

Agency, Roads, and the Landscapes of Everyday Life in the Bolivian Amazon

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Landscapes of Movement:
Roads, Trails, and Paths in Anthropological Perspective
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Abstract

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Introduction

Pierre Bourdieu's practice theory stresses the dynamic relationship between the agency of individuals and groups and structure, the interface of which he labeled *habitus* (1973). Bourdieu's concept of *habitus* is particularly relevant to archaeology because of the focus on the built environment, space, and the practices of everyday life. Bourdieu's original case study was the Berber house, a highly structured physical entity that is both a model of and a model for society. Human individuality and creativity produces cultural innovations that can become *habitus* (structures) if adopted in human routines of life. Over time, *habitus* become a guiding force for human activity. In turn, individual agents through daily practice can alter those structures of everyday life. The complex recursive relationship between practice and structure produces what we recognize in the archaeological record as long-term traditions; local, regional, and cross-cultural variation; and continuity and change over short and long temporal scales.

The concept of built environment provides an excellent framework for addressing issues of space and place, landscape, and agency by regulating the flow, circulation, and interaction of human agents within physical structures laden with cultural, social, political, economic, and symbolic meaning (e.g., Low and Lawrence 1990; Low and Lawrence 2001; Moore 2003; Atkins and Rykwert 2005). The concept of built environment address issues of aesthetics, design, planning, function, and meaning of architecture, usually formal buildings, monuments, and cities, although in more recent years vernacular architecture is often included. Because built environment is often highly patterned and physical (a form of material culture or human artifact), archaeologists can document, analyze, and interpret its origins, function, evolution, and meaning. In this chapter, I apply the concept of built environment to cultural or anthropogenic landscapes.

In their search for agency in the built environment and the more traditional artifacts, ecofacts, and features, archaeologists generally rely on heavy use of historical documents, ethnography, and cross-cultural analogy, which are applied to or imposed on the archaeological record, often uncritically (e.g. critiques by Stahl 1993; Isbell 1997). Most of the archaeological applications in South America highlight the agency of the elite rather than the rest of society (e.g., Stanish 2003; Kolata 1996; Janusek 2004 for the Andean highlands; Heckenberger 2005; Neves and Petersen 2006; Roosevelt 1991; Spencer and Redman 200? for the tropical lowlands of South America).

In this chapter, I apply practices of everyday life and evaluate top-down and bottom-up approaches to understanding social interaction on the ground, in this case a pre-Columbian cultural landscape. I focus on repetitive bodily movement through space and the physical structures that result from and channelize this movement. Informal movement creates paths and trails, which over time, grow and become more complex through accretion. Although movement through already established routes is often unconscious, circulation through most space involves decision making (consideration of

slope, natural obstacles, least resistance, and other physical contingencies of movement) and negotiation (where you can and you cannot go because of neighbors, land tenure, and other social contingencies of movement). At the other extreme, movement can be highly structured through designed roads, bridges, and stairs which aid and direct traffic and walls, barriers, and other obstructions that impede circulation (Hyslop 1985; citations). The formality of roads is often contrasted to informality of trails and paths (e.g. Earle 1991, Trombold 1991). Trails and paths can evolve into roads and vice versa.

Roads and paths connect people to people, people to resources, or in the case of ritual roads and pilgrimage-- people and the gods. As complex networks of relationships, routes map communication, transportation, interaction, and social, political, economic organization. On the other hand, where roads do not go can demarcate territorial boundaries and territories between groups occupying the same landscape. Roads may be the best media for highlighting the potential of archaeology of landscapes because of their materiality, longevity, patterning, and multiple functions.

The Archaeology of Landscapes

Traditionally and up to the present, archaeological research has focused on "sites" as loci of investigation. Regional investigation tends to stress settlement pattern and settlement system as determined through archaeological site survey (citations). In contrast, a landscape archaeology perspective stresses the space between the sites or "points" on the landscape. Early attempts at "landscape archaeology" tended to focus on the natural environment and its relationship to occupation sites (resource availability, carrying capacity, human adaptation, and strategic locations). A contemporary landscape perspective highlights the cultural, "anthropogenic," or built environment--in this case human modification and transformation of the natural landscape in the form of pathways, roads, causeways, monuments, walls, gardens and fields and their boundaries, astronomical and calendrical sightlines, shrines and sacred places, and water management (citations). The concern is to understand how and why human actors consciously and unconsciously modified, created, and maintained the cultural landscape through their daily routines and ritual activities (citations). The perspective considers human land use over the long term (hundreds to thousands of years) and at multiple geographic scales (the garden to the macro-region; often "dangerously" large survey regions [Lekson 1999]). The approach assumes that landscapes are dynamic and have complex histories. Features can be examined in terms of the "social logic" or patterning of cultural space that can provide insights into indigenous structures such as measurement systems, land tenure, social organization, cosmology, calendrics, astronomy, sacred geography, cognition, and ritual practices (citations). This approach assumes that landscapes have complex human histories and are continually under construction.

