Wetlands as Domesticated Landscapes: Pre-Columbian Water Management in the Bolivian Amazon

Clark L. Erickson, PhD
Department of Anthropology
University of Pennsylvania
33rd and Spruce Streets
Philadelphia, PA 19104-6398
215-898-2282
cerickso@sas.upenn.edu

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Personal Statement

I am interested in how archaeology can provide a long-term perspective on environmental change, biodiversity, and sustainable management. Since 1974, my Andean and Amazonian research focuses on the contribution of archaeology to understanding the complex human history of the environment and cultural activities that have shaped the Earth. I use historical ecology, landscape archaeology, and applied archaeology to understand the long-term complex human history of the environment and cultural activities that have shaped the Earth. My contributions include the human role in contemporary biodiversity, indigenous knowledge systems, native agriculture, sustainable landuse, and cultural landscape structure and aesthetics. I have considerable experience collaborating with descendant communities on applied archaeology projects with potential for sustainable development (Quechua in Peru, Cofán in Ecuador, and Arawak in Bolivia). Most recently, I investigated pre-Columbian cultural landscape in the wetlands, forests, and savannas of the Amazon region of Bolivia (raised fields, ring ditches, fish weirs, causeways, and canals). I am editor of two recent volumes Time and Complexity in Historical Ecology: Studies in the Neotropical Lowlands (2006) and Landscapes of Movement: Trails, Paths, and Roads in Anthropological Perspective (2009) in addition to numerous other scientific and popular publications. I am currently Professor in Anthropology at U. Penn and Curator-in-Charge of the American Section of the Penn Museum. My research has been funded by the National Aeronautics and Space Administration, National Science Foundation, H. John Heinz Charitable Trust, the University Research Foundation, American Philosophical Society, and the Interamerican Foundation.

“What I know.” Statement of the perspective or area of expertise you bring to your panel relevant to the themes of the symposium.

Since 1974, my Andean and Amazonian research has focused on how archaeology can contribute to understanding the complex human history of the environment and the effects cultural activities have had on the Earth. I have pioneered the use of historical ecology, landscape archaeology, and applied archaeology to answer questions related to environmental change, biodiversity, and sustainable
management of resources. My contributions reflect my anthropological orientation by highlighting the human role in contemporary biodiversity, indigenous knowledge systems, native agriculture, sustainable landuse, and cultural landscape structure and aesthetics. In much of my work, I have collaborated with descendant communities (Quechua in Peru, Cofán in Ecuador, and Arawak and Sirionó in Bolivia) on applied archaeology projects that present some potential for sustainable development, local empowerment, and revitalizing cultural heritage. Most recently, I have been investigating pre-Columbian cultural landscapes in the wetlands, forests, and savannas of the Amazon region of Bolivia (raised fields, ring ditches, fish weirs, causeways, and canals).

Archaeology of Landscapes

I believe that the archaeological study of rural or mundane landscapes can tell us about the “people without history” (as Eric Wolf has called them), large segments of past societies often disregarded or consider mere faceless masses within the political economies of states and empires. While traditional archaeologists study sites, cities, and monuments, I focus on the built, engineered, and sacred landscapes found between sites, the patterned human modification and transformation of the natural landscape in the form of paths, roads, causeways, monuments, walls, agricultural fields and their boundaries, gardens, astronomical and calendrical alignments, and water management systems. My approach focuses on sorting out the multiple layers and identifying complex patterns, social logic, and structures that are physically embedded in landscapes as they provide insights into core indigenous structures such as measurement systems, land tenure, social organization, cosmology, calendars, astronomy, cognition, ritual practices, and the aesthetic values of past communities.

