Journal of Archaeological Science 39 (2012) 1111–1122

Contents lists available at SciVerse ScienceDirect

Journal of Archaeological Science

journal homepage: http://www.elsevier.com/locate/jas

Spatial network analysis of a terminal prehispanic and early colonial settlement in highland Peru

Steven A. Wernke*

Department of Anthropology, Vanderbilt University, VU Station B #356050, 2301 Vanderbilt Place, Nashville, TN 37235, United States

ARTICLE INFO

Article history:
Received 9 September 2011
Received in revised form
6 December 2011
Accepted 8 December 2011

Keywords:
GIS
Spatial analysis
Network analysis
Space syntax analysis
Built environment
Architecture
Inca
Andes
Colonial archaeology
Historical archaeology

ABSTRACT

This study uses GIS-based spatial network analysis (SNA) to simulate patterns of foot traffic and analyze the manipulation of the built environment of a small Inka imperial outpost that became an early Franciscan doctrina (doctrinal settlement) in the Andean highlands of southern Peru. Excavations show evidence for growth and remodeling of the site's public and domestic spaces over its short use life as a doctrina, pointing to an increasingly orthodox regime of indoctrination. The results of SNA-based walking simulations show specifically how movement through the site was rerouted to isolate the old Inka ceremonial core, producing new rhythms of interaction and directing public processionals to the colonial plaza and chapel of the doctrina. The complementarity of SNA with other established forms of access analysis and its broader utility for archaeological research design, sampling strategies, hypothesis testing, and interpretation are discussed.

Most systematic studies of the built environment of archaeological settlements rely on variants of space syntax analysis (Hanson, 1994, 1998; Hillier, 1985, 1989, 1996; Hillier and Hanson, 1984; Hillier et al., 1987a,b). Space syntax analysis is of proven utility for characterizing scale, integration, and relative asymmetry of spatial connectivity within archaeological settlements (e.g., Banning and Byrd, 1989; Dawson, 2002; Fairclough, 1992; Ferguson, 1996; Foster, 1989; Hopkins, 1987; Moore, 1992; Parker Pearson and Richards, 1994; Shapiro, 1999; Van Dyke, 1999). Its graph-based schematic representations, however, visually dissociate analysis from the architectural plan, making its legibility and interpretation less intuitive.

This paper uses a complementary but distinct method – Spatial Network Analysis (SNA) – as the basis for simulation and analysis of movement through the built space of a well-preserved terminal prehispanic (1450–1532 C.E.) and early colonial Franciscan *doctrina* (doctrinal settlement) (ca. 1540–1570 C.E.) in Peru. The GIS-based SNA analyses presented provide a quantitative, visually-intuitive, and reproducible means of simulating and characterizing movement through the built space of an archaeological site. Developed and used primarily for modern urban planning, SNA is readily adaptable to the modeling of foot traffic through archaeological settlements. In this case study, SNA reveals striking reorganization of pedestrian movement through a settlement as it was transformed from a small local Inkaic imperial outpost into a doctrina in the early years following the Spanish invasion. By extension, it shows the potential of SNA for other contexts, as well as its applicability for guiding the formation of hypotheses and sample selection criteria for excavation.

A focus on the built environment is especially appropriate in the context of early evangelization in the Americas. The Spanish invasion of the Americas was ideologically and legally predicated on the spiritual "salvation" of the indigenous populace. While the *entradas* and initial period of violent conflict made significant impacts on indigenous lifeways (Beck et al., 2010; Murphy et al., 2010), religious personnel – usually Mendicant friars – constituted the only sustained Spanish presence in many rural hinterland settings in the early years following initial invasion. Following early campaigns of mass baptism and extirpation of idolatry, the longer-term project for a more penetrating religious transformation was intimately tied to a larger colonial social engineering program that viewed

* Tel.: +1 615 775 3702.
E-mail address: s.wernke@vanderbilt.edu.

0305-4403/$ – see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jas.2011.12.014

urbanism as the pathway to a Christian social order (Cummins, 2002; Gose, 2003; Kagan, 2000; Lara, 2004). The foundation of mission settlements was central to that project (Deagan, 1990; Graham, 1991, 1998; Hanson, 1995; Jacobi, 2000; Pendergast, 1991; Thomas, 1988, 1993; Wernke, 2007, 2011, in press).

