Journal of Anthropological Archaeology 44 (2016) 56–68

Contents lists available at ScienceDirect

Journal of Anthropological Archaeology

journal homepage: www.elsevier.com/locate/jaa

Nets and canoes: A network approach to the pre-Hispanic settlement system in the Upper Delta of the Paraná River (Argentina)

Eduardo Apolinaire *, Laura Bastourre

CONICET - División Arqueología, Facultad de Ciencias Naturales y Museo, UNLP, Paseo del Bosque S/N, La Plata City 1900, Buenos Aires Province, Argentina

ARTICLE INFO

Article history:
Received 4 November 2015
Revision received 30 April 2016

Keywords:
Network analysis
GIS
Landscape
Upper Delta of the Paraná River
Settlement system
Earthworking

ABSTRACT

Graph theory-based network analysis provides useful methodological tools for the exploration of several landscape related issues. In particular, it favours the examination of the topological configuration of space; that is, the arrangement of its constitutive elements into a relational order. This is an important aspect of spatiality in terms of its social significance for it reflects, as well as shapes, the way in which social relations are structured. Based on this approach, a case study from the Paraná River Delta, where occupation strategies included the construction of earth-mounds and mobility strongly depended upon water courses, is herein presented. In this scenario, we examined the ways in which spatial arrangement of settlements and waterways linking them through the landscape reflected and shaped social interaction. More specifically, we evaluated the spatial configuration of the Paraná Delta hydrographic network in relation to settlement distribution and hierarchy. Thereafter, we found that archaeological sites are mainly located in highly accessible locations and that the most prominent sites within the settlement system are located at high centrality areas. Subsequently, we discussed the implications of these results for the understanding of the emergence of incipient social hierarchies and the significance of earthworking for the topographic writing of cultural landscapes in the studied area.

© 2016 Elsevier Inc. All rights reserved.

1. Introduction

The deeply entangled relationship between human societies and their inhabited landscapes has been a major topic of interest for many archaeologists in the past several decades. On the one hand, it has been stated that social interactions are woven into networks traced over the physical environment in ways in which socialized landscapes are created (Conkey, 1984; Gamble, 1998, see also Langley, 2013). The key elements in these socially constructed territories are paths and trackways along which information flows in order to join individuals and groups together (Gamble, 1998). On the other hand, it has also been widely recognized that landscape in not merely an external scenario where social relationships take place but a social production where meaning is imbued into the physical features of the terrain, both natural and anthropic (Bender, 1993; Cosgrove, 1997; Ingold, 1992, 1997; Thomas, 2001; Tilley, 1993). Moreover, significant spaces, landmarks and the pathways that connect them through landscape topography are attached to meanings and stories which are evoked over the generations. Such continuum contributes to the construction and transmission of historical memory and the constitution of group and individual identity (Bender, 1993; Ingold, 1997; Thomas, 2001). These socially constituted spaces in turn play an active and significant role in the organization, reproduction and transformation of social life. In other words, spatiality at any scale (landscape, places, settlement systems, architectonic spaces) enables and shapes certain social relationships, practices and meanings while other actions and connections are disabled or ignored (Hillier and Hanson, 1984; Giddens, 1984; Rapoport, 1990, see also Acuto, 2013).

In line with the abovementioned considerations, the configuration of space -that is, the arrangement of its constitutive elements into a relational order- proves one of the most prominent properties of spatiality in terms of social significance. Social spaces display an organization that reflects, as well as shapes, the way in which social relations are structured (Giddens, 1984). An important issue that arises then is how to recognize and depict this topological configuration. In this regard, graph theory-based network analyses provide quantitative tools and concepts for analyzing and representing spatial structurations. An example of such

Abbreviations: PUD, Paraná Upper Delta; HTN, Hydrographic Transport Network model; ASN, Archaeological Sites Network model.

* Corresponding author.
E-mail addresses: eapolinaire@gmail.com (E. Apolinaire), laurabastourre@yahoo.com.ar (L. Bastourre).

http://dx.doi.org/10.1016/j.jaa.2016.08.003
0278-4165/© 2016 Elsevier Inc. All rights reserved.

approach is provided by space syntax, a graph theory-based analysis drawn upon to assess social aspects expressed in the distribution and design of architectonic spaces (Bermejo Tirado, 2009; Dawson, 2002; Hillier, 1996; Hillier and Hanson, 1984). We believe that graph theory concepts applied to network analysis may also prove useful tools for the study of social structuration of space in a broader scale and considering a landscape perspective, a subject which has been hardly explored but for a few notable exceptions (Brughmans et al., 2015).

In recent years, network science applications to archaeology have significantly increased. Such studies place relationships in the core of our analytical techniques and allow us to approach a great variety of topics such as hierarchy emergence, settlement systems and circulation of information, people and goods, among others (Brughmans, 2013; Collar et al., 2015; Knappett, 2013; Mizoguchi, 2009). Usually, these relationships are traced among common features of material culture in order to create relational webs (Collar et al., 2015). An alternative way of benefiting from network methods involves shifting the focus of attention to the spatial properties of the archaeological record and analyzing inter-site connections in a landscape framework. In this paper, we explore these ideas via the pondering of a case study from South American lowlands.