Landscape is a valuable medium for addressing agency, structure, and habitus. Landscape archaeologists read the physical, non-randomly patterned "residues" of accumulated human routines and practical knowledge, or habitus. We do this through sorting out palimpsests (layering of patterned landscape features, much like the buildup on an

incompletely erased blackboard), determining context and association, and recognizing disjuncture and anomaly in landscape patterning (citations). With fine-grained analysis, even ephemeral patterning is detectable. Anomalies and disjunctures reveal discrete agency and spatial and temporal groupings and boundaries, which often relate to socio-political organization on the ground or changes over time (citations).

My research focuses on mundane landscapes, the landscapes of everyday life including farming, daily economic activities, routines of work and sociality (Erickson 1993, 1996, 2000a, 2000b, 2003, 2006a, 2006b, 2006c). These landscapes are engineered environments: as constructed and planned as formal architecture anywhere on Earth.

Top-Down vs. Bottom-Up Approaches for Understanding Pre-Columbian Landscapes

Note: I may drop this section and use it for a larger more comprehensive analysis of both the Minor and Major Causeway-Canals in another publication.

Two contrasting approaches, the top-down and the bottom up, emerged from debates in the 1980s about the creation and management of pre-Columbian intensive agriculture in the Andean highlands (Scarborough 1993; Erickson 1988, 1993, 1996, 2006c; Kolata 1996, 2001; Stanish 1994, 2004; Walker 2002).

The Top-Down Approach is based on the assumption that sophisticated intensive farming systems (such as raised fields or terraces) must involve state administration and bureaucracy for the planning, mobilization of labor, construction and maintenance. This perspective assumes that peasant farmers and small communities are unable to (or refuse to) produce surpluses without state guidance or coercion. The approach can be traced to Karl Wittfogel (1956) and his classic work on despotic societies (Erickson 1988, 1993, 2006c; Stanish 1994) and assumptions about agricultural intensification derived from Ester Boserup (1965) (Stone 1996; Downing 1976; Spooner 1982; Morrison 1996; and others). In contrast, the Bottom-Up Approach is based on the assumption that complex anthropogenic landscapes are formed over long periods of time by a process of accretion. In this perspective, generations of farmers and communities are capable of and responsible for the massive transformation of landscapes by mobilizing local labor through traditional social organization and reciprocal labor exchange. These transformations produced by generations of farmers are part of a vast landscape capital that is available for later farmers. Evidence of technological indigenous knowledge systems and organization of labor is embedded in physical landscape features. Farmers commonly "overproduce" to support a rich social and ceremonial life. Farmers, although often overexploited and oppressed, have agency and are not faceless masses. The approach often draws upon the scholarship of Robert Netting (1993), William Denevan (2002), Harold Brookfield (2002) and others.

Add: landscape signatures and testable hypotheses for the Major and Minor Causeway-Canals of the Bolivian Amazon based on practice theory, top down and bottom up approaches outlined above.

In this case study, I focus on three themes that may help distinguish between the top-down and bottom-up creation and management of specific landscape features, pre-Columbian roads, in the Bolivian Amazon:

- 1) spatial patterning, destinations, and intents of road design and construction,
- 2) energetics or labor dedicated to construction and maintenance of roads through reference to ethnographic analogy and experimental archaeology (Erickson 1988, 1996),
- 3) scale, hierarchy and complexity of roads.

Archaeology of Roads

Archaeology of roads, paths, and trails is an important, but understudied, theme within cultural landscapes. New World archaeologists tend to stress the descriptions and functions of roads, often through the lens of political economy and cultural ecology. In contrast, Old World archaeologists focus on the meaning and interpretation of roads, framed in phenomenology, practice, interpretive, and semiotic approaches.

Add concise discussion here or introductory chapter of the edited volume:
Archaeological, ethnographic, and historical examples of roads (sort by geography and/or themes)

Old World: Roman, Silk Route, Ghana, Near East, South Asia, Europe, etc—out side of Andes or Amazonia.

