest two tentative stages of diverse earthwork occupation for the Riberalta region: an initial phase around 200 B.C.–A.D. 500, and a later phase A.D. 1200–1600 (Paper I, Table 2). It should be remembered, though, that the perceived hiatus of some 700 years is not necessarily factual, as it may be, and most likely is, the result of the sparse sampling of archaeological sites in the region. Consequently, the existence of more ancient occupations in the region is feasible.

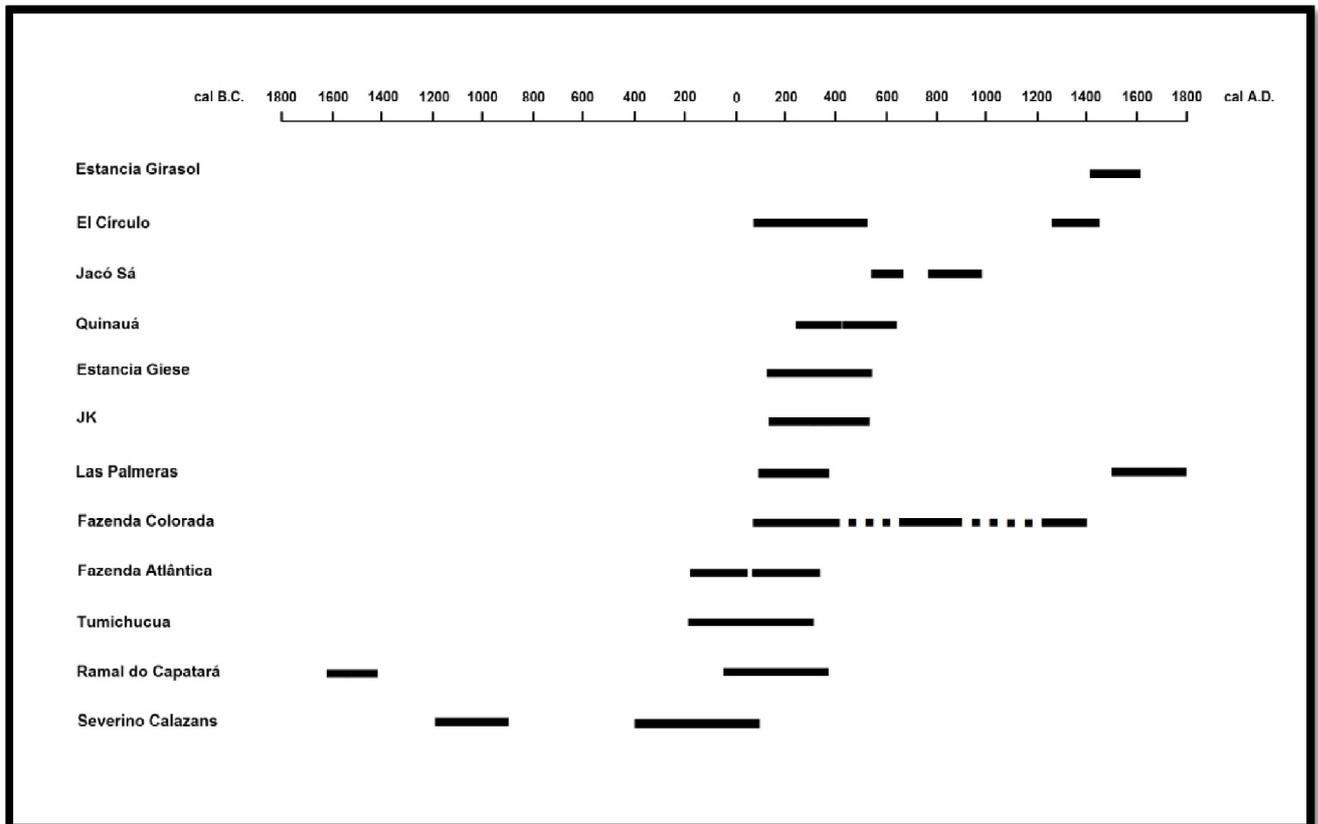


Table 2. Chronological diagram showing confirmed periods of occupation at a number of earthwork sites in Brazil and Bolivia. The dotted line indicates a tentative continuous use of the Fazenda Colorada site, yet to be verified by 14C dates.

In Acre, we face the same problem of not having enough dated sites to establish a definitive chronology, especially for the earthworks' initial construction phase. The dates obtained so far are instructive however, indicating the time span of approximately 200 B.C.–A.D. 900 as the culmination period of the regional geometric earthwork tradition (Table 2), which is displayed in several successive overlapping occupations (Paper III), while the initial establishment of earthwork architecture in the eastern Acre probably commenced at least some 1,000 years earlier (Dias 2006; Nícoli 2000; Papers II–III). The decline of this cultural tradition likely began during the eleventh century A.D., but the 14C date cal. A.D. 1229–1386 suggests that the vast Fazenda Colorada site, covering an area of approximately 10 hectares, continued to be used. However, it is uncertain whether the most recent occupation at the site was actually that of the original geometric earthwork tradition or that of another group

utilizing the site for purposes (such as dwelling) other than those of the site's initial builders.

The period of uninterrupted use of individual sites varied between 200 and 500 years. It seems, as was to be expected, that the more extensive and complex sites (such as Fazenda Colorada, Fazenda Atlântica, and Severino Calazans) were used for longer periods than many smaller sites. The 14C measurements indicate gaps in the depositional record of the Fazenda Colorada, Severino Calazans, and Ramal do Capatará sites (Paper III). However, again, this may well be only the result of a bias created by insufficient sampling and should be verified by more comprehensive chronological intra- and inter-site testing. The early dates from Severino Calazans and Ramal do Capatará may also indicate an occupation preceding the earthwork construction, as was perceived at the Quinauá site (Paper IV). A gap of approximately 100 years is also evident in the Jacó Sá 14C record (Table 2). The dates cal. A.D. 780–977 and cal. A.D. 782–984 pertain to the earthwork structure-related cultural layers, whereas the date cal. A.D. 562–662 was obtained from the sooty outer surface of a sherd collected from the inner ditch slope (Paper II). At the geometric earthwork sites, some of the discarded sherds in the ditches may be in secondary locations, as a result of cleaning of the enclosed areas. Therefore, the ditch slope was probably not the initial depository context of the dated sherd, and it may have been transported to the site prior to or during the initial ditch construction.

