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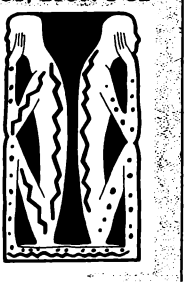

# Locational Analysis and Elite Activities in a Prehispanic Chiefdom of the Western Venezuelan Llanos

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## Introduction

The spatial organization of settlements in a particular region is an important source of archaeological information because of the frequent assumption that it is the counterpart of social organization, or that there at least exists an important degree of correspondence between these two aspects of society (Renfrew 1978:106, 1982:3). Yet, many aspects of the models applied to the analysis of ancient regional systems are less explicit (Clarke 1977:7; Johnson 1977:479; Wandsnider 1992:286).

The purpose of this paper is to discuss some of the assumptions made by the locational model developed by Vincas Steponaitis (1978) for the analysis of settlement patterns of complex societies on the chiefdom level.[1] First, I will briefly examine the characteristics and assumptions of this model by focusing on the relationship between its different components and its theoretical background. Second, the spatial distribution, architecture and connectedness of secondary centers in a prehispanic chiefly polity of the Gaván region in western Venezuela are discussed in the light of this particular model. And finally, I discuss some of its limitations and make suggestions to enhance the model.

In the lowlands of South America and particularly in Venezuela, regional archaeology is still at its beginning stages. In this country, the program of regional survey and excavations carried out by Charles Spencer and Elsa Redmond in the Gaván region, located on the Western Llanos (Figure 1) (Redmond and Spencer 1989, 1994; Spencer 1991, 1994; Spencer and Redmond 1992, 1995, 1998) is an exciting

[1] The original version of this paper was prepared for graduate seminar "Regional Settlement Patterns" under the direction of Dr. Robert Drennan (Spring 1994). I would like to thank Dr. Charles Spencer and Dr. Elsa Redmond, who kindly facilitated necessary data for this paper. In addition, I would like to acknowledge the help and comments of Dr. Robert Drennan and Dr. Rodrigo Liendo. Carlos Quintero produced the illustrations. However, I take full responsibility for any errors and misinterpretations.

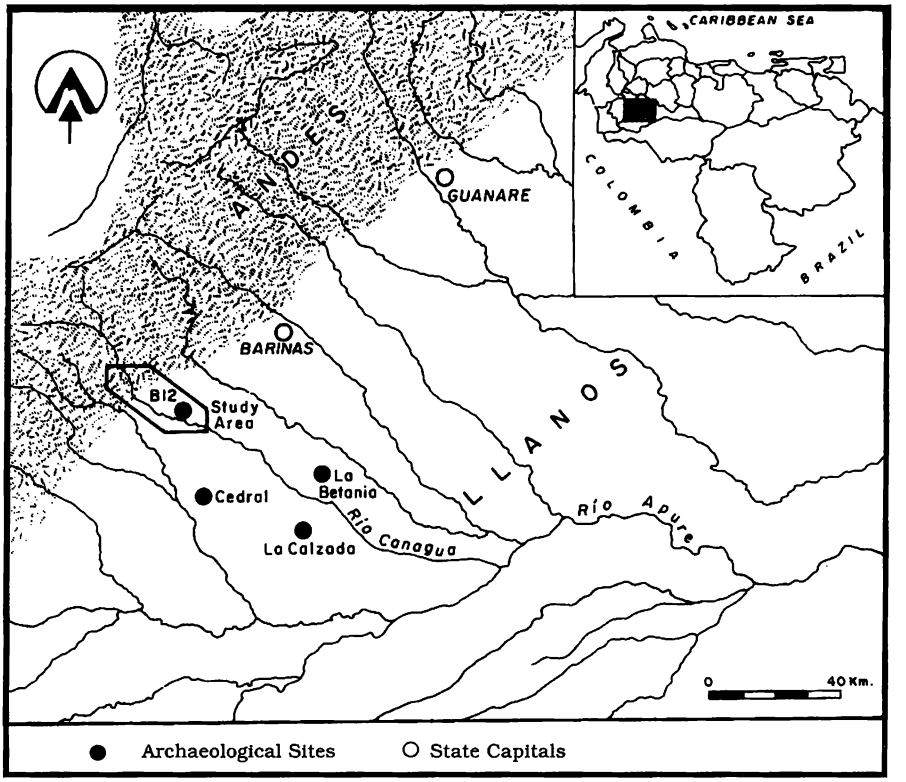



FIGURE 1
WESTERN VENEZUELA, INCLUDING THE GAVÁN REGION
(after Spencer and Redmond 1994)

opportunity for the application and testing of a variety of methods and techniques proposed for the analysis of hierarchical settlement patterns in other areas of the world. Furthermore, the characteristics of the landscape in this region, particularly its largely plain-like topography and the absence of major geographical elements imposing conditions for regional transportation and mobility, makes it an ideal site for regional analysis and the testing of locational models. Finally the absence of further levels of social complexity will facilitate the testing of the model within the context of chiefdoms—the simplest of complex societies.[2]