New World:

North America: Chaco, Alaska, Hopewell, Iroquois,

Mesoamerica: Aztec roads and causeways, Tenochtitlan, Xochicalco, Maya sacbes, Costa Rica

Andean: Inca, Sajama, Nasca, ceques, Kogi, Qhapaq Ñan

Amazonian: Gê and Bororo, Kayapó, La Calzada (Venezuela), Carvajal accounts, Upper Xingú River Basin, trekking, log races Central Brazil.

Methodological and Theoretical Perspectives: concise discussion

Tilley 1994, 2002; new BAR and Archaeopress, Snead 1999; Snead and Preucel 1998;

Keller 2006; Ur 200?; Wilkinson 2001; Hyslop 1984; Trombold 1991; Earle 1991;

Silverman 2001, GIS (Kantner, Archaeopress and BAR volumes)

Geographic Information Systems and archaeology of roads: topography, terrain analysis, least resistance, friction models, transport models, route analysis, simulation, central place models; agent based models, settlement patterns, settlement systems)

ritual roads: Stephen Lekson (1999); Sofaer et al. 1979; John Kantner various; Aveni 1990, 2001; Silverman and Aveni 1991, Silverman and Proulx 2001; Morrison 1978;

1979; Zuidema 1964, 1999; Bauer 1998; Hyslop 1984, Marcus Rendel (2005); Reiche various; Stanish and Bauer 1999; Johan Reinhart various.

roads of everyday life: Ingold 1993 taskscape; Erickson 2000, 2001, Oyuela 2000, Snead various.

roads as/for/in terms of: transportation, communication, ideology, cosmology, worldview, political economy, cultural evolution, energetics, meaning, pilgrimage, engineering, aesthetics, art, structure, boundaries, territories, memory, travel, interaction, commerce, stages, processions, theater, etc. [see list of conference discussion topics]

Roads within the Engineered Landscapes of the Bolivian Amazon

The Llanos de Mojos (Moxos) or Plains of Mojos are vast region of seasonally inundated grassland savannas, permanent wetlands, lakes, gallery forests, forest islands, and forest in northeast Bolivian Amazon (today, the Department of the Beni) (Figure 01). The inhabitants of the Bolivian Amazon imposed their agency and structure on the environment through permanent and significant engineering (Figure 02). Major earthworks include

- **Raised fields**: Raised fields large elevated planting platforms constructed in seasonally inundated savannas and permanent wetlands. The earthworks provide drainage and irrigation, enhance soils and microclimates, and enhance sustainable intensive production of crops and aquatic resources (Denevan 2001; Erickson 1985; Walker 2003).
- **Fish Weirs**: Common throughout the Americas, fish weirs are barriers or enclosures of wood, basketry, nets, stone, or earth used to trap migrating fish in lakes, streams, rivers, or savannas. In the case of Baures region in the Bolivian Amazon, these structures are made of ridges of earth with wooden or basket traps in funnel-like openings and cover an area of 550 square kilometers (Erickson 1999).
- **Water management structures**: Earthen causeways and canals, combined with reservoirs, dams, ponds, and raised field canals, formed an integrated system of water management across the region (Erickson 1980; Lee 1979; 1996; Erickson and Walker, this volume; Spanish project). The pre-Columbian inhabitants also expanded and improved wetland habitats for the capture, storage, and management of fish and other aquatic species by creating fish weirs, artificial ponds, reservoirs, dams, canals, and causeways (Erickson 2006a).
- **Occupations**: Settlements were generally located on river levees, large artificial mounds, ring ditch settlements, and artificial and natural forest islands within the savannas (Nordenskiöld various; Denevan 1966; Prümers various, Dougherty and Calandra 1981; Erickson 2000, Walker 2003).
- **Artificial river meander cut offs and inter-river channels**: Channels were cut through meander loops of the major rivers, large forest islands, and between river

drainages for efficient canoe communication and transportation (Nordenskiöld 1916; Denevan 1966; Pinto Parada 1987; Erickson et al. 1996).

- Causeways and canals: Causeways and canals are two related classes of earthworks found in the Bolivian Amazon. Adjacent canals from which soil was removed accompany raised earthen causeways. These landscape features provided transportation and communication across the savannas and wetlands and manage water for agriculture, aquaculture, and canoe and pedestrian traffic during the rainy season when the savannas are flooded and in some cases, year round (Pinto Parada 1987; Lee 1996; Denevan 1966, 1991; Erickson 2000, 2001).