At the composite earthwork sites, the separate earthworks were most likely built with the idea of the structures' concurrent use and of creating a balanced entity using different monumental elements. Contemporaneous use of the earthworks is most convincingly confirmed by 14C dates at the Jacó Sá and Quinauá sites (Papers II, IV). Many of the separate earthworks are connected by roads, which re-enforces the argument of synchronic utilization of adjacent geometric earthworks. However, the chronological data do not shed light on the meaning of differences in the forms and sizes of the earthworks. The older sites are not notably smaller or simpler than the most recent ones, so the temporal factor seems not to be of special significance to the invention and completion of different earthwork site layouts.

The 14C dates for the earthwork sites in Riberalta and Acre range between the Formative and early Colonial periods. The Amazonian Formative period (ca. 1000

B.C.–A.D. 500) is characterized by the advance of forest-farming among several locally differentiated cultures and the beginning of large-scale migrations, mainly by the Arawak and Tupi-Guarani groups (Heckenberger 2006). The subsequent period, which continued until the European invasion, corresponds to the emergence of powerful regionally integrated polities, the further development and expansion of cultural traditions by these complex societies (e.g., Gomes 2001; Guapindaia 2008; Heckenberger et al. 2008; Moraes and Neves 2012; Roosevelt 1999; Schaan 2008), and the definitive establishment of a sedentary, agriculture-based lifestyle, indicated above all by a high incidence of sites associated with extensive ADE strata (e.g., Arroyo-Kalin et al. 2009; Myers et al. 2003; Neves et al. 2004; Rebellato et al. 2009).

Material Culture

The ceramics of the Riberalta sites can be considered to represent local styles that have some shared features with other traditions of western Amazonia, but from which the key attributes of the Incised Rim Tradition, as well as of the Amazonian Polychrome Tradition, are missing (Paper I). Due to the generally eroded state of the ceramics recovered from the Riberalta sites, we could reconstruct few vessel forms. However, globular bodies and closed forms seem to have predominated. The collections show some typical features widely recognizable in Amazonian pre-Columbian pottery styles, such as incised decorative motifs (Paper I: Figures 6A–B, 8), fine-line incision (Paper I: Figure 9C), finger-nail incision (Paper I: Figures 9D, 11B), and slip covering the entire vessels. Molded ornamental elements are absent, but some handle fragments are present in the collections of Tumichuca and Las Palmeras (Figure 4). At the former site, a fragment of an anthropomorphic vessel was also collected (Paper I: Figure 4). Stylistic parallels for this figure with coffee bean-shaped eyes can be found in the region of the upper Beni River (Portugal 1978). The non-decorated utility ware at the sites is of inferior quality and includes the remains of large containers with rim diameters of up to 40 cm. The most common tempering material is *caraipé*, but grog, charcoal, sand, and hematite particles were also used. It is noteworthy that *caraipé* is atypical of the Tumichuca ceramics. The major stylistic differences between the collections are few, despite their chronological dispersion. The ceramics from the El Círculo site are the most divergent. Incised

decoration is scarce in this collection; instead, it features pottery with painted red and black designs on white (Figure 5). Spindle whorls (Paper I: Figure 11D–E), indicating spinning and weaving of cotton at the site, and open-mouthed vessel forms (Paper I: Figure 11A) are also present.



Figure 4. Handle fragment from the 30–40 cm level of Trench 2, excavated on the small mound/depression feature at the Las Palmeras site.

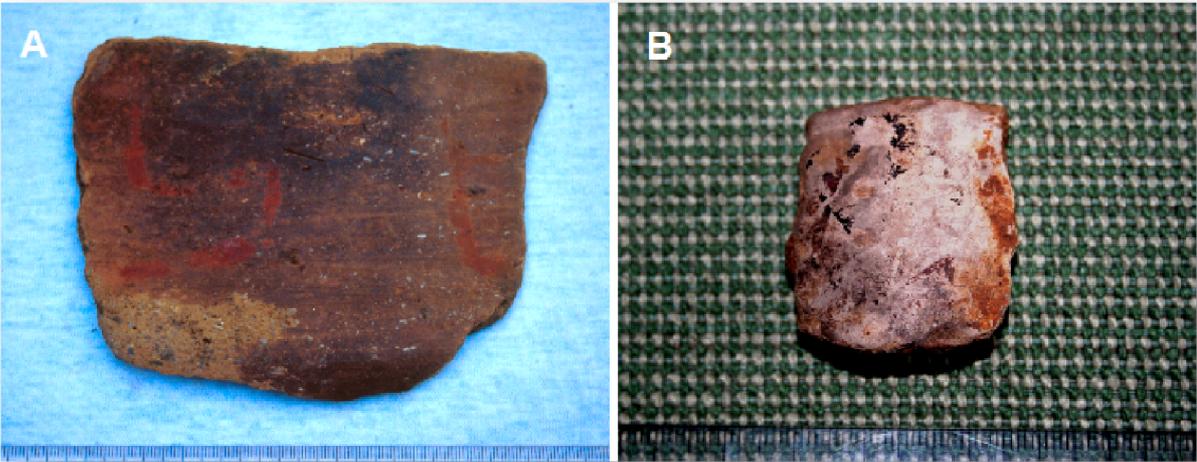


Figure 5. Painted pottery from the trench excavated at El Círculo in 2003. (A) Red curved lines; sherd recovered from the 70–80 cm level. (B) Direct rim sherd from the 120–130 cm level, decorated with red and black designs.

