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A predictive model of archaeological potential: An example from northwestern Belize

Sallie Vaughn [a,*], Tom Crawford [b]

[a] Department of Geography, East Carolina University, NC 27858, USA
[b] Brewster A-234, Department of Geography, East Carolina University, Greenville, NC 27858, USA

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A B S T R A C T

Binary Logistic Regression is used to identify areas of high archaeological potential in a portion of northwestern Belize. The predictive modeling process involves remotely sensed imagery, Geographic Information System (GIS) data and techniques, and multivariate statistical approaches. Predictive variables represent both the pre-historic current landscape of the ancient Maya and the present day physical landscape. An optimal predictive model obtained using logistic regression includes one variable derived from a Landsat image representing contemporary vegetation patterns associated with Maya settlement and two variables derived from a digital elevation model (DEM) and an analog hydrography map representing resource endowments relevant to the ancient Maya. The predictive model identifies several areas of high archaeological probability as well as areas that are unlikely to contain any archaeological remains. Results can be used to inform future field surveys in a more cost efficient manner. Prior research has utilized remote sensing and GIS approaches for Maya site identification in the southern lowlands region of the Mexican Yucatan peninsula and the northern lowlands of Peten, Guatemala. This research represents the first landscape archaeological approach using satellite imagery for the Maya region in northwestern Belize.

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Introduction

Researchers discover archaeological sites through systematic field survey of the landscape – a costly, time consuming, and labor intensive process. Geospatial techniques that integrate Geographic Information Systems (GIS), remote sensing, and predictive modeling can enhance and expedite the process of site discovery by identifying areas of high archaeological potential for subsequent field investigation. By maximizing efforts in high probability areas, time, energy, and money generally used for surveying areas with little or no archaeological wealth can be reallocated to mapping and excavation efforts in higher probability areas. This project uses GIS in conjunction with remotely sensed imagery, paper map data, and Binary Logistic Regression to predict the probability of ancient Maya archaeological site presence in northwestern Belize.

Study area and background

The ancient Maya were a complex civilization occupying present day southeastern Mexico, Belize, Guatemala, and portions of Honduras and El Salvador (Fig. 1). The Maya region of Mesoamerica is broken into two basic culture areas based on

* Corresponding author at permanent address: 2915 Chapel Hill Rd., Durham, NC 27707, USA. Tel.: +1 252 412 4474; fax: +1 919 461 1215.
E-mail addresses: sallie_vaughn@urscorp.com (S. Vaughn), crawfordt@ecu.edu (T. Crawford).

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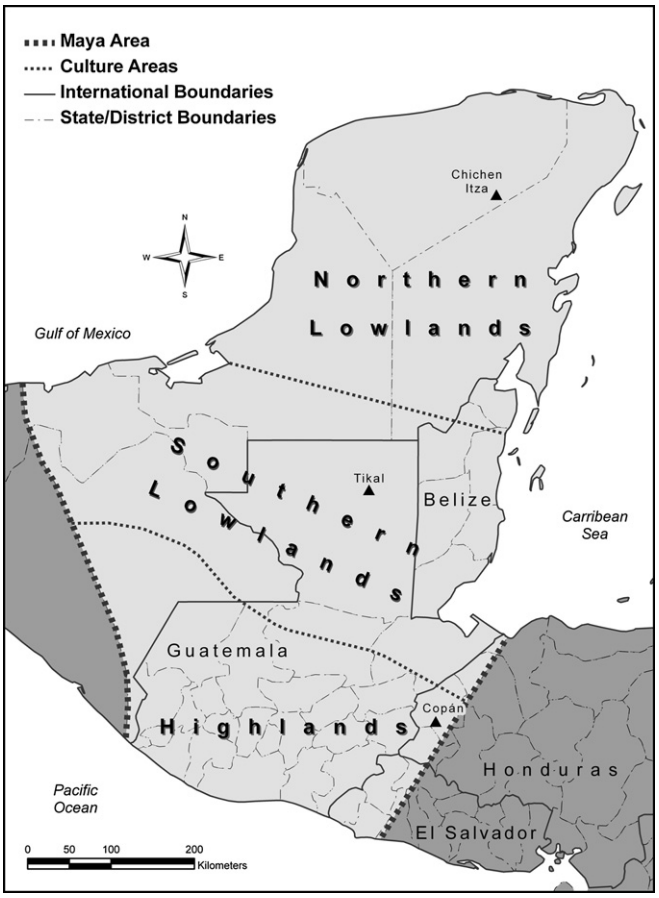

Fig. 1. The Ancient Maya world, its sub-regions, and well-known sites.

topography: the highlands and the lowlands. Northern and Southern sub-regions within the lowlands are differentiated on the basis of Maya cultural elements in those areas (Coe, 2005). Maya civilization began in the lowlands near the present day borders of northern Guatemala, Mexico, and Belize and then spread to other regions in Mesoamerica (Coe, 2005; Demarest, 2004). Hallmarks associated with Maya civilization such as hieroglyphic writing, the calendrical system, massive stone cities, and the corbel arch originate from this centrally located portion of the lowlands (Coe, 2005: 24). A portion of this region in present day northwestern Belize, also known as the central Maya lowlands, serves as the focus of study for this research.

The Maya are known for their large stone cities such as Chichen Itza, Copán, and Tikal. By 300 BC., they had established large, complex trade networks, a hierarchical social system, and built numerous settlements of varying sizes throughout the region (Coe, 2005; Demarest, 2004). Using evidence from the complex social, economic, political, and religious hierarchies, a ranking system can be applied to the settlements of the Maya. Many researchers recognize a four-tiered ranking system (Adams & Jones, 1981; Folan, Faust, Lutz, & Gunn, 2000). Other ranking systems reveal as few as three and as many as nine tiers within the settlement hierarchy (Adams & Jones, 1981). Evidence of a hierarchical settlement ranking system may be observed today by the number and function of structures, cultural remains such as pottery and stone tools, food preparation items such as grinding stones, and other cultural remnants such as large carved stone pillars known as stelae, and painted stucco masks that adorned buildings. Higher ranking settlements were sizable, had a large number of multi-purpose structures, and functioned as religious, economic, social, and political centers. Smaller, lower-ranking settlements, had fewer structures, most of which were dedicated to residential purposes, and typically contained resource specific artifacts indicating the particular economic activity of the settlement, such as stone tool production, pottery making, or agriculture (Coe, 2005; Demarest, 2004).

A common feature of Maya settlements, regardless of size, is an emphasis on enclosed interior courtyards or plazas surrounded on all four sides by structures which may serve as residential structures or civic and ceremonial structures (Adams & Jones, 1981). The courtyard floor was often covered with locally made limestone plaster (Demarest, 2004; Saturno, Sever, Irwin, Howell, & Garrison, 2007). Typically, the four structures surrounding the courtyard were oriented towards the cardinal directions with a specific emphasis on the structure built on the eastern side of the complex (Demarest, 2004; Ricketson, 1933). Quite often, the eastern structure in a courtyard complex is the tallest and most ornate due to an associate between the east, sunrise, and re-birth. These structures likely served a religious function (Adams & Jones, 1981; Demarest, 2004).

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