6-2009

Comparative Variables for Trails, Paths, and Roads

Clark L. Erickson
University of Pennsylvania, cerickso@sas.upenn.edu

Comparative Variables for Trails, Paths, and Roads

LANDSCAPES *of* MOVEMENT

Trails, Paths, and Roads in Anthropological Perspective

EDITED BY

James E. Snead

Clark L. Erickson

J. Andrew Darling

University of Pennsylvania Museum of Archaeology and Anthropology
Philadelphia 2009

Appendix 2

Comparative Variables for Trails, Paths, and Roads

In the course of the conference, the participants agreed to key variables defining landscapes of movement in their individual studies for comparative purposes. The variables are:

1. Amount of construction/over what time
2. Technology of movement
3. Characteristics of terrain
4. Points/places of access (terminal points, resources, facilities, shrines)
5. Ownership/access/stewardship
6. Functions
7. Form/network organization
8. Scale
9. Meaning

The responses of the authors are provided below in chapter order.

HOPI (ARIZONA/NEW MEXICO) .

T.]. Ferguson, G. *Lennis Berlin, and Leigh]. Kuwanwisiwma*

Amount of construction/over what time

Hopi trails are generally unconstructed linear features. They are formed by use rather than engineered construction projects. There may be some

Scale

The roadways themselves might be called "monumental" (up to 100 m wide and 2 m deep) as long as this is understood to be the unintended result of generations of traffic, rather than any sort of "materialization." The largest of the radial networks extend out to a radius of 5 km but most are around 3 km; thus the cultivated catchments are between 30 km^2 and 80 km'. The scale of the entire network is immense; more than 1,700 km of roadways have been documented via CORONA satellite photographs (Ur 2003) with many more kilometers not yet mapped. The entire Upper Khabur basin was crisscrossed with sites and interconnecting roadways; the basin itself is 200 km EW and about 100 km NS, but the roadways spill over into the plains to the west and to the east, where they continue another 100 km to Nineveh (modern Mosul), Although impossible to prove the contemporaneity of all roadways, most of the EBA-articulated features probably were used simultaneously.

Meaning

Meaning is the most difficult aspect of EBA roadways. As non-constructed features which formed over several centuries, roadways were not the material manifestation of, or symbolic of, any particular worldview or understanding of the cosmos (as in Mayan sacbeob), nor did they serve to project political or military power (as in the Inka and Roman roads). As in the Arenal case (Chapter 8, this volume), they may have ultimately been assigned meaning, but it is difficult to say what that would have been, given the proto-historic time period. As a product of a resilient pattern of land ownership, they may have come to be associated with unequal control over land, but this is pure speculation.

BOLIVIAN AMAZON (CAUSEWAYS-CANALS)

Clark 1. *Erickson*

Amount of construction/over what time

The Major Causeways-Canals (Major CC) and Minor Causeways-Canals (Minor CC) of the Baures Hydraulic Complex (BHC) are tentatively mapped; thus, construction and maintenance labor of the features is estimated. Major CC are created by removing earth from adjacent canals to create a raised platform using digging sticks, shovels, baskets, and cloth.

Based on ethnographic analogy of construction of modern causeways and canals and experimental raised fields in the Bolivian Amazon, a single person can move 1 rn" per hour or 5 m' per day (5 hour day). Major CC vary in cross-section and length; thus, estimates of earth moved and labor costs in construction of individual CC are difficult. The Major CC total 475.909 linear km. If we assume that the causeways of Major CC are 4 m wide and 1 m tall, a total of 1,903,636 rrr' of earth was moved or a total of 1,903,636 person-hours or 380,727 person-days of labor were invested for the BHC.

The construction and maintenance costs of Minor CC or canoe paths of the San Martin Forest Island Complex are much lower than Major CC discussed above. Canoe paths required little effort, since poling or paddling a large dugout canoe repeatedly in the same location will produce a channel in the savanna. The straight trajectory of the Minor CC up to 2 km indicates more planning, design, and construction than today's informal canoe paths but still much less than the Major CC. The Minor CC total 93.491 linear km. If we assume a channel of 50 em wide and 30 cm deep, a total of 14,023.65 m' of earth was moved for the creation of the Minor CC of the San Martin Hydraulic Complex, representing 14,023.65 person-hours or 2,805 person-days. The average labor for a single Minor CC is 16.5 person-days. A family of five could construct a single feature in a little over 3 days. Maintenance involves periodic removal of vegetation and sediments, although regular use keeps the channel free.

Due to their straightness, most Major CC were created in a single episode, although earthworks may have been enlarged through periodic maintenance and reconstruction.

A single corrected radiocarbon date from the base of a causeway in the BHC of 1615 BP probably indicates protohistoric construction and use. Pottery from ring-ditch sites and settlements suggests that the majority of the earthworks are late prehistoric in date and were used for 300-500 years.