At the Acrean sites, the principal ceramic characteristics correspond to the description of the Quinari tradition (Papers II-IV), provided by Dias (2006). Undecorated utility ware, which represents the majority of the ceramics recovered at the sites, is fragmented, and potsherd surfaces are eroded. However, red and brown slips are perceptible on some sherds. Charcoal and *caraipé* are the most common tempering materials, but hematite, grog, and sand tempers were often used as well. Many vessels were formed by coiling, and air bubbles and dark cores were frequently found. The collected sherds suggest mostly globular and direct vessel body forms. The decorated pottery is of better quality, harder, and evenly colored. The body walls are generally thinner, and ceramic fragments reveal open forms. Decoration consists mainly of incisions in parallel horizontal lines, which are often executed on the rims. Curvilinear and stepped incisions and finger-nail incision also occur, but to a lesser extent, as do painted sherds.

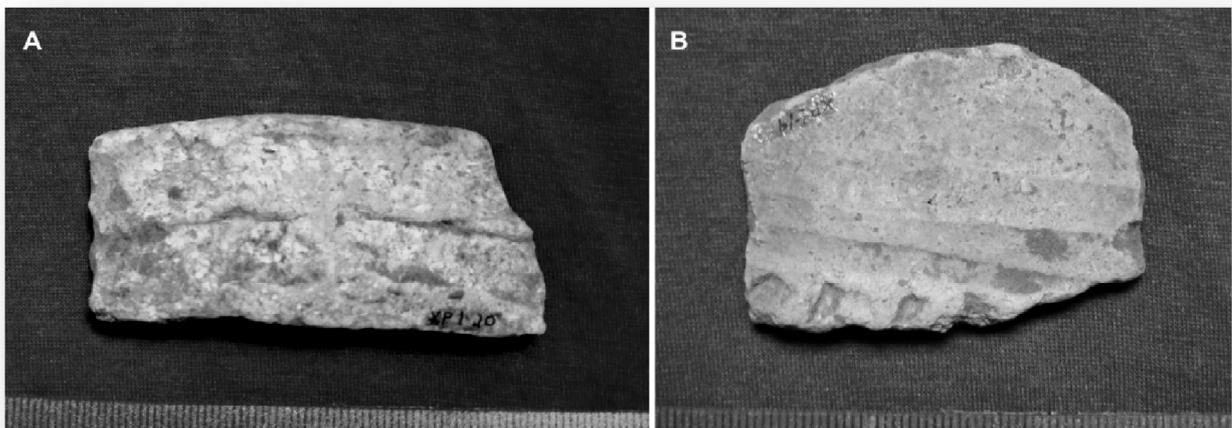


Figure 6. Decorated sherds recovered from Unit 2 at the Fazenda São Paulo site. (A) Finger-pressed motifs on a rim sherd from the 5–15 cm level. (B) Sherd with shallow grooved lines and angular punctuations from the 35–45 cm level.

At the sites described here, we did not observe significant differences between ceramics collected from earthworks of different forms, that is, the squares and

circles. However, differences are evident in the finer ware encountered in particular contexts at the enclosure sites (Papers III–IV). In the Fazenda São Paulo assemblage, noteworthy is the pottery decorated with fingernail impressions (Paper III: Figure 8A), finger-pressed motifs (Figure 6A), and shallow grooved lines together with angular punctuations (Figure 6B), recovered from an excavation on the external embankment, near the main entrance of the site. At JK, the sector of the main entrance yielded most of the decorated better-quality ceramics. Of great interest is an elaborate square-shaped lid decorated with incised-excised motifs (Paper III: Figure 8B), which differs greatly from the otherwise homogenous ceramic material collected at the site. Moreover, this context also contained rims with a labial flange and parallel incised lines (Figure 7A), everted rims decorated with incised motifs (Paper III: Figure 8C), a rim sherd of an open bowl painted red on the inside, rim sherds of a vessel decorated with parallel incised lines and having rows of triangular punctuations on the labial flange (Figure 7B), a rim with an interior incision (Figure 8A), and a sherd featuring black painted designs on white (Figure 8B). At Fazenda Atlântica, the small mound inside the square-shaped ditch yielded an abundance of better-quality ware. In addition to a carinated bowl with a down-slanting labial flange (Paper III: Figure 8A), the mound contained several rims with labial flanges (Figure 9A), sherds featuring curved and stepped incised lines (Figure 9B), rim sherds of an open-mouthed vessel decorated with parallel incised lines on the interior of the rim (Paper IV: Figure 10A), an out-folded rim with fingernail impressions (Paper IV: Figure 9B), a direct rim painted with a red band and fine black lines on white (Paper IV: Figure 9A), and a flat spindle whorl fragment (Paper IV: Figure 9C).

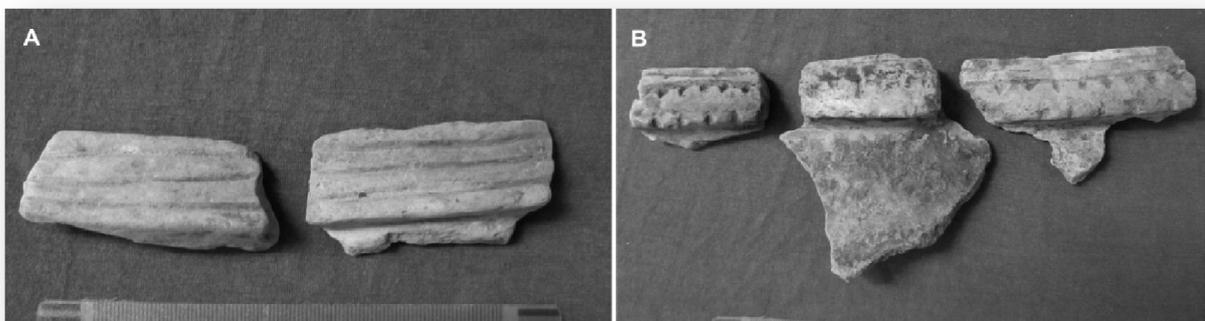


Figure 7. Decorated labial flanges from Unit 5 at the JK site: (A) rim sherds with simple parallel incised lines from the 90–100 cm level, and (B) rim sherds with parallel incised lines and rows of triangular punctuations from the 210–220 cm level.