I have applied this landscape approach to two major culture areas of the world: the Andes and Amazonia of South America. I have examined pre-Columbian raised field agriculture in Peru and Bolivia through mapping field patterns, excavating landscape features, and conducting experimental archaeology reconstructions in which local farmers put abandoned fields back into use. My recent research explores the concept of monumentality as it can be applied to the massive transformations and creations that multiple generations of farmers imposed on community landscapes as a form of land capital in the Andes and Amazonia. I also explore “landscapes of movement” as a means of reconstructing circulation and communication networks, labor organization, territorial boundaries and how these relate to memory and identity in past societies. My students in studio seminars have applied the landscape approach to understand ritual road networks and sacred landscape calendars in Sajama, Bolivia, and Cuzco, Peru. One of my publications concerns dark earths or terra preta, a widespread Amazonian phenomenon, that are anthropogenic organic black soils resulting from the activities of pre-Columbian peoples, a topic that has received considerable attention in the press in the past few years as a solution for recycling of carbon to enhance food production, especially in tropical regions with poor soils. In addition to my research on past peoples, I am currently working with Bolivian colleagues on proposals to protect, manage, and promote archaeological and living cultural landscapes.

My landscape research in the Bolivian Amazon is receiving new attention as colleagues have begun to document large populations, complex societies, intensive agriculture, and earthworks throughout Amazonia and other regions of the Neotropics. In September of this year, I was an invited guest at a conference on Amazonian Archaeology in Manaus, Brazil, that was attended by 400 other scholars and students.

Historical Ecology
Historical ecologists attempt to understand the complex human history of an environment and how cultural activities have shaped that environment. I believe that archaeologists should play an important role in historical ecology by providing a long-term perspective on the human history of the environment, thus providing a means to address issues of environmental change; biodiversity; the creation, use, and management of resources; and sustainability. An important aspect of my work is that it integrates my insights with those of investigators in other disciplines in order to address issues that have greater scope than any one field alone. The book that I co-edited with ethnobotanist and ethnographer William Balée, Time and Complexity in Historical Ecology: Studies from the Neotropical Lowlands (Columbia University Press 2006), highlights multidisciplinary approaches to understanding anthropogenic (human created) landscapes. I also believe in the importance of making research available and relevant to local stakeholders and the general public. A recent BBC documentary on the archaeology of Amazonia titled The Secret of El Dorado (2002) also features this research, and I have received many emails and letters from interested viewers around the world.

The Amazon has traditionally been considered a cultural backwater where unchanging native cultures were limited by technology, poor soils, and a lack of protein sources. Historical ecologists and landscape archaeologists have now shown that Native Amazonians actually had a wide range of crops, practiced agro-forestry, created fertile soils (Amazonian Dark Earths or terra preta), and actively transformed their environment into a highly productive and orderly cultural landscape. I call this a “domestication of landscape,” whereby humans altered the diversity, distribution, and availability of plant and animal species, soils, and water to such a degree that they actively made and managed the resources that they desired, as opposed to accepting and adapting to natural environmental limitations. In an investigation of a large pre-Columbian settlement mound in the Bolivian Amazon, ethnobotanist Bill Balée and I demonstrated a high level of biodiversity of more than 800 trees surveyed on the mound and nearby, especially high frequencies of economic species, despite a nearly complete replacement of the species that would have grown there before the period of intensive settlement. Using GIS and hydraulic simulations, John Walker and I have documented that the water management practices by the pre-Columbian farmers of the Bolivian Amazon operated on a regional scale, as they expanded wetlands, controlled water levels during annual floods, and harnessed the fertility of aquatic plants and sediments.

**Indigenous Knowledge and Applied Archaeology**

My study of historical ecology and cultural landscapes documents past, and also contemporary knowledge and technology that are relevant to sustainable land use, agrodiversity, and indigenous knowledge. In some cases, archaeology provides the only means of recovering forgotten technologies such as the raised fields and fish weirs of Bolivia and Peru, but my interest in these old technologies is not simply to study something about the past, but to investigate how the past can usefully serve people today. I have collaborated with international agencies, government officials, and the private sector in exploring new ways of promoting and appropriately managing archaeological, cultural, and environmental resources.

