PETEN: AN ARCHAEOLOGICAL SITE PREDICTION TECHNIQUE

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TECHNIQUE

The present-day boundaries of Guatemala and nearby areas, including the Yucatan, encompass the Maya, whose presence can be traced to 2,500 B.C. (Coe: 1966). The Maya have experienced a great part of general evolution, passing from the hunter and gatherer to agricultural/technological levels; they have organized as bands, tribes, and chiefdoms and now live within a modern nation state. Throughout this progression they have had to contend with forces in the natural environment and still continue to adapt to it with many of the techniques assumed to have been part of their cultural repertoire during the phase of sedentary village life in the area. The lack of settlement pattern studies in the Peten region has produced a situation in which the localized definition of tribal society is not yet complete (Sanders and Price: 1968), and until archaeology unearths the remnants and reflections of their struggle, we will be unable to do more than make broad assumptions about Mayan society and culture in the middle Formative period.

The technique which follows is designed to apply specifically to this problem with emphasis on the ecological limitations to Mayan culture during a particular period of development—the movement to sedentary agriculturalism in the lowand Peten. In order to do so, I am applying concepts from general systems theory to determine if specific environmental variables can be isolated and shown to limit the range of possible cultural behavior during a period of dynamic transition, one in which a negative feedback system has been disrupted and a new level of homeostasis has not yet been reached.

Through the application of Liebig's Law of the Minimum applied to archaeological site location, it seems possible to predict the areas which reflect the greatest probability of containing sites, and conversely the areas in which sites should not be found. Liebig's Law states (Odum: 1971): "To occur and thrive in a given situation, an organism must have essential materials which are necessary for growth and reproduction. These basic requirements vary with the species and situation. Under 'steady-state' conditions, the essential material available, in amounts most closely approaching the critical minimum needed [for survival], will tend to be the limiting factor."

In geographic areas characterized by seasonal rainfall and a tropical rain forest/savannah environment, the first sedentary villages of a people with a swidden based agricultural technology will be limited to areas of the physical environment in which the least available resources most necessary to sustain the given technology occur in conjunction and in sufficient quantity to be utilized by the people. Conversely, where one or more of these resources does not occur in sufficient quanitity, sedentary agricultural villages will not develop. In the Peten, it is assumed that these resources are life sustaining and consist of fresh water and land suitable for use in swidden agricultural food production. It is not assumed that these are the only variables that would affect the establishment of sedentary villages in the area, but within the limits of this analysis they are the only ones that will be considered. Sedentary villages are defined as settlement sites at which a given population maintains continual occupation for one year or longer, and in which population does not fluctuate significantly on a seasonal basis.

To operationalize a test of the hypothesis, the resources mentioned must be qualified in order to permit accurate measurement in relation to their availability and to population needs.

1. Water resources: Units of water (W_u) are defined as the mean annual available liters of fresh water within a square hectare of land surface. This includes surface water and rainfall.

2. Land resources: Units of land (PFP_u), or potential food production units, are defined as the mean annual maximum calorie production from the labor of one man within a specific technology and crop preference on any square hectare of land.

3. Calorie needs: Units of calories (C) are defined as the annual minimum calories needed to sustain the life of one person at a healthy level.

4. Water needs: Units of water need (L) are defined as the annual minimum liters of fresh water necessary to sustain the life of one person at a healthy level.

Thus for any given population (N), the relationship between W_u and PFP_u can be expressed as a function of CL.

5. Labor units: Units of labor (H) are defined as equal to one man hour of labor measured in expended calories (C_e). Thus, average annual labor units (¢) equals the sum of (C_e) multiplied by the sum of (H), and the total divided by the number of years under consideration.

6. Maximum calories potential (Mc): The maximum annual calories potential of any given hectare of land regardless of the (H) applied within the technology and crop preference.

The sum of all PFP_u cannot excede the sum of all Mc. Where the sum of PFP_u is less than the sum of NC and/or where the sum of W_u is less than NL, then it is predicted that sedentary villages could not occur. On the other hand, in any geographic area where the sums are equal to or greater than NC and/or NL, then it is predicted that sedentary villages could occur. In conjunction, the greater the sum of units, the greater the probability of the occurrence of sedentary villages, other factors not considered.

SITE SELECTION SAMPLE

To sample the prediction, a map grid of an area can be constructed and divided into square hectares with each square assigned a number. When, under simple linear techniques, PFP*u* and W*u* are plotted at maximum potentials (maximum being arbitrarily set at the upper 25 percent range for all values of the two units, where W*u* is greater than or equal to NL, and PFP*u* is greater than or equal to NC), a random sample of grid squares using random sampling techniques would be used to select potential site locations for inspection. An equally random sample with negative values could be used to select sites where sedentary villages should not occur.

Prior to the input of data into the model, certain facts need to be established. Accurate estimates of average sedentary village population must be determined. The maximum distance (radius) from a village site which is feasible to travel for agricultural purposes and still maintain a sedentary village under the technological level of the society must be set. Accurate estimates of annual available W*u* for the geographic area during the time period need to be examined. Accurate estimates of crop preference and crop usage patterns must be established, and Mc determined for the land types (rain forest, grass land, etc.) in the survey area. Food production units need to be determined for the land usage. The number of liters of water and the annual number of calories necessary for one life to be sustained must be computed. The development of these figures is not a part of this proposal, only the notation that they are necessary before further development can take place. Ideally, computer applications would enhance the study.

TEST DESIGN

To determine the validity of the results of the hypothesis, one geographic region must be selected, the model applied, and a random sample of grids determined for actual inspection in the field. An equal number of grids should be selected as a control group by the same process, the model not applied, and the results compared. Grid squares can be selected from the total population of possible grids and all surveyed in the field to determine the predictive capabilities of the model. If a significant difference is discovered between the results of both examinations, the test and control goups, the hypothesis can be said to be valid. Such a test should be considered for both the positive and negative predictive aspects of the model.

If it is shown that simple components of the environment, technology, and social structure can be isolated and used predictively, then it would be possible to develop a more complex model, including more sophisticated variables. With minor modifications, this technique could be applicable to other social groups, e.g., hunters and gatherers, and to other geographic regions. As noted in Bee

(1974: 166), annual group caloric production can be estimated for Bushmen hunters and gatherers as 2100 calories per day per person in a band of thirty people, based on the formula $E = m \times t \times r \times e$ (calories as a function of population, work hours, calories expended, and calories produced). This formula, presented by Harris (1971: 203ff) suggests greater caloric production through swidden technology. With the inclusion of more defined variables—economic, sociopolitical, and behavioral—archaeological site prediction could become possible for various levels of technology and social organization.

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