In this chapter, I focus on causeways and canals of the Baures region of the Bolivian Amazon (the northeast region of the Llanos de Mojos; Llanos de Moxos, or Department of the Beni) (Figure 03). Many years ago, Erland Nordenskiöld (1916) and William Denevan (1966, 1991) recognized the importance for transportation and communication of the complex causeway and canal networks of the Bolivian Amazon (Lee 1979; 1986; Pinto Parada 1987). Following in their footsteps, we have expanded their documentation and interpretations (Erickson 1995, 1999, 2000a, 2000b, 2006, Erickson and Walker, this volume). The pre-Columbian causeways and canals provided transportation, communication, land tenure boundaries, hydraulic control, ideological statements about labor and engineering of community and polity, and stages for ritual events and processions. In a society with no stone pyramids, palaces, temples, monumentality was expressed in grand avenues and canals--far beyond what was necessary for daily life in terms of number, density, redundancy, width, overengineering, and complexity.

Add concise discussion of ethnographic use of roads and paths in Amazon: analogy; compare and contrast historical/ethnographic and archaeological roads; importance of trekking in Amazonia, log races and initiation, ethnohistorical accounts of roads by Carvajal, summaries in Denevan 1991; Laura Rival Huarani, etc.

Although dispersed settlements, trekking, long distance trade, reciprocity, and competitive feasting are emphasized in native Amazonian ethnography, and landscapes and agency are popular in archaeology, archaeologists rarely discuss paths and roads.

Posey (date) found that Kayapó paths are often biologically rich corridors with economic species distributed and maintained through transplanting, selection, clearing, and discard of fruit seeds, taking the form of a long linear orchard over time. My Sirionó informants discuss paths as webs of interconnected cultural places on the landscape that is full of recent and distant history and memory. Bill Balée and I can verify these rich memories of old farm and settlement clearings, orchards, and camps through ethnobotanical and archaeological signatures (Erickson and Balée 2006b).

Add here: Bolivian Amazon roads: summarize the ethnographic and ethnohistorical literature (Baures and rest), Metraux summary in 1943, Denevan 1966, 1991.

Amazonia: Classic Tropical Forest Culture defined by list here and canoes (Nordenskiöld 1916; Lowie 1948; Lathrap 1970, Steward 1948). Much of the core culture lost due to massive depopulation of the várzea and bluff settlements on the major rivers.

define “Baure” = people; “Baures” = mission and modern town; “Baures region” = geographic location (between the Blanco and the Itenez (Guaporé) rivers, Itenez forest and [what?]; Baures Hydraulic Complex = (subset of Baures region); needs detailed geographical description.

In this chapter, I focus on the Baures region, a remote corner of the Amazon in northeast Bolivia (Figure 03). I will use the term “Baure” for the contemporary, Colonial, and pre-Columbian native peoples of the region, “Baures” for the mission and contemporary town, “Baures region” for the areas of archaeological features and contemporary occupied landscape, and “Hydraulic Complex of Baures” for the engineered landscape (recently declared the Kenneth Lee Archaeological Reserve by the national government of Bolivia). The Baures region is a complex landscape of vast wetlands, open savanna, and forest islands. Much of the landscape is under a thin sheet of water during the rainy season. Water is actually scarce during the dry season. In contrast to the anthropogenic forest islands in central Bolivian Amazon, most forest islands of Baures region are natural formations (upwelling of the Brazilian Shield). Forest islands rise a meter or two above the surrounding savanna and can cover many square kilometers. Due to lack of present population, forest islands are an impenetrable tangled mass of forest, often full of chocolate and fruit trees--the historical ecological legacy of the past inhabitants.

The region was the last to be subjugated by the Spanish. After a brief bloody retribution by the Spanish army for killing their first missionary, the Jesuits established control over the region in the early 1700s. The Jesuits were impressed by what they recognized as civilization in the Baures region: elaborate dress, urbanized settlements, political organization, intensive agriculture, and monumental earthworks associated with the ethnic group Baure (Eder date; Metraux 1943; Denevan 1966; Block 1994).

We are mapping 500-700 square kilometers of concentrated earthworks and forest island settlements (Figure 03). No raised fields have been found in Baures region, thus agriculture was practiced on the forest islands and to a limited degree on the savanna. In the continuously populated forest islands to the west, island soils are capable of sustained and intensive production. The study region is unpopulated today; thus, the remains are remarkably well preserved in contrast to areas subject to years of heavy cattle grazing and ranching.

All surveyed forest islands larger than 1 square kilometer have ring ditch sites of diverse size and shape: octagons, hexagons, squares, rectangles, “D” shapes, circles, ovals, and irregular shapes (Figure 11). Large forest islands have multiple, evenly spaced, ring ditch sites. Ditches are often several meters deep and steep sided and some ditches extend 1-2 linear kilometers and include multiple concentric rings. The Jesuits described these as forts with deep moats and palisades (Eder [1772]1981:104-5 check) (Figure 12).