As my interests in archaeological cultural landscapes developed, I became interested in how indigenous communities today perceive and use their landscape, and how this is elaborated over the long term through the cultural practices of everyday life. I began to explore the importance of indigenous mapping, place making, naming, defining boundaries and territories, conceptualizing homelands of origin, and how these practices relate to modern identity, community, indigenous territory, and empowerment. In 2007, I participated with colleagues at the Division of Environment, Culture, and Conservation of the Field Museum of Chicago and the University of Texas-San Antonio on a collaborative
project with the Cofán, an indigenous Amazonian people in eastern Ecuador. After training a team of four young Cofán interns, we video-recorded in-depth oral history interviews about settlements, historical and sacred places, ethnogeography, and toponyms of the Cofán. The Mapping Cultural Landscapes of the Cofán through Oral History Project produced a poster-sized full color map locating over a hundred cultural places and a two-disc DVD program, *Ingi Canse’cho Ande* (“The Land Where We Have Lived”) of oral histories about cultural landscapes. The maps demonstrate that the Cofán sphere of activity used to be much larger than their current, legally recognized indigenous territory, and the cartography and oral histories from this project may play an important role in future land claims.

“What I want to know.” What do you hope to learn, or be able to discuss with participants from other disciplines?

I have the following questions related to the themes of resilience and sustainability of past and present human societies:

What do we mean by “collapse” of society? Are all “cultural” or “radiocarbon” hiatuses evidence of collapse? How is collapse measured and at what temporal and spatial scale? How is collapse distinguished from normal expected cultural change? Does the collapse of urban centers and elite lifeways necessarily cause the collapse of the rest of society in rural landscapes?

At what point do human activities that disturb and transform the environment become degradation of environment? How is degradation or improvement of the environment measured?

What do we mean by “resilience” when applied to the environment and human societies?

How is sustainability measured in the archaeological record? What specific past practices of creation, transformation, and management of environmental resources are relevant to modern, global society?

**Discussion of your current research, or a relevant case study. Please write for an interdisciplinary audience; define all acronyms and explain terminology used in specific ways within your own discipline.**

**Flood Regimes and Carbon Cycling in Anthropogenic Landscapes of the Bolivian Amazon**

The current project is a multidisciplinary investigation of the hydrology within pre-Columbian anthropogenic landscapes of Amazonia and their implications for past and present Global Change, environmental conservation and management, and sustainable development. Our proposal focuses on the impact of pre-Columbian earthworks on the hydrology of savannas and wetlands in Bolivia. Landscape Archaeology and Historical Ecology are frameworks to understand how: 1) native peoples transformed their environment, 2) engineered landscapes impact biodiversity, agrodiversity, ecological heterogeneity, and sustainable land use, and 3) landscapes with deep human history can contribute to contemporary conservation and management. Amazonia was historically considered to be of limited potential for humans. Scholars therefore assumed that simple socio-political organization, mobile lifeways, and subsistence based on hunting, gathering, fishing, and small scale farming characteristic of the historic period, adequately reflected pre-Columbian conditions. The discovery of raised fields, causeways, canals, fish weirs, reservoirs, dikes, mounds and other earthworks throughout the Bolivian Amazon challenged this perspective, as pre-Columbian societies built a landscape that supported a complex culture in a currently underpopulated and economically depressed area. The past inhabitants
built elaborate earthworks for controlling, which sustained intensive agriculture, fisheries, and dense
human settlement, and in some cases, high biodiversity. Our project proposes to map the seasonal
dynamics of regional flooding over multiple years and how native peoples managed water and aquatic
resources through earthworks. Mapping protocols are based on remote sensing of imagery from NASA
and other institutions to facilitate computer modeling and temporal simulation of complex, dynamic
landscapes. GIS and remote sensing will be verified using previous archaeological, ecological, and
pedological research within the region. Principle goals include 1) constructing a detailed DEM for local
and regional hydrology, 2) defining sources, processes, and variation of seasonal flooding, 3) mapping
and modeling water flow before, during, and after annual flooding, 4) detecting and documenting pre-
Columbian earthworks from remote sensing, combined with predictive modeling based on the
signatures of known earthworks, 5) defining, modeling, and interpreting pre-Columbian anthropogenic
landscape transformation, and 6) evaluating positive and negative impacts of human activities over time
on local and regional hydraulic patterns through experimental reconstruction of pre-Columbian
earthworks. This research will provide a foundation for future modeling of carbon production, flow,
cycling, sequestration, and loss within anthropogenic landscapes.

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