[2] In terms of this work a chiefdom or a chiefly polity is a society that is *"...based on hierarchical principles of sociopolitical organization and comprehend more than a single local group and yet lack the organized bureaucracies of states."* (Drennan 1992: 57). This broad conceptualization has the advantage of avoiding classificatory schemes, since gradations on scale of social hierarchy are more important than the type of hierarchy (Brown 1981:28).

**Locational theory and complex chiefdoms: Steponaitis' model**

The terms "locational theory" and "locational model" refer to a wide variety of approaches to the study of settlement distribution in a given geographical space. Roper (1979) identifies two basic sets of approaches. The first emphasizes the importance of human/human relationships in structuring social space. Central place theory, the rank-size rule, and gravity models are three of the analytical procedures included in this approach. The second emphasizes the human/land relationship as the primary force that determines the location of settlements in a given space. Site catchment analysis is one example of the analytical procedures used in this approach (Roper 1979:119-120). Despite the potential of some of these techniques for the study of past regional systems, examples of their application are relatively scarce; particularly with respect to the first approach (Crumley 1979; Gorenflo and Bell 1991; Sebastian and Judge 1988).

A classical example of locational analysis applied to complex societies on the chiefdom level was provided by Vincas Steponaitis (1978). Steponaitis developed a general model to study the possible effects of sociopolitical relations (particularly tribute mobilization) on the spacing, distribution and characteristics of chiefly minor centers in regional settlement patterns. The model is based on the analysis of the spatial form of administrative areas discussed by Massam (1975) among others, and was applied to the analysis of settlements of the Moundville phase of the Black Warrior River Valley in Alabama (USA). In general, the results of this analysis were consistent with the expectations generated by the model (Steponaitis 1978:449). Below I mention two of the most important expectations of the Steponaitis model:

1) When there exists a high degree of political centralization, the ideal location of the capital is primarily determined by the position of the lower-order centers. In order to optimize movement costs, the optimal location of a primary center should be in or near the center of gravity; the geographical point from where yearly costs of intradistrict movement to and from the capital are minimized (Steponaitis 1978:435).

2) Since movement costs increase with distance, it is likely that sites closer to the paramount center would pay a larger amount of tribute (in the form of produce or human energy) than those sites situated farther away. Assuming that the population of each district was similar, we can test this proposition in the following manner: the more surplus and human energy a minor center was forced to

pay, the less would have been available for expenditure in, for instance, mound construction. Therefore, the closer a site is to the paramount center, the less there would have been available to invest in mound construction (Steponaitis 1978:446).

The components of this model can be divided into two different parts. The first part is the general, uniformitarian Central Place Theory, that is derived from geography and regional science. Models obtained from this theory structure economic behavior among different centers on a regional scale. Major assumptions of the classical Central Place model are those of an unbounded, featureless plain and a "closed" economic system. The modified, or contemporary model, assumes a dominance of economic factors in the settlement and growth of centers, the rational basis of individual (consumer) behavior, and the congruence of the spatial distribution of centers with that of other (non-economic) factors affecting settlements (Smith 1976:23; Crumley 1979:151).

The second addresses the specific form or forms of economic behavior. In this case, an important part of Steponaitis' critique is directed to the application of locational models based on markets and marketing behavior to the study of chiefly systems because this form of economic behavior is not universal, but rather, related to the state level of social development (Steponaitis 1978:427; 1981:322). Instead, redistribution, in the form of *mobilization*, is considered to be the specific form of economic behavior related to the political economy of complex societies, particularly those on the chiefdom level (Steponaitis 1978:421). Mobilization refers to the recruitment of goods and services for the benefit of a group not coterminous with the contributing members. Examples of mobilization are tribute (either food or material property), taxation, and corvée labor (Earle 1977:215).