The Spanish soldiers, missionaries, and authorities observed the use of pre-Columbian and contemporary causeways and canals of the Bolivian Amazon (Anonymous 17??; Lizarrazú 1901 expedition accounts; Marbán, Altamirano, Métraux, Denevan 1966, 1991,

Block 1994). Father Francisco Eder provides a wonderful eyewitness account of causeways and canals during the Mission period in the mid-18th century:

...most of the year the savannas are covered with high water. Boats are the only way to get from one island to another. Since most of the natives have no boats (either due to laziness or because they don't know how to make them), but they still find it necessary or enjoyable to go visiting their neighboring friends, usually for the purpose of drinking, they built a certain kind of bridge or dam-like structure of earth by digging a ditch on two sides and piling earth in the middle. These causeways generally remain dry in the floods and are wide enough for Spanish two-horse carriages. The water filled ditches created by their construction are also used for canoes. During the hot dry period and burning of the savannas, these ditches retain enough water so that maize and other goods can be transported. These causeways were mostly used by the Baure tribe; although they are found elsewhere. Nowadays, however, few are in use, partly because the number of canoes at the disposal of the Indians and partly because after all these years of disuse, they have become ruins (quote from Eder [1772]1981:104-5 and Eder [1772] 196?: pages [translation by Hungarians] with my editing for clarity).

Canoe transportation is still highly valued in the Baures region. My informants and guides repeatedly tell me that they “would rather ride in a canoe than walk any day.” While most scholars focus on the use of causeways for pedestrians, canoe traffic may have been more important.

The roads of the Baures region are raised earthen causeways with adjacent canal or canals that provided fill (Erickson 2000a, 2000b, 2006a). Widths range from 1 to 10 meters and elevations vary from 0.5 to 3 meters tall (Figure 05-07). The anthropogenic topography structures vegetation in complex ways (Figure 08). Water filled canals block savanna burns, and after abandonment, trees covered the causeways. Most causeway-canals are near perfectly straight and extend for 1.0 – 7.5 kilometers. As noted by Eder above, pedestrians used the elevated causeway and two-way canoe traffic circulated in the adjacent canals (Figure 09).

For this discussion, I use the terms Major Causeway-Canal and Minor Causeway-Canal as equivalent to formal roads. The Major Causeway Canals are long inter-forest island causeways. Monumental in design, labor, and scale; most appear on satellite imagery from space. A number of double and triple parallel causeways-canals have been recorded (Figure 05). In recent publications, I have addressed the utilitarian, political, and ritual functions of pre-Columbian roads in the Bolivian Amazon (Erickson 2000a, 2000b, 2006a). The Major Causeways-Canals and the complex transportation networks that they form are the subject of a monograph (Erickson ms). Although constructed with care as straight alignments, Minor Causeway-Canals are shorter in length and scale of construction than the Major Causeway-Canals (Figure 06). Many of the Minor

Causeway-Canals often consist of a single shallow canal have no clear raised causeway. These features are referred to as Minor Canals (and canoe paths).

In this paper, I will briefly discuss Minor Causeway-Canals that connect medium sized forest islands in close proximity: the San Martin Complex within the Hydraulic Complex of Baures (Figure 13).

Methodology:

The data for this study is based on a simple GIS of the Baures region. Georeferenced Digital Elevation Models and Landsat ETM scenes from the Global Land Cover Facility of the University of Maryland, aerial photographs from the Military Geographic Institute from [dates], and photographic enlargements printed from Corona negatives and later scanned were used for mapping cultural landscape features. Overflights in a small Cessna of a total approximately 10 hours during 1995, 1996, and 1999 provided opportunities for oblique photography to better understand the landscape features. Two short seasons of pedestrian survey, mapping, and excavation in the Baures region were conducted in 1995 and 1996 under permit granted by the Bolivian government to Wilma Winkler (Project Co-investigator) and Clark Erickson (Director) as a part of a larger multiyear international project (Agro-Archaeological Project of the Beni).

Description, Analysis, and Interpretation

A remarkable concentration of minor causeways-canals is found in a 3-4 square kilometer area of savanna between and around two large forest islands (Figure 13). I detected 168 linear features on Landsat ETM, Corona, and aerial photographic images (Figure 14). The features are easily distinguished by their narrow linear patterns of lines of trees and shrubs on the larger features (major causeways), standing water and aquatic vegetation (major canals), and subtle differences in savannas grasses and soil moisture (minor causeways and canals). The majority are minor causeway-canals of 1 kilometer or less. The irregular features to the south of the study area are fish weirs. The 11 major causeway-canals are located south and north of the study area. Some of the features extend a short distance into the forest islands.