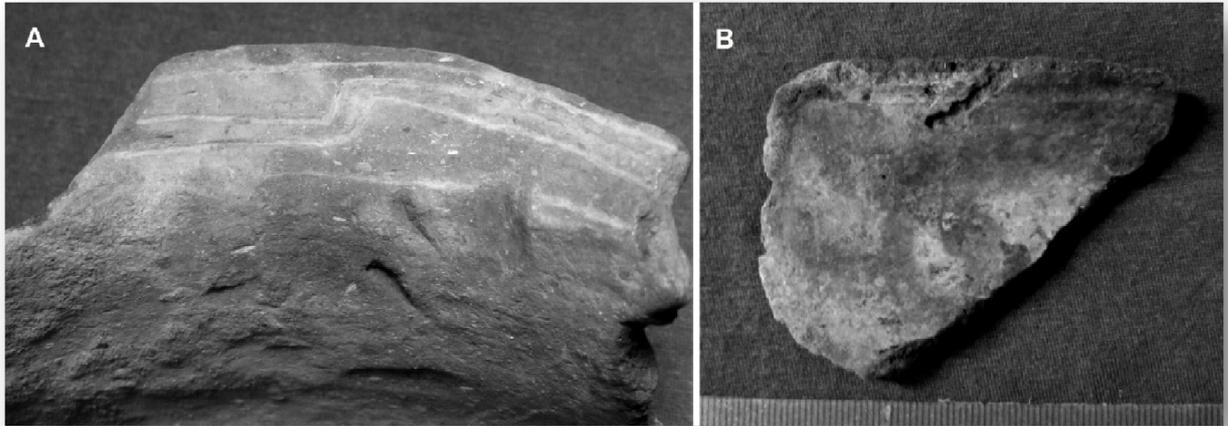


Figure 8. Pottery from Unit 5 at the JK site. (A) Everted rim with interior incision from the 160–170 cm level. This is the sherd illustrated in Paper III: Figure 8C. (B) Direct rim sherd from the 150–160 level featuring black painted designs on white.

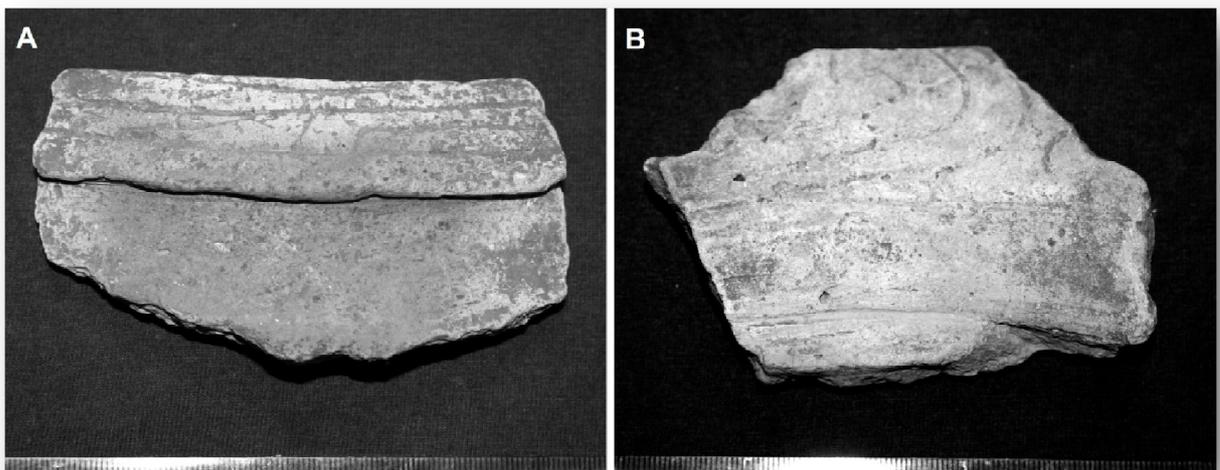


Figure 9. Pottery from Unit 5 at the Fazenda Atlântica site. (A) Rim with a labial flange and parallel incised lines from the 90–100 cm level. (B) Sherd decorated with curved incision from the 50–60 cm level.

The studied ceramic assemblages of Acre indicate a functional difference, with the majority being composed of utilitarian wares and the smaller portion including finer decorated pottery with features common to certain contemporaneous western Amazonian ceramic traditions. Stylistic parallels for these ceramic attributes can be recognized among certain Upper Amazonian Formative period assemblages (Papers III–IV). These parallels are perceptible in the material recovered from votive contexts at the Fazenda Atlântica and JK sites that yielded large fragments of vessels with labial flanges and carinations, fragments of painted open bowls, and pottery decorated with elaborate incised-excised motifs. Open bowls, as well as carinated bowls, are often associated with ritualized practices of food and drink consumption (Chicoine 2011:447; Silverman 1988). The unusual elements visible in the ceramic material may imply long-distance interaction between communities of distinctive regions and the exchange of ideas, values, and information, in addition to the exchange of material goods.