The link between the geographical and economic aspects of the model is given by the existence of a regionally centralized decision-making elite who are assumed to control and regulate both the settlement hierarchy and the flow of tribute to finance their public and private activities (Earle 1977:216):

> What is important... is that different nodes in the political hierarchy are usually associated with spatially discrete (and archaeologically recognizable) central settlements. Insofar as administrative control and collection of tribute are the major activities that structure the political hierarchy, these activities may also have correlates in spatial terms influencing the location of central settlements relative to one another and tothe population they serve. (Steponaitis 1978:421).

A critical assumption of Steponaitis' analysis is that the population size of each district was similar because only if populations were similar, would the amount of tribute given by each district be equivalent. If we assume that populations were the same in each district, it would be possible to substitute "population" by "amount of tribute" in the calculations for the Center of Gravity of Minor Centers (CGMC) because they are constants. Hence, if we substitute the weights by a constant (as did Steponaitis), we only need to know the geographical location of the centers (Steponaitis 1978:437). In this way, we have a locational model that integrates the general Central Place theory and a form of economic behavior that we assume to be characteristic of chiefdoms (tribute mobilization).

However, recent developments in the archaeology of chiefdoms question the assumption that mobilization is always the main cause of centralization (Earle 1991; Drennan and Quattrin 1994). On the other hand, if we substitute the constants in Steponaitis' model for actual population data, then centralization and tribute flow become two independent aspects in a model that assumes tribute mobilization as a central part of the political economy of chiefdoms because tribute flow (which was assumed to be a constant dependent on an equally constant center's population) has been eliminated from the equation.

Therefore, if we find that there is high centralization at the regional level and higher mobilization in sites closer to the regional capital, it is likely that mobilization played an important role in regional centralization. However, it does not prove or refute that tribute mobilization was the main cause of this centralization because it is only an assumption based on what we think about the nature of chiefdoms. Hence, in order to assess the value of any assertion, and in order to reject alternative explanations, we also need to specify what percentage of the observed centralization can be "explained" by tribute mobilization, and assess how other factors could have altered the observed spatial distribution.

It is unlikely that all administrative districts of prehistoric chiefdoms were equivalent in population, amount of tribute, or other demographic and economic characteristics. However, we can test the validity of those assumptions by applying the method as explained by Massam, in which the "weight" of each point (settlement) is given by its population (Massam 1975:26). Such an attempt will be made here with data obtained from the Gaván region which is located in the western*Llanos* of Venezuela.

**The Gaván Region**

The lowland savannas of Venezuela cover approximately 300,000 km$^2$; most of which are located in the Orinoco Basin. In general, this area comprises five main geomorphologic units: (1) the mountain front; (2) the high piedmont; (3) the low piedmont; (4) the high Llanos (flood plains); and (5) the low Llanos (Corpoocidente 1982:21-29). Some authors include the middle Llanos as an additional "intermediate" category. The climate is uniform, with two well differentiated rainy and dry periods. In the piedmont and Llanos units (Figures 2 and 3)there exists a diversity of landscapes due to variations in topography, altitude and seasonality (Silva and Moreno 1993). The natural vegetation can be divided into four main types: (1) forests; (2) dry savannas; (3) wet savannas; and (4) swamps (Sarmiento, Monasterio and Silva 1971). Because of the contrast in resource distribution, the differentiation between fluvial gallery forests and inter-fluvial open grasslands is another basic ecological distinction to be considered. The availability of soil moisture during the dry season and the low level of nutrients contained therein are the most important ecological constraints that limit agricultural productivity in this particular area (Silva and Moreno 1993:242).

Although archaeological investigations in the Llanos go back to the nineteenth century, research aimed at the study of regional settlement patterns began with the work of Garson, who conducted the first systematic settlement pattern survey in the Hato de la Calzada region (Garson 1980). Here, Garson located twenty-two sites related to the Osoid series. These sites varied in size and thirteen of them contained artificial mounds. In addition, he identified other earthen structures including nine causeways and a probable system of raised fields for intensive agriculture (Garson 1980:98, 129). The most important result of this work was the identification of a three-level settlement pattern in the Hato de la Calzada region related to the Osoid archaeological series (Garson 1980; Spencer and Redmond 1992:138).