Of late, the traditional point of view regarding South American lowlands as pristine habitats occupied by egalitarian forager bands who had no significant impact over the environment has been challenged by increasing evidence of anthropically modified landscapes. Theoretical contributions on Amazonian anthropology, especially Historical Ecology, have been highly influential in this regard (Balée and Erikson, 2006; Hornborg, 2005; Hornborg and Hill, 2011). Pre-Hispanic societies from different regions of South America developed wetland management strategies involving the transformation of the landscape through the mobilization of great volumes of sediments. Such strategies developed into a rich tradition of earth engineering incorporating mounds, raised fields, channels and other earthworks spread all along the major South American basins (Amazon, Orinoco and Paraná-Plata) and transcending cultural and linguistic boundaries (Gianotti and Bonomo, 2013; Heckenberger and Neves, 2009; Rostain, 2010; Souza et al., 2016).

Herein, we provide a case study from one of the southernmost expressions of this earthworking phenomenon, the Paraná River Delta. In this flood-prone wetland, occupation strategies included the construction and habitation of earth-mounds and other topographically elevated areas in an environment where mobility greatly depended upon water courses. Based on this scenario, we hereby address how spatial arrangement of settlements and waterways linking them through the landscape reflected and shaped social interaction. For assessing this topologic configuration, we resort to a graph theory-based network analysis. Spatial structuration of waterways in the study area defined movement and circulation of information, goods and people hence conditioning interaction possibilities that produce and reproduce social networks. In this way, mobility pattern observations provide information on social connectivity and, also, inequality (Howey, 2011; Richards-Rissetto and Landau, 2014). Spaces are usually tied together in the form of webs within which some locations are more accessible than others or boast higher potential for controlling communications. This structuration both influences and reflects mediation and interpellation abilities of social actors and the range and nature of the strategies they can implement (Dobres and Robb, 2000; Mizoguchi, 2009). We discuss the implications of these ideas for the understanding of the emergence of incipient social hierarchies and the significance of earthworking in the construction of cultural landscapes in the study area.

2. Graph theory and network analysis in archaeology

Formal properties of networks can be mathematically addressed through graph theory. “Graph” is a term utilized to describe a twodimensional structure composed of spatially distinct points or nodes connected by lines or edges. The relevance of this approach lies on the fact that its use favours the representation of topological links between network elements beyond the nature or specific content of these relationships (Cardozo et al., 2009; Hage and Harary, 1983; Wallis, 2007; Wilson, 2014). Therefore, graphs have been used to represent structures as diverse as neural circuits, urban transportation systems, insect colonies or social networks while currently being widely applied to disciplines such as Physics, Neuroscience, Sociology, Geography, Computer Science and Economics, among others. One of the most remarkable properties of graphs is centrality. Graph centrality measures are mathematical methods for quantifying the importance of each node in terms of its position with respect to the surrounding elements in the network. Two of the most commonly used centrality measures are betweenness and closeness. These measures indicate how accessible a location is and the potential for mediation or control that it may exercise with respect to the traffic between other nodes in the network (Freeman, 1977; Friedkin, 1991; Sevtsuk and Mekonnen, 2012).

Formal network analysis through graph theory has been applied to archaeological research since, at least, the 1960s (Brughmans, 2013). In two influential articles, Pitts (1965, 1979) used measures of closeness and betweenness to analyze Moscow’s strategic position within the river trade network of medieval Russia. The archaeological potential of network analysis was clearly recognized in the 1970s by Irwin-Williams (1977), who described the analytical possibilities offered by network models for quantitative analyses of prehistoric trade. Particularly, the author explored the potential of these models when addressing the influence of exchange systems in prehistoric settlements of northwestern New Mexico. For his part, Rothman (1987) highlighted the advantages of graph theory in settlement systems analysis in terms of how it allows researchers to test hypotheses drawn from anthropological theories bringing into play mathematically objective measures. The author illustrated this approach by applying graph theory concepts to the interpretation of regional survey data from south-western Iran. Influenced by these works, Peregrine (1991) used centrality measures to explore the evolution of the Cahokia center within the Mississippi Basin. He visualized this basin as a graph where lines represent the rivers and nodes correspond to river heads and junctions. By applying measures of degree, betweenness and closeness, he argued that the evolution of Cahokia was possible due to its strategic central position at the confluence of several major rivers which facilitated control over riverine exchange.

These early applications of graph theory in archaeology developed discontinuously and had no significant influence on the widespread adoption of network techniques in later archaeological research (Brughmans, 2013, 2014). Network analyses in archaeology faced a significant breakthrough in the last ten years and were influenced by two research traditions (Brughmans, 2014): social network analysis (Wasserman and Faust, 1994) and studies of complex networks in physics (Barabási and Albert, 1999). The issues addressed in archaeological network analyses are as diverse as the methods therein applied: spread of information following the Antonine Itinerary (Graham, 2006), religious innovations in the Roman Empire (Collar, 2007), impact of natural disasters on maritime connectivity in the Aegean Bronze Age (Knappett et al., 2008), identification of social and cultural boundaries in Papua New Guinea (Terrell, 2010), distribution of Roman pottery (Brughmans and Poblome, 2016), social interactions between Near

Download English Version:

https://daneshyari.com/en/article/1034842

Download Persian Version:

https://daneshyari.com/article/1034842

Daneshyari.com