Globular anthropomorphic vessels with cylindrical necks and bases, representing human faces, constructed using the appliqué technique, and considered typical of the Quinari tradition (Dias 2006), were not noted among the ceramics collected at the sites discussed here. Furthermore, to date, vessels of this type have not been found in contexts securely related to the geometric earthworks. Several anthropomorphic jars (Figure 10), presently stored in the Museu da Borracha, in Rio Branco, were recovered in the early 1970s by Arthur Jerosch, a local resident of the municipality of Plácido de Castro. According to the museum's catalogue, the artifacts were found deposited on the ground surface in the forest, in the region of the Abunã river basin. Therefore, to determine the function of these vessels, a re-evaluation is needed to verify whether the globular anthropomorphic vessels in fact correlate with the geometric earthworks or if they were manufactured by another population occupying the region after the construction and primary use of the earthworks.



Figure 10. Examples of anthropomorphic jars donated to the Museu da Borracha, Rio Branco, Acre. The height of the smaller vessel on the left is 18 cm.

The ceramics collected at the earthwork sites of Riberalta and Acre share some features that are common in Amazonian pottery, such as the use of *caraipé*-temper and the decorative technique of incision, but they evidently pertain to separate local styles and sub-regional traditions. The pottery of the El Círculo site displays more similarities with the Acrean ceramics than with the pottery from the other sites of Riberalta. Clearly, the El Círculo site is worthy of further investigation in relation to its possible cultural connections with the Purus river basin sites. In addition to ceramics, fragments of ferruginous laterite slabs (Paper IV: Figure 8), most likely used as grinding stones, were found at all sites. Simple polished stone axes were also recovered at some sites in both the Riberalta and the Acre regions (Figure 11).

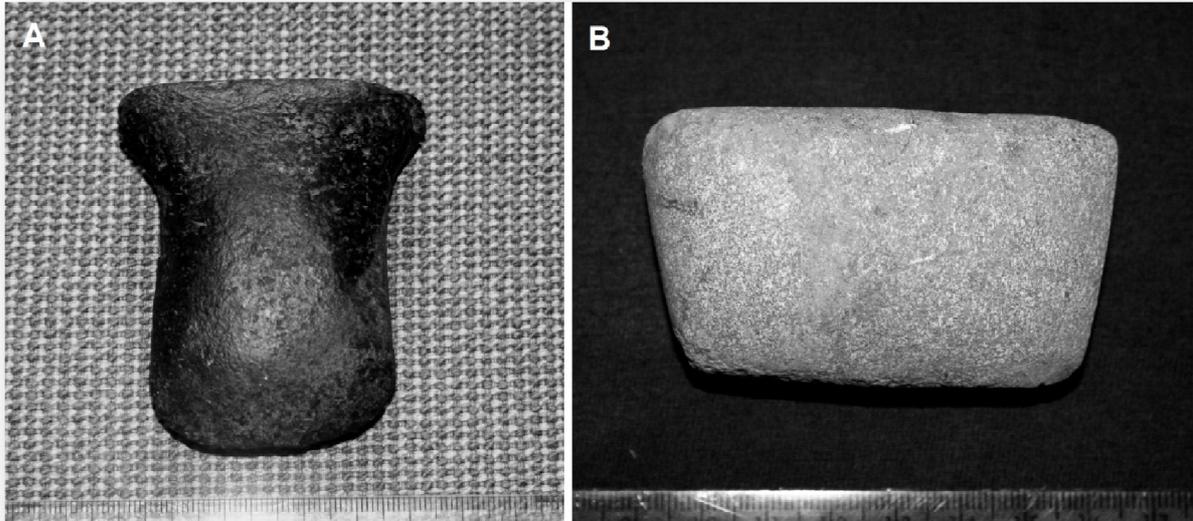


Figure 11. Stone axes recovered as surface finds from the (A) Estancia Giese and (B) Fazenda Atlântica sites.

Range of Earthwork Functions

The functions of earthworks may be as diverse as their structural features. One of the most frequent interpretations in archaeological literature for the different shapes of ditches is that they served to protect the occupation areas (e.g., Heckenberger et al. 1999, 2008; Pärssinen et al. 2003). Arnold and Prettol (1988) also explain the earthworks of Tumichucua as defensive moats, as does Arellano (2002), arguing that at the sites located alongside the Orton River, the occupational area is surrounded and protected by semicircular or square-shaped ditches adjacent to the bluff of the river. Villages surrounded by moats and palisades in the eastern lowlands of Bolivia are reported in the ethnographic record (Denevan 1966; Metraux 1948:82; Nordenskiöld 1918). However, besides having been interpreted as occupation areas protected by palisades (Erickson 2010) or as hydraulic systems and territory markers (Walker 2008a), the ditched sites of the Bolivian eastern lowland savannas may have been constructed as elite residences, ritual or gardening spaces, and/or cemeteries (Erickson 2006a; Prümers et al. 2006).

Similarly, although conscious and apparently planned landscape modifications were common in both study regions, the reasons for the construction of earthworks differed from region to region. Interpreting the distribution and characteristics of archaeological deposits and vestiges, the Riberalta earthworks seem to have had more diverse and practical functions (Paper I), whereas the space usage at the Acre sites appears to have been linked to symbolic concerns, e.g., to the cosmology and worldview of the ancient peoples, issues that are not primarily based on ecological or economic motives (Papers II–IV).