More recently Spencer and Redmond, from a neo-evolutionary perspective, have addressed the problem of social change and inter-societal relationships in the Gaván region of western Barinas (Figure 1) which crosscuts the *piedmont* and the *Llanos*. In the high Llanos, they identified two archaeological phases: Early- and Late Gavan. According to these authors, complex societies of the chiefdom level emerged there around 500-600 AD. Their conclusion is supported by five types of evidence: 1) the appearance of a three-level settlement hierarchy, 2) monumental architecture, 3) increase in overall population, 4) socialdifferentiation in burial and residential patterns; and 5) complex social relationships with other polities, including trade and warfare. More recently, ritual feasting has been identified as yet another form of estab-

(Photo: R. Gassón 1988)

FIGURE 2
THE PIEDMONT

(Photo: R. Gassón 1988)

FIGURE 3
THE LLANOS

lishing and reinforcing social relations (Gassón 1998:163; Redmond, Gassón and Spenser [in press]).

Here, our analysis will focus on the Late Gaván phase of the*Llanos* (500-1000 AD) where these authors located a total of 32 Late Gaván habitation sites (Figure 4). Sites are briefly described below in accordance with their position in the regional hierarchy:

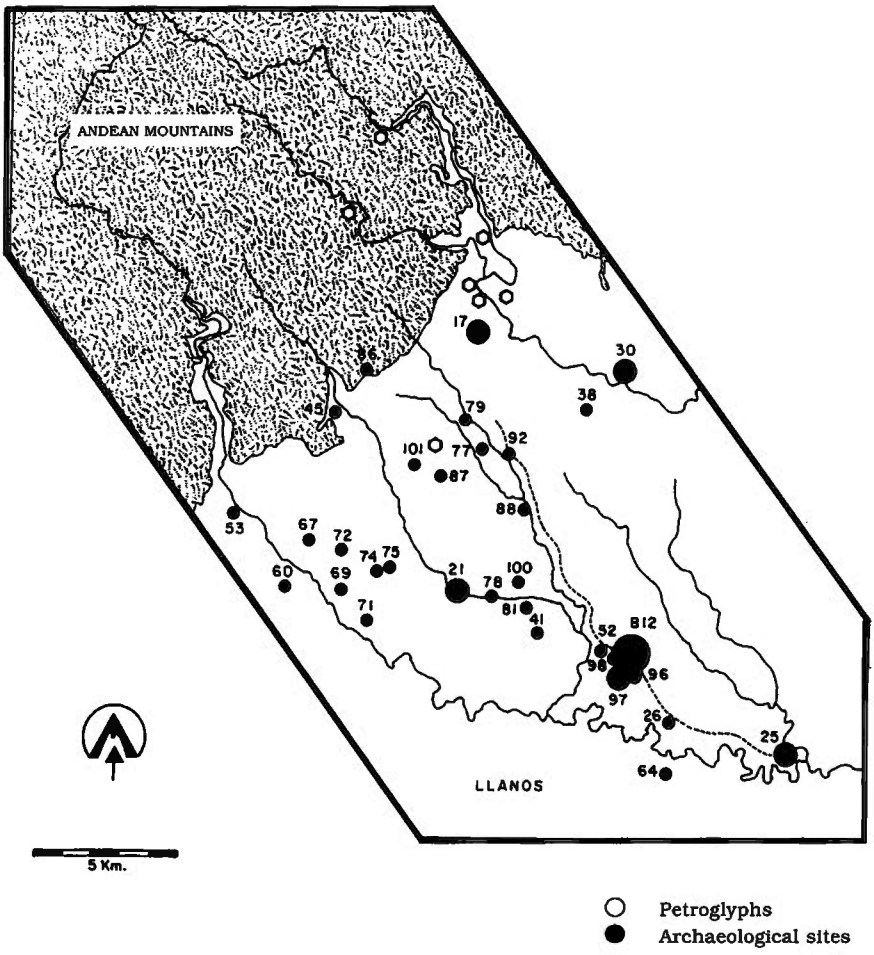
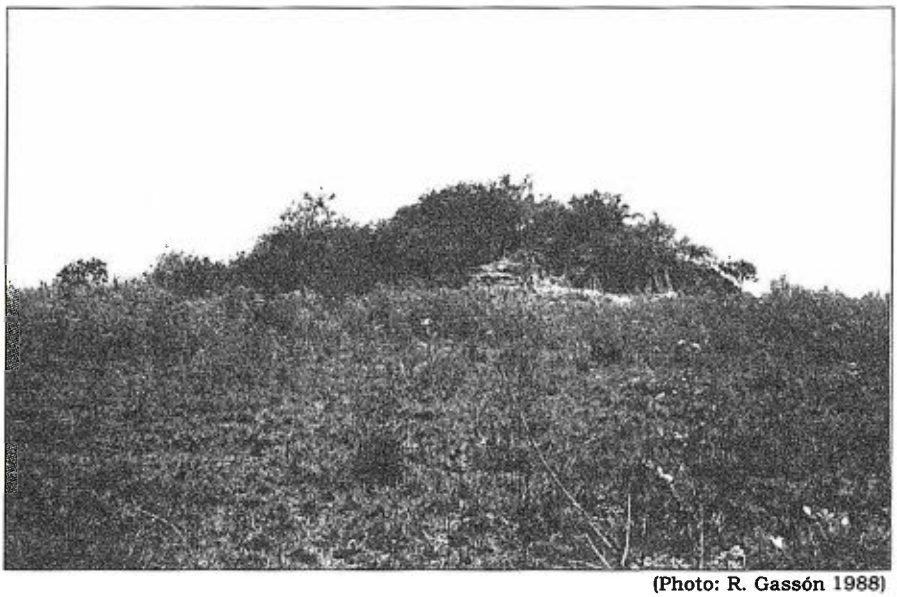