Most features are canals without causeways rather than causeway-canals. These canals easy to miss in pedestrian survey and most are highlighted by subtle vegetation differences (Figure 17). My informant-guides and I interpret these shallow canals as canoe paths: channels for paddling or poling large heavy canoes across the shallow inundation of the savanna during the wet season. Most straight causeways-canals are oriented roughly east-west or inter-cardinally and do not intersect. The sinuous paths, seldom-used modern hunting trails or animal tracks, stand in sharp contrast to the straight landscape features.

The major inter-forest island causeways-canals often coincide with (but not perfectly) ring ditch sites (Figures 11-12). The tangled mass of minor causeway-canals is clearly different. Although large urbanized settlements existed, the Jesuits describe the traditional settlement pattern as dispersed, though dense, throughout the forest islands. In our limited survey, we have not located substantial middens or dark earths of large population centers (citations). Although likely candidates for large central plaza circular villages similar to those of the Central and Eastern Amazon basin, the large ring ditch sites tend to be devoid of evidence of domestic activity.

Interpretations and Discussion

Based on their number and spatial organization, the minor causeway-canals probably were constructed and used by individual extended families or hamlets dispersed over the two forest islands. Each provided an individual, direct physical connection to kin (lineage or clan), affines, and friends.

In the ethnographic and historical record for Amazonia, the social, political, economic, and ritual organization of complex and non-complex societies is based on dynamic and delicate balancing of alliance, competitive feasting, labor reciprocity, trade, host-guest asymmetry, raiding, and warfare. All activities rely on physical connections linking people face to face across the landscape.

The design of Minor Causeway-Canals mirrors the longer, more monumental Major Causeway-Canals. We can predict bands of dispersed households and hamlets stretching along the edges of forest islands overlooking the open savanna. Borrowing from, or perhaps the origin of, the formality of major causeways, each family or hamlet forged their own formal roads and canoe paths across the local landscape. Although low energy constructions (compared to the major inter-forest island causeway-canals), the minor causeway-canals imply agency, intentionality, and planning in their design and implementation (Table 00).

The result was an urbanized population with highly structured circulation; but unlike Western models of spatial hierarchy, center-periphery, and orthogonal grid. Small groups of agents established direct connections with others rather than through hierarchical, dendritic networks. Obsession with straightness and radial patterns is common in the Americas. In Amazonian ethnographic cases, straight roads are sacred axes of circular plaza villages dedicated to ritual uses such as log racing of the Bororo and Gê (Figure 00).

To move pedestrians or long heavy canoes between points A and B, the most effective means is a straight line. Contemporary farmers, hunters, ranchers, and cattle use informal paths to cross the savannas and wetlands (Figures 18-19). We recognize these as historical or modern paths by their irregular, sinuous trajectory despite the flat topography and open savanna. Although some produce worn trench-like ruts in the landscape over time, these paths are not formally constructed like the prehistoric cases (those that are straight are usually superimposed on the pre-Columbian causeway-canals).

Continually poling or dragging a large canoe through the shallow water can create canal-like depressions over time with minimal planning or labor. My informants showed me their wet season canoe path whose sinuous path contrasts sharply with the ruler straight pre-Columbian canals (Figure 19).

The irregular scar of annual canoe transit of my guides/informants is a good example of what a few hunters can do through even irregular routines over a period of years. Their patterned entry into and exit from the region has been permanently etched on the landscape as modern layer of palimpsest. I can trace their canoe path (minor canal) from their “port” at the end of a pre-Columbian canal, which connects the San Joaquin River, and traverses [number] kilometers of savanna ending at their camp at the east end of Crisóstomo Forest Island. The formation process, which created this landscape feature involved poling a heavy canoe through shallow flood water (scrapping the soft surface [bottom]), [add here]. To my guides, the major causeway-canals that crisscross their path are obstacles where their canoes must be portaged or cut with shovels, creating a new palimpsest. [contrast to pre-Columbian here?]

In the top-down approaches of traditional perspectives of cultural evolution and political economy, all causeways and canals of the Bolivian Amazon would be considered the works of chiefdoms or state societies (e.g. Earle 1991; Trombold 1991a). Ethnographic analogy suggests that households, lineages, and communities are capable of these public works. Ten years ago, the indigenous community of Cairo in western Baures built this straight causeway measuring 1 kilometer to connect two forest islands in a few weeks (Figure 20). Although the road connected two forest islands of individual communities, the road was entirely built by the “end of the line” community to have pedestrian and oxcart access to roads leading to the population center of Baures. [also an element of community pride] [add more data here from Erickson 2000] Another causeway of 0.5 kilometer was constructed between the town plaza and port on the Negro River (Figure 21). The project was a grass-roots effort by the community sponsored by Catholic Church outreach and community empowerment (make work project; small salary or food donations). A 0.25 kilometer meander cut canal was also created by the Community of (name).