In fact, colonial policy thinking by the mid-16th century was predicated on a rather deterministic view of the role of the built environment in the constitution of Christian subjects. *Civitas* (orderly urban community life) was thought to be not just reflective of ideal social order (*policía*), but actually generative of it (Cummins, 2002; Kagan, 2000: pp. 26–28). The built environment was thus considered a key medium for social control. New kinds of Christian communities were to emerge through the inculcation of new daily practices and public rituals shaped by the novel spatial configurations of planned colonial towns. Mission settlements were usually the first of these to be constructed (Deagan, 1988; Fraser, 1990; Gisbert and Mesa, 1985; Graham, 1998, 2011; Hanson, 1995; Lara, 2004; McEwan, 2001; Thomas, 1991; Wernke, 2007). Andean peoples, for their part, were accustomed to the manipulation of the built environment as a dimension of imperialism (Dean, 2010; Hyslop, 1990; Niles, 1999). On the eve of the Spanish invasion of the Andes, Inka imperial consolidation was negotiated in many social practices and material media analogous to those of Spanish evangelization – especially through elaborately staged, public ritual in plazas and associated ceremonial buildings (Coben, 2006; Dillehay, 2003; Morris and Thompson, 1985; Wernke, 2007). New urban forms were therefore not such a straightforward means of social control as Spanish colonial policymakers thought. In addition to the complications stemming from cultural differences (disparate beliefs and practices associated with the built environment), architecture and associated spatial practices had become variably hegemonic and contested as a dimension of imperial control under Inka rule.

How were these spatial practices and ideologies sequentially negotiated in situ? Documentary sources only obliquely refer to this key dimension of the experience of colonial rule, so the only way to address the question in a rigorous manner is through systematic archaeological and architectural analysis. Here it is explored through quantitative, GIS-based spatial network analysis that tracks the restructuring of built space – and movement through it – at an Inka provincial outpost that became an early doctrina in the Colca Valley of southern highland Peru (Fig. 1). This site – known as Malata today – was established as a doctrina by a small group of Franciscan friars sometime between the 1540s and 1560s, and forcibly abandoned during a viceroyalty-wide colonial resettlement program in the 1570s (Wernke, 2011). It thus provides a chronologically-controlled window into domestic and ritual practices in a provincial evangelical complex during the critical period of sociocultural transition during first generation after the Spanish invasion.

Excellent architectural preservation enabled detailed mapping of buildings and paths at the site via mobile GIS (see Tripcevich and Wernke, 2010), which in turn enabled spatial network analysis as a means of simulating patterns of foot traffic through it. The results of this analysis demonstrate how movement through the site changed dramatically as the site was transformed from a provincial Inka to Franciscan doctrinal outpost. The marked changes in site layout point to a perhaps surprising degree of penetration of

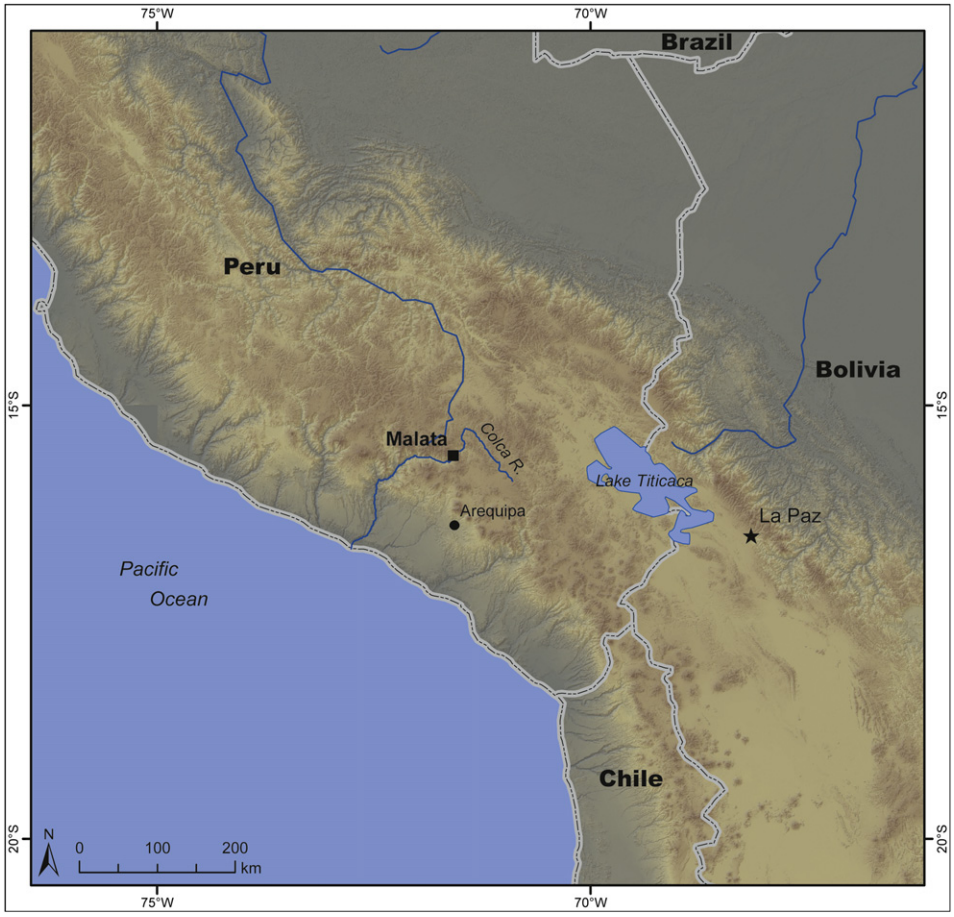

Fig. 1. Location of Malata in the southern highlands of Peru.