FIGURE 4
THE GAVÁN REGION
(After Spencer and Redmond 1990:15)

1) **Primary Regional Center:** Site B12 occupies the top level of the regional hierarchy and covers approximately 33 hectares (Figure 5). This site has the greatest number of earthworks including two large mounds with a height of 12 and 10 meters respectively, four mounds that range from 1 to 4 meters in height, and 130 habitation mounds of 1 meter or less. In addition, the site is surrounded by an earthwork that probably supported a palisade and shows evidence of internal and external causeways (*calzadas*) designed to facilitate and probably to institutionalize communication and transportation among the different settlements. It is very likely that B12 was the ceremonial and civic center of the regional hierarchy. First, the tallest mound was not used for habitation, thus representing some sort of public or ceremonial facility. Second, the site has a very well defined central space or *plaza* that was probably used for collective ceremonies. Finally, although there are differences in burial treatment, the type and amount of offerings were rather modest; suggesting that wealth was not the main criterion in social differentiation. Rather, it seems that war and/or religion played a more important role in burial treatment (Spencer and Redmond 1992:147-149).

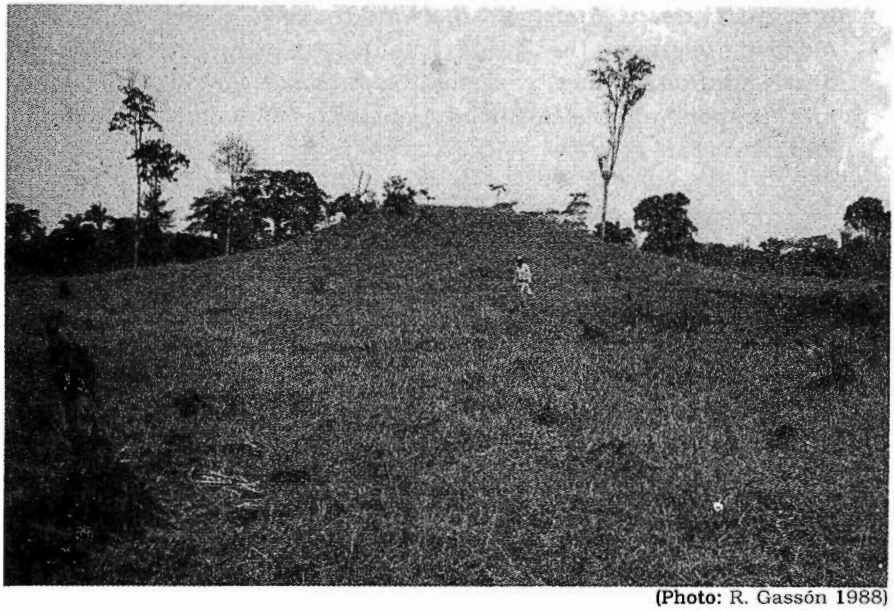


(Photo: R. Gassón 1988)

FIGURE 5
MAIN MOUND OF THE PRIMARY REGIONAL CENTER
B12-EL GAVÁN

2) **Secondary Centers:** The second level of the regional hierarchy is constituted by five sites: B97, B30, B25, B17 and B21 (Figure 6) that vary in size from 6-10 hectares. Each contains 2-4 mounds between 2 and 6 meters in height. Four of these sites are linked to B12 by causeways. These sites also present a public space, thus imitating (on a minor scale) the spatial arrangement of the regional center. However, less is known about the functions of the mounds and burial treatment in secondary centers.

3) **Habitation Sites:** There are 26 habitation sites on the third level of the regional hierarchy. None of these sites present evidence of architecture and they vary in size from 0.5 to 4.4 hectares. Only nine of these sites are linked to the regional network of causeways.



(Photo: R. Gassón 1988)

FIGURE 6
SITE B25-LA COTIZA

As previously mentioned, a network of causeways indicates an important degree of regional centralization in the Gaván region. Additional evidence of centralization was provided by the existence of raised fields' agriculture, probably for surplus production. These agricultural

facilities were connected by the network of causeways to centers B25 and B97, and most importantly to B12; the regional capital.

A summary of the basic data for the analysis is presented in Tables 1 and 2. Table 1 includes basic information for all of the different settlements (site name, position in the regional hierarchy, and estimated population). Table 2 includes more specific information about the centers including center name, population size, the population of each center's "district" (see below), the distance from each center to the regional capital (in kilometers), the number of mounds for each center, and a rough Mound's Construction Index (MCI) for each center (calculated by adding up the mounds' height at each site). In addition, the presence or absence of connections via causeways to the regional communication network is indicated (Spencer personal communication; Spencer and Redmond 1998: Table 1; Redmond and Spencer 1995: Table 1).

TABLE 1
SETTLEMENTS OF THE GAVÁN REGION

| Site No. | Hierarchical Order | Estimated Population | Site No. | Hierarchical Order | Estimated Population |
|---|---|---|---|---|---|
| B12 | 1 | 670-1000 | B74 | 3 | 20-30 |
| B97 | 2 | 122-182 | B75 | 3 | 25-38 |
| B21 | 2 | 179-267 | B69 | 3 | 89-133 |
| B30 | 2 | 191-285 | B72 | 3 | 61-91 |
| B17 | 2 | 152-227 | B67 | 3 | 20-30 |
| B25 | 2 | 203-303 | B60 | 3 | 61-91 |
| B98 | 3 | 20-30 | B53 | 3 | 20-30 |
| B52 | 3 | 25-38 | B88 | 3 | 51-76 |
| B96 | 3 | 25-38 | B87 | 3 | 10-15 |
| B26 | 3 | 61-91 | B101 | 3 | 20-30 |
| B64 | 3 | 61-91 | B77 | 3 | 20-30 |
| B41 | 3 | 89-133 | B92 | 3 | 61-91 |
| B81 | 3 | 51-76 | B79 | 3 | 25-38 |
| B78 | 3 | 10-15 | B38 | 3 | 76-114 |
| B100 | 3 | 25-38 | B45 | 3 | 51-76 |
| B71 | 3 | 10-15 | B86 | 3 | 10-15 |

Source: Spencer and Redmond 1998 Table 1.

TABLE 2
SUMMARY OF MOUND CENTER'S CHARACTERISTICS
AT THE GAVÁN REGION

| Site | Site population | District population | Distance (Km.) | Mounds (Number) | Index | Causeway (yes/no) |
|---|---|---|---|---|---|---|
| B12 | 835 | 835 | 0 | 6 | 36 | yes |
| B97 | 152 | 497 | 0.5 | 2 | 4 | yes |
| B17 | 190 | 400 | 12 | 2 | 8.5 (*) | yes |
| B25 | 253 | 253 | 7 | 2 | 9 | yes |
| B21 | 223 | 817 | 6 | 4 | 9 | yes |
| B30 | 238 | 333 | 9.75 | 4 | 9.5 (**) | no |

(*) Much destruction due to road-building here; there could have been more mounds.
(**) One of the mounds was probably higher.

I have organized these settlements in a number of different hypothetical units called "administrative districts" or more simply "districts". An administrative district is a sub-regional unit constituted by a secondary center and the habitation sites that were closer to it than to any other secondary center. Thus they were likely to be under its control. Since Steponaitis states that each minor center could have relied on the population of its entire district, it was important to try to determine what settlements would have been related to an specific center[3].

The assessing of prehistoric administrative districts is a difficult task. After a number of trials with different methods, I decided to utilize Thiessen polygons in order to estimate the hypothetical administrative districts of the Gaván region. In order to do this, I used theVORONOI option of the SYGRAPH software program (Wilkinson 1990b:210). This decision was made because of the consistency of Thiessen polygons

[3] The population of each settlement is based on an average value of the population estimates calculated by Spencer and Redmond (Spencer and Redmond in press: Table 1). These estimates were generated by multiplying site areas by 20.3-30.3 persons/ha; a figure based on the population density estimated for B12, where all the