The desire to travel by canoe has shaped the Baures landscape in other major ways. The obsession with straightness was also applied to the vast meandering rivers of the region. Nordenskiöld (1916) documented a number of river meander short cuts or cut offs and canals, which connect the main channels of adjacent rivers or their headwaters, many of which were still functioning. Denevan (1966) and I have documented additional canals designed to cut travel time and canoe portage (Figure 10). My informants state that the historical and modern river cuts are the product of and “owned” by local communities. Similar features have been documented in other regions of the Amazon basin (citations: Ucayali, Manus Winkler-Prins and Raffles 2003). Nordenskiöld (1916) cited informants who stated that these artificial canals could change mighty river courses over time, a phenomenon that has been documented recently in other locations.

In the Hydraulic Complex of Baures, we identified three clearly artificial canals pierce long narrow forest islands, which would require portage or hours of poling/paddling to circumnavigate (Figure 10) (Erickson et al. 1996). Cutting canals through the rock and soil of forest islands of the Baures region, even the narrow ones, is much more difficult than in alluvial river floodplains as discussed above. Such engineering implies clear intent.

The historical and ethnographic literature suggests that Major Causeway-Canals could be designed, built, and maintained by communities. The preliminary mapping of [number] of major causeway-canals within the Baures Hydraulic Complex suggests the accumulated construction efforts of many communities over possibly hundreds of years. Based on our raised field experiments conducted between 1991 and 1996, the profiles of major causeways-canals, and our preliminary GIS, an estimate of labor for Major Causeway-Canal is possible. I estimate that [number] total earth moved and [number] total person-days of labor. [Add details of energetics study here for all mapped Major Causeway-Canals; also attempt an energetics study of Community of Cairo case based on the number of participants and time in field notes].

We have dates for causeway and canal use beginning 1500 years ago in the Central Bolivian Amazon [Erickson 2000; Erickson et al. 1991; cases: raised fields with associated canal-El Villar 1, dated causeway after AD 600 El Villar 2] Were all the Baures roads and canals in use simultaneously? Possibly not, although I am convinced that most were built and used in the late prehistoric and the early protohistoric periods [before Spanish conquest of Baures]. [add concise summary of the radiocarbon dating of Baures causeway (Erickson 2000; Erickson et al. 1996)]. In the case where minor causeway-canals intersect, one may have been out of use at the time. In many cases, the cutting of old by recent causeway-canals is clear. In the case of canals, the crossing was probably not disruptive for the functioning of the canal for canoe transportation.

A less likely explanation is that the Minor Causeway-Canals represent landscape-accumulation over time as households migrating across settlement space through deaths, house replacement, fissioning communities, and growth and Minor and Major Causeway-Canals were abandoned and replaced as needed. Amazonian houses are not permanent structures and need maintenance and replacement. Ethnographic studies place the lifespan of typical Amazonian houses at [number] years (Hiraoka, Turner, Heckenberger, Hecht, Basso, Ted Grayson, and others-thatch replacement—Erickson 2003 ADE chapter). The dispersed households and multifamily hamlets documented in the ethnographic record are relatively ephemeral. Denevan (1993, 2006) convincingly argues that because of the limitations of stone axes for clearing primary forest, farmers such as those in the Baures region would have valued intensive farming of relatively permanent gardens, swiddens, raised fields, and orchards. We expect that over time, ideal house sites are regularly cycled back into use because of anthropogenic improvements over generations orchards, garden, dark earth formation, and secondary growth which is easier to fell for fields (Balée and Erickson; Denevan 2001; 2006) [footnote: the implications of this explanation are that extensive agricultural systems such as swidden and slash and

burn which characterize Amazonian ethnography appeared with depopulation after 1492 and the availability of the iron and later steel ax and machete.]

Who “owned and operated” the minor canals (canoe paths) between these forest islands? Few contemporary inhabitants of the Baures region own dugout canoes and Father Eder noted a lack of canoes during the Mission period. The high number of canoe paths suggests that the situation was different in the past. If we assume that each canoe path had a single canoe parked on one end, the number of canoes was impressive. Although individually owned, canoes are often left at non-fordable, bridge-less river crossing between communities. Canoes are left “parked” for anyone to use for the crossing. [Add implications of canoe materials for deforestation (combined with palisade walls around the ring ditch sites, firewood, and house construction)].