Technology of movement

The widths of Major CC suggest that they were constructed for two-way traffic (heavily loaded canoes and human porters). Minor CC are smaller and shorter. In some cases, Minor CC are simply shallow depressions with little raised platform. Many Major CC were wider and taller than necessary to avoid floods and move bi-directional pedestrian and canoe traffic. Many Major and Minor CC are parallel and redundant.

Characteristics of terrain

The landscape consists of forest, savanna, wetlands, and earthworks. The forest occurs along rivers as gallery forest and in forest islands. Forest islands in the Baures region are natural formations. Savanna and wetlands are predominant. Because of the flat terrain, large areas of the savannas are inundated during the wet season. Forest islands tend to remain dry.

Earthworks such as causeways, canals, fish weirs, ponds, reservoirs, and ring-ditch sites alter the character and drainage of the BHC, in addition to providing enhanced resources, transportation, communication, and settlement locations.

Points/places of access

Individual Major and Minor CC generally begin and end on forest islands. Forest islands were locations of settlements, gardens, fields, agroforestry, and hunting. Most large forest islands have one or more ring-ditch sites which are interpreted as settlements, cemeteries, forts, central places, and temples. Most multiple Minor CC connect forest islands in close proximity. In many areas, causeways and canals overlap with fish weirs and enhance fish availability through water management.

Most Major and Minor CC rarely cross or intersect. When this happens, one usually bisects the other suggesting sequential construction and use. Individual causeways and canals are part of a larger integrated network within the BHC over 550 km",

Ownership/access/stewardship

Minor CC (canoe paths) were built, maintained, and owned by pairs of individual families or multiple families living in hamlets on separate forest islands (although used by a larger spectrum of society). They represent the agency of individuals and small social groups by their scale, construction, location, destinations, numbers, and density. The features document repetitive movement. Although simple to construct, the straightness of the features indicates intentionality, planning, and design.

The Major CC represent a larger social realm of interaction, access, and ownership. Long, wide Major CC between adjacent forest islands probably were constructed and used by paired communities on separate forest islands.

Functions

The functions of the Major CC were transportation, communication, water management, and symbols of community pride. The Minor CC were smaller versions primarily used for local transportation and communication. Networks of causeways, canals, and natural waterways provided a means to move bulk staples and people and create local and regional interaction.

Form/network organization

The Baure are recognized as having urban-scale settlements, regional organization, powerful leaders, temples, forts, and large populations, and the term chiefdom has been applied to this society.

The network of Major CC of the BHC are regional (550 krrr'). Using Major CC, an individual could traverse the entire BHC. Individual Major CC are organized locally between adjacent forest islands. Most forest islands are connected to their neighbors by Major and MinorCC (1 to 7.5 km), A few larger forest, islands, assumed to be population and possibly political centers, have multiple radial Major CC, suggesting a weak hierarchy of center vs. hinterland. Major CC appear to be organized at the multi-community level.

Most Minor CC are local in organization. All are straight. Because the majority of Minor CC connect nearby forest islands, the organization is beyond the individual. The density and number of Minor CC of the San Martin Forest Island Complex suggest interacting households or hamlets. Collectively, each forest island represented a community.

Scale

Major CC are found throughout the Bolivian Amazon and linked vast regions. The Major CC of the BHC cover an area of 550 krrr'. The surrounding area has few causeways and canals. The San Martin Forest Island Complex of 3-4 km^2 represents a small-scale landscape. Eleven Major CC connect forest islands of the complex and beyond over 4.6 km. The main cluster of 168 Minor CC over 3 km^2 represents a local landscape. The boundary of this particular study area is culturally, rather than arbitrarily defined by the patterning, direction, and presence-absence of the Minor CC. This complex of Minor CC represents the scale of interacting families living in hamlets, multiple families or lineages, and! or communities.

Meaning

Based on the intent, design, scale, and over construction, the Major and Minor CC were public symbols of identity and pride. Some Major CC were probably a form of monumentality where large stone architecture was unknown. On the flat, open landscape, perfectly straight, long, wide elevated avenues, crossing which appear to reach the horizon, created an impressive experience for travelers. The obsession with straightness in the built environment also shows a concern with microcosm, axis mundi, and sacred alignments.

The Major and Minor CC mark who was connected socially and who was not, creating a map of organization and interaction.

BOLIVIAN AMAZON (EARTHWORKS)

Clark L. *Erickson and]ohn* H. *Walker*

Amount of construction/over what time

Precolumbian earthworks, including causeways, canals; raised fields, settlement mounds, fish weirs, and other structures are found throughout the Bolivian Amazon. We focus on an arbitrarily defined area of causeways, canals, and raised fields along the Middle Apere River of 12.77 knr'. The landscape of causeways, canals, and raised fields on the Middle Apere River is tightly integrated (23.93 linear km of causeways and 12.77 km^2 of raised fields). Raised fields with wavelengths of 5 m and platforms raised 0.5 m required movement of 125,000 m" of earth per krrr', or a total of 1,596,250 m" of earth.