At the Tumichucua, Estancia Girasol, and Las Palmeras sites, the ditches demarcated and, at the same time, protected occupational areas and settlements, as is indicated by the evenly dispersed cultural deposits inside the enclosed areas. The embankment at Estancia Giese apparently fulfilled a similar purpose. The case of the El Círculo site was a bit different, as it featured a central communal plaza surrounded by a residential area, the remains of which are the small mounds attached to the circular embankment. Interestingly, corresponding sites, composed of small mounds forming a circle and a road entering the encircled area, have been recently recorded in Acre, in the area of the geometric ditched enclosures.⁵ This means that the El Círculo site is not necessarily a single isolated example; rather, circular-type villages definitely existed in southwestern Amazonia. Previously, archaeological circular, or ring, villages have been considered typical of late pre-Columbian central Brazil (Wüst and Barreto 1999) and the Upper Xingu region in southern Amazonia (Heckenberger et al. 1999), and have also been documented in central Amazonia (Moraes 2010). However, some regional differences are evident. The domestic areas of central Brazilian ring villages, indicated by circular or oval patches of cultural debris with hearth features, form a ring 100–560 m in diameter (Wüst and Barreto 1999), whereas in the Xinguan villages, the areas of residential units were kept clean by depositing cultural debris behind the houses, thus gradually creating a circle of elevated midden features (Heckenberger et al. 1999).

The canal structures documented at Tumichucua, Estancia Girasol, and El Círculo seem to have served as conduits for connecting different waterways, in this case the main river with a minor watercourse, but their definite function remains uncertain. The most feasible explanations for the use of canals in the Bolivian tropical lowlands are

connecting, changing, or removing water flows, or serving as shortcuts for movement and transportation (Erickson 2001). These types of earthworks were not registered at the Acrean sites.

The monumental, carefully planned, and surprisingly flawlessly executed outlines of the ditches and embankments, displaying some degree of symmetry in the positioning of the earthworks in the landscape, suggest that the original significance of the Acrean geometric ditched enclosures was more complex than mere delimitation of space and protection. The repetitive forms, mainly circles and squares, suggest that the planning and construction of these geometric earthworks involved somewhat uniform principles and methods. Spread over an area of approximately 60,000 sq km, the geometric earthwork tradition can be considered a cultural tradition that was not necessarily restricted to a certain ethnic or linguistic group (Paper II). It was instead a shared regional phenomenon characterized by local variants and alterations.

The interpretation of the Acrean geometric earthwork sites as predominantly ceremonial in nature is based on the characteristics and distribution of cultural deposits at these sites, and on the monumental scale and stylistic complexity of the earthworks (Papers III–IV). The sparse archaeological material is mainly concentrated in the embankment and ditch structures, while the flat spaces enclosed by these are void of cultural residue. Some discarded sherds in the ditches seem to be in secondary locations, most likely having ended up there as a result of periodic site maintenance. According to Silverman (1988), the pattern of sweeping and cleaning the central sector is common at ceremonial sites. Site use following the completion of the earthworks seems to have been sporadic, and no clearly identifiable residential layers have been encountered.

Further evidence for the geometric earthwork sites' primary function as non-residential public monuments for the surrounding communities is indicated by the purposeful placement of finer ware in the ditches and elevated parts of the embankments near the site entrances. The ditch bases close to the main entrances at the JK and Fazenda São Paulo sites were places for depositing elaborately decorated pottery (Paper III), implying that these contexts had a special, possibly

votive function, in the same manner as the small mound structure at Fazenda Atlântica (Paper IV). The mound could have functioned as an offering context, exclusively utilized during certain public services that took place at the site. The rituals carried out at the earthwork sites most likely included social gatherings and communal feasting, reflected in the large amount of scattered utilitarian wares in the ceramic assemblages. Communal consumption probably occurred during the initial construction phase of the public monuments and continued throughout the sites' recurring use.

Roads are one of the key components of human landscapes, a physical proof of movement in anthropogenically altered places (Snead et al. 2009). They are a significant feature of the geometric earthwork sites, not only connecting the individual earthwork structures but also linking the sites to the profuse network of streams, typical of Amazonian *terra firme*, and thus creating a complex regional system of fluvial–terrestrial routes. The roads at the Acrean earthwork sites guided movement in the direction of the central sectors and, at the same time, controlled the ways of entrance and exit. In addition to serving as routes of movement, the road structures incorporated into the geometric enclosures were likely ceremonial pathways. Perhaps passage through the site along the roads was an important element of the ceremonial institution, as seems to have been customary at certain prehistoric civic-ceremonial centers of central Andes (Burger and Salazar-Burger 1991; Moore 1996).

Formative-Stage Population

The results of the fieldwork carried out at the earthwork sites of Riberalta and Acre do not support the traditional idea of Amazonian pre-Columbian cultures as non-sedentary egalitarian groups lacking properly developed societal and religious systems. In the Riberalta region, we found different types of sites, indicating a fairly dense occupation, although not necessarily long-term permanence in all cases. The Tumichucua and El Círculo sites are the most convincing examples of a stable village lifestyle. The 14C dates, in addition to the scattering and characteristics of the cultural deposits at Tumichucua, indicate several generations of residential permanence in the area defined by the earthworks. The situation at El Círculo is

similar, with only the time-depth and extent of occupation being minor. The Las Palmeras and Estancia Giese sites also show evidence of continuing occupations, the former site displaying a re-occupation phase. The Estancia Girasol site would need more extensive sampling to clarify the meaning and possible connection of the diverse earthworks and the occupations related to them. Nevertheless, it is clear that none of these sites were created and occupied by small groups constantly on the move.

Apparently, to plan, build, maintain, and use the monumental, supposedly public spaces enclosed by the geometric earthworks in Acre, a certain degree of social order was needed, evidently of a tighter type than would be expected of loosely organized itinerant groups. Although we do not yet have clear evidence of social ranking systems in the archaeological record of the ancient earthwork building society in Acre, the emergence and extension of geometric enclosures suggest growing complexity among the region's societies. This dissertation attempts to show that the local communities that built and used the geometric ditched enclosures were united by a dedication to a religious and/or sociopolitical ideology, materialized in the monumental earthwork architecture (Papers II–IV). The geometric earthworks played a central role in ceremonial and/or ritual gatherings of peoples integrated by regional ideological devotion. The establishment and gradual development of regional confederations, often connected by ritual and elite exchange, took place during the late Formative period in different parts of Amazonia (Heckenberger and Neves 2009).

Indications of long-distance relationships, based principally on exchange, between the Formative cultures of central Andes and Amazonian lowlands have been acknowledged in archaeological literature (Lathrap 1971, 1973; Valdez 2008). Social integration networks of this type undoubtedly reached southwestern Amazonia as well, as demonstrated by certain attributes of the more elaborate ceramics and the architecture of the Acrean ceremonial sites (Paper III). The interaction between these two, seemingly distant and inaccessible regions (i.e., the Andes and Amazonia) may have been much more vigorous than is often thought because the hindrances posed by the physical and environmental barrier of the tropical *terra firme* forest were apparently conquered by the pre-Columbian peoples. In addition to roads connecting the central Andean area with Amazonian lowlands, chroniclers provide evidence of

far-reaching lowland interfluvial road-systems leading from the main tributaries of the Amazon to inland forests at the time of the European contact (Myers et al. 2003:19; Vázquez de Espinosa [1629] 1969:287). Ethnohistoric accounts also frequently refer to *varadouros*, trails that connected the adjacent tributaries of southwestern Amazonia's main rivers, the Ucayali, Madre de Dios, Beni, Juruá, and Purus, and mention that the region's native peoples often affirmed the existence of these routes since primordial times (Chandless 1866a; Da Cunha [1905] 2006; La Combe et al. 1904).

Regional integration and inter-cultural exchange certainly occurred between the regions of Riberalta and eastern Acre, which does not necessarily imply, however, that the earthwork builders of these two areas would have been of the same ethnic or linguistic affiliation. I believe that in the future, when we have more information on these cultures, it may be possible to define sub-traditions within a larger area of the regional tradition of earthwork engineering, rather than a single homogeneous area of occurrence of these archaeological sites. At the moment, it seems that the earthwork tradition began earlier in Acre than in Bolivia. If the practice of earthworking indeed commenced in the eastern Acre region, and from there more or less steadily advanced toward the Bolivian lowlands, it is also possible that the technique of earthwork engineering was adopted without the original ideological connotations coupled to the geometric ditched enclosure tradition. This could be an explanation for the much simpler earthwork layouts encountered at the Bolivian sites.

The current lack of information on habitation sites related to the geometric earthworks and the small number of dated sites result in quite complicated population density estimates. More data are necessary to confirm whether the residential patterning of the population was dispersed in the surroundings of the ceremonial earthwork monuments or was concentrated in villages. If the majority of the sites were built and used contemporaneously, this would imply an extremely densely populated area, as the number of registered geometric earthworks is approximately 270 in the east of the state of Acre alone. Conversely, if, after more comprehensive chronological data on the earthwork sites are available, it becomes clear that most of the sites were built sequentially over an extended period of time, then fewer people might have constructed these labor-intensive public monuments than would have

been required to construct them more swiftly. It is possible for small communities to produce large-scale communal constructions within non-hierarchical societal systems by the collective effort of many (Erickson 2006b). Although we simply need more data to be able to definitely resolve the question of the study region's pre-Columbian demographic density, the existence of an elevated number of sedentary populations, occupying both river bluffs and interfluvial terrains, can be affirmed.

I therefore return to the issue of the lack of ADE deposits at the investigated sites. If the presence of ADE is taken as an implication of a sedentary lifestyle and increased population growth, should not labor-intensive earthworks be considered to be related to this process? Was the number of inhabitants in the region too small after all? Were the subsistence-producing practices of the earthwork builders not intensive enough? The geometric ditched enclosures were predominantly constructed as public monumental spaces reserved for ceremonial and ritual concerns and not for permanent residential or agricultural purposes, and the use of the sites was seasonal, short-term, or sporadic (Papers III–IV). Thus, as expected, the most important ADE formation factors, agricultural intensification and prominent population density (Arroyo-Kalin 2010; Neves et al. 2004), could not contribute to the creation of ADE at these sites. Still, ADE deposits have so far not been registered at the studied settlement sites in Bolivia, either in the close vicinity of earthwork sites or along the main rivers of the study area, which, as was previously discussed, could also be due to limited archaeological surveying in this region. Moreover, settlement sites related to the Acrean geometric earthworks are yet to be discovered to convincingly resolve this issue. In any case, certain other issues may be related to the absence of genuine ADE at the investigated sites as well. For example, it seems that the upsurge of ADE throughout Amazonia is generally somewhat later than the establishment of the geometric earthwork tradition in Acre. In the case of dated occupations with ADE, the period of intensive formation of anthropogenic soils began around A.D. 1 (Arroyo-Kalin 2010). A much-discussed topic in Amazonian archaeology has been the array of cultigens that could sustain permanent large-scale populations (e.g., Gross 1975; Meggers 1971; Roosevelt 1980). Bitter manioc is a plant that needs no fertile soils (i.e., ADE), can also be cultured in upland areas, and could have provided a sufficient subsistence base for incipient sedentary populations (Arroyo-Kalin 2010).

Among the dilemmas facing future researchers are fully explaining the absence of ADE at the earthwork sites and exploring the predominant means of subsistence of the earthwork society. A rather interesting detail concerning southwestern Amazonia's earthwork cultures is the distribution of Brazil nut (*Bertholletia excelsa*) stands, because this distribution roughly overlaps that of the geometric earthworks (Mori and Prance 1990:137). Ethnohistoric evidence also confirms the abundance and importance of the Brazil nut in the region (Maurtua 1907:68). As Armentia ([1883] 1976:131) tells us: "abunda sobre todo la almendra, cuyo fruto constituye el alimento principal de los barbaros". Shepard Jr. and Ramirez (2010) conclude that the inefficient dispersal method and discontinuous distribution of the Brazil nut derive from the anthropogenic origin of this species. This conclusion suggests that Brazil nut arboriculture may have been one of the sustaining resources of earthwork-building societies, in addition to probable semi-intensive crop growing (reliant mainly on bitter manioc) and the exploitation of the region's aquatic and forestal resources (Balée 1988; Clement 1999, 2006; Maurtua 1907:69; Virtanen 2011).

Conclusions and Future Research Perspectives

Our increasing knowledge on the earthwork sites of the tropical lowlands is radically changing many traditional concepts of Amazonian prehistory. The native peoples were not just creating adaptive responses to survive in an antagonistic tropical environment. Instead, they were able to operate actively and manage their surroundings, making use of the natural forest and aquatic resources. The lack of extensive cultural layers and ADE at the investigated sites may indicate lesser population densities compared with the late pre-Columbian chiefdom-level societies of the central and lower Amazon. However, without a doubt, our emerging understanding of the earthworking societies under study does not comfortably correspond to that of the Standard Model's Tropical Forest Culture (Steward 1948). The monumental earthwork sites clearly show that both the immediacy of the floodplains of the major Amazonian rivers and the interfluvial areas supported long-term permanent populations of considerable size long before the arrival of the Europeans. Chronologically and culturally, these earthworking peoples were formative-stage societies that demonstrated emerging sedentism and evolving socio-

organizational structures and in Acre a society united by a highly developed ideological complexity materialized in the geometric enclosure architecture.

A variety of pre-Columbian earthworks has been documented in southwestern Amazonia, including ditches, embankments, canals, mounds, and roads of different forms and dimensions. The studied sites exhibit varied earthworks but rather homogenous types of occupation, cultural deposits, and materials. The Bolivian sites are interpreted as permanent settlements, while the Acrean earthworks were constructed principally for ceremonial purposes. The earthworks documented in the Riberalta region are simpler than those studied in eastern Acre, and are found in slightly different locations, on high river bluffs or inland, some kilometers from the main rivers. In Acre, the sites are located on high interfluvial plateaus near minor watercourses. The earthwork tradition prevailed in the Riberalta region from around 200 B.C. until the period of European contact, whereas in Acre, the geometric earthwork tradition began earlier, around 1200 B.C., if not before. By the tenth century A.D., the ideological/social configuration that generated the geometric enclosures was already disintegrating. Even so, some sites apparently remained in use until the fourteenth century A.D. However, the regional tradition that manifested its ideological and/or political order in the monumental earthwork architecture had most likely come to its end by that time. The archaeological record is still too preliminary to conclude whether it was the same group who initially built the earthworks and continued using them for over two millennia or whether several successive re-occupations by culturally different groups took place at the sites.

Research focusing on the wide range of Amazonian cultures, both past and present, is becoming ever more pronounced in the globalized world of today. Increasing economic and political interests in the Amazonian rainforest are causing irreversible changes and even destruction, not solely in the natural environment but also in the social and cultural spheres. In the worst case, certain cultural phenomena may disappear completely in the not so-distant future. The most serious threats the earthwork sites face, are related to the construction of infrastructure, logging, agriculture, and cattle grazing. These wide-ranging mechanized land-use activities not only directly destroy archaeological sites and features but also often accelerate soil erosion, which in turn will hastily fill up and flatten the earthworks. Without

protective surface vegetation, the earthworks may disappear in only a few decades, and it is uncertain whether we have sufficient time and resources to acquire comprehensive information about the earthworking cultures before this happens.

This dissertation, through pioneering fieldwork carried out at earthwork sites in northern Bolivia and in the eastern Brazilian state of Acre, confirms the importance of initial research. Although preliminary in some aspects, it provides interesting results concerning the modes of use and dating of these earthworks, the ceramic styles associated with them, and the unique capacity of Amazonian peoples to modify and control their habitat permanently in an area that has conventionally been considered to lack significant human occupation and anthropogenic environmental alterations. This dissertation has both regional and international interest value, providing new radiometric dates and site plans for the understanding of the dimensions of the earthwork tradition in the cultural sequence of Amazonia. The Formative pre-Columbian cultures were already creating and maintaining monumental anthropogenic landscapes in the uplands of southwestern Amazonia. The contribution of this study is important for regional archaeology but is also relevant to Amazonian scholars of other regions and disciplines because it treats a significant topic that has recently aroused much attention: the time-depth, extent, intensity, and consequences of human impact on tropical lowlands, and interfluvial uplands in particular. As often occurs with basic research, this study has suggested various new potential topics for archaeological studies in southwestern Amazonia. This dissertation enhances our knowledge on certain archaeological issues of southwestern Amazonia and raises several new research questions that, I believe, future research will soon be able to answer. The most important challenge for the archaeology of southwestern Amazonia is to determine the location and characteristics of the settlement sites related to the geometric earthworks in Acre, the means of subsistence and modes of social organization of the earthworking peoples, and, obviously, the total temporal and spatial scale of the earthwork tradition.

Notes

¹I use the term "anthropogenic" instead of "anthropic" here because I believe that shortly after becoming a generalized tendency in Amazonia, ADE formation developed into a result of intentional human interference and was not a mere by-product of sedentary lifestyles.

²The first archaeological investigations in Brazilian Amazonia were conducted in 1871 at the Pacoval mound on Marajó Island by Joseph Steere of the University of Michigan and Domingos Ferreira Penna of the Museu Paraense (Barreto 1992).

³New sites are discovered at the same pace as the satellite imagery coverage in the region improves, so the number of known earthwork sites and the extent of their area of occurrence are constantly increasing and changing.

⁴All dates discussed in this synthesis paper were re-calibrated with the OxCal 4.1 program using the ShCal04 curve for the Southern Hemisphere, so the calibrated ages are slightly different from the ones presented in Papers I and II.

⁵The preliminary results of a trial excavation carried out in June 2012 at the Sol de Maio site imply that the mounds forming a circle were the remains of habitation units, contemporaneous with the El Círculo site's occupation (Saunaluoma 2012).

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