Add short comparison to other Amazonian road systems: Heckenberger (2005, Heckenberger et al. 2004) documents formal roads that connect large urbanized settlements in the upper Xingú River basin/region. Settlements of [range here] separated by [range distance here] are connected by radial road system. These roads are located in uplands (terra firme) rather than savanna and are defined by earthen curbs [size? describe]. Heckenberger interprets these roads as [add here]. [comparisons, interpretations, and implications here; Other archaeological cases: and Redman LAA Venezuela, interpreted as a paramount chiefdom; Augusto Oyuela, Inca, etc. compare and contrast?-small scale; keep these limited to archaeological cases: Silk Road, Romans, Incas, Maya, Aztec].

Conclusions

The causeway-canals of Baures represent engineered networks for social interaction. Surprisingly, these landscape features is better preserved than the ephemeral sites where people lived. Their linear patterning stands in sharp contrast to natural formations. Even the animal paths that wander between forest islands often follow or are determined by what the past humans created. As mentioned above, straight roads are a form of monumentality and billboard to physically show off community labor and pride. The causeways and canals, directing the eye to the distant horizon on a near flat landscape or convergence on key forest islands, provide a powerful phenomenological experience even today (Figures 04-06). Wide Major Causeway-Canals may have been elegant tree lined avenues (Figure 22).

Paths, trails, and now modern roads crisscross the occupied areas of the western edge of Baures (the old mission site and modern town of Baures and surrounding forest islands occupied by ranchers, colonists, and native peoples). Before the construction of roads for vehicular traffic in 1999, the rare straight roads and paths were probably based on pre-existing pre-Columbian roads, canals, and earthworks. Modern ranches can easily be identified by irregular patterns of radial paths used by cattle and ranch hands (Figure 23). Modern trails connecting dispersed households and hamlets are similar. In some cases, thousands of years of continuous use have produced deep ruts across forest islands.

Why are irregular, informal paths that accumulate through accretion, such as those found in other cultures or today near settlements (as discussed above), so rare in the region? If they existed, the daily routine activities should be etched on the cultural landscape with a physical signature similar to the Minor Causeway-Canals of the Baures region. The indigenous peoples apparently preferred a more orderly, formal circulation and structure although the informal would have been easier to create and maintain. This landscape is a clear case of structure imposed on everyday life at the local and regional scale. [the realm of aesthetics, art, cosmology, and agency].

I am convinced that the tangled mass of minor causeways-canals was organized grass roots fashion (or bottom up) by families, hamlets, lineages, and communities rather than imposed top-down from a chiefdom or state (Figure 24). The causeway-canals structured the practices of everyday life (or habitus) as much, or more so, as they were formed by those practices. The archaeology of landscapes provides an excellent means to address issues of agency, structure, and habitus in prehistoric contexts. The complex cultural patterning of mundane everyday life in the Baures landscape demonstrates human agency, intentionality, and sophisticated indigenous knowledge by Amazonian peoples.

The focus of this study has been on the minor causeways-canals and I have argued that these features are better explained by the bottom-up approach and practice theory. The main causeway-canals are larger, longer, require more labor and engineering, and are recognized as monumental. The political organization of inhabitants of the late pre-Columbian Baures region as a chiefdom, state, or something else (Steward and Faron 1959; Denevan 1966; HBSAI 1963, citations) will be addressed in another publication. In the case of prehistoric intensive agriculture, I have argued that the assumption that such regional scale works could not be created and managed by communities and inter-communities needs to be reexamined (Erickson 2006c). Archaeologists often assume that all monumental works of cultural landscape are the result of states and elite agency, the core of the top-down approach (e.g., Trigger 1990; DeMarriss et al. 199? CA). Based on energetics, spatial organization and patterning, and scale, the Minor Causeways-Canals of the Baures region are the creation of local communities as predicted by the bottom-up approach. In the case of the Major Causeway-Canals, the organization may be more complex, although I believe that much of what we know about the Minor applies to the Major Causeway-Canals. By attributing the causeway-canals to communities, I do not imply that the features exist outside of chiefdoms, states, and empires. Communities appear, thrive, and fail within the context of hierarchical states, globalism, failed states, and other forms of complex society.

Acknowledgements

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Table 00: Minor Causeway-Canals of the San Martin Forest Island Complex (generated from digitizing roads: angles, lengths of each causeway-canal).

Table 00: Labor Estimates for Major Causeway-Canal Construction.