Raised field experiments showed that farmers can move 0.5 rrf per person-hour. Using a 5-hour work-day, 6000 person-hours or 1200 person-days are required to built a 3-m-wide, t-m-tall, and t-krn-long causeway. Thus, the measured causeways on the Middle Apere River required 143,580 person-hours or 28,716 person-days to construct. The raised fields required 3,192,500 person-hours, or 638,500 person-days to construct.

Radiocarbon dates show earthworks were constructed and maintained as landesque capital for *mote* than 2,000 years. The landscape was built-through accumulation of effort and infrastructure over this time. The organization of labor was within the capabilities of small communities. The integrated landscape probably involved collaboration between hamlets and communities. Although capable of managing large quantities of water, increasing crop production, and lowering risk, the precolumbian engineering was relatively simple.

Technology of movement

Causeways and canals had hydraulic and land-tenure functions for raised field agriculture. Some causeways and canals connect settlements, fields, rivers, and wetlands, suggesting that year-round transportation and communication were the primary functions. Canals would have extended the use of canoes into the dry season. One person can move a ton or more by canoe.

Although the technology was simple (moving earth from adjacent canals to create the raised road), most earthworks are long and straight implying intention and pride.

Characteristics of terrain

Relevant characteristics of the terrain include topography, hydrology, slope, and vegetation. The Bolivian Amazon is a low plain crossed by many rivers. These rivers deposit their sediments on forested levees, which gently slope (levee backslope) towards the low-lying wetlands between rivers. Microtopography determines which areas of the landscape are inundated or dry.

Most settlements and modern fields are located on the highest levees. Causeways, canals, and raised fields are generally found on the levee backslope where seasonal inundation occurs. The anthropogenic topography created by causeways and canals could manage water for raised fields and transportation by canoe and provide dry walking surfaces.

Points/places of access

The regularly spaced causeways and canals were oriented parallel or perpendicular to the course of the river. Some causeways and canals have settlements and mounds as terminal points; others connect a settlement with the river, wetlands, and raised fields. Some parallel to the river were shortcuts bypassing large meanders. The raised fields are integrated into the network of causeways and canals suggesting hydraulic and transportation functions.

Ownership/access/stewardship

The issue of ownership, access, and stewardship is central to our argument of causeways and canals as landscape capital. This landscape represents the accumulation of many small investments of labor and engineering over millennia. The patterned raised-field blocks and easily accessed causeways and canals create an orderly structured landscape. The patterning suggests land tenure and labor organization, key to accumulated landesque capital. Experimental raised fields and causeways show that earthworks can be created at the local level. As accumulated and inherited landesque capital, the earthworks benefited successive generations of farmers as a valuable resource.

Functions

The causeways and canals served for transportation, communication, organization of the landscape, and water management. Hydraulically, the causeways organized capture, flow, and drainage of water on the levee backslopes. In the early wet season, causeways and canals channeled and impeded rainwater that moved down the levee backslope and managed rising water from the wetlands below: In the late wet season and early dry season, causeways and canals held water.

Form/network organization

The causeways are 0.5-1 m tall, 2-4 m wide, and length ranges from 276 m to 2.5 km. They are built of earth from adjacent canals. The network integrated the river, settlements, wetlands, and raised fields. Eleven causeways are parallel to the general course of the Apere River and 16 causeways are perpendicular to the river, crossing the backslopes. Both types allowed transportation and communication along the river (in both the dry season and the wet season) and between the river and intervening wetlands, in addition to the hydraulic functions.

Scale

Our study area (65 km') represents a medium scale of landscape. The boundaries are artificial because the features discussed extend many kilometers across the regional landscape. Causeways and canals range in length from 276 to 2,508 m, providing a minimal measurement of social interaction scale. Because local causeways and canals intersect up and down the river, in addition to canoe traffic in the river and wetlands, the potential social interaction sphere is much larger.

The causeways oriented parallel and perpendicular to the river define units of 100 to 300 ha which we interpret as land tenure, possibly at the lineage or community level. These causeways contain tens of individual blocks of parallel raised fields (0.2-38.9 ha or an average of 3.23 ha), possibly the work of individual families.

Meaning

We argue that the causeways and canals had multiple meanings as landesque capital. The first meaning was social as boundaries of land tenure, production, and community organization. What they connect and did not connect were expressions of territory and place. The second meaning of patterned landscape was a physical representation of family, lineage, and community identity, organization, and pride. The precolumbian landscape features were overconstructed in the sense that much of the structure is beyond what would be necessary, which implies design, aesthetics, and pride. A fourth meaning is the value of the landscapes for contemporary inhabitants. Local ranchers and native peoples are proud of the precolumbian design and engineering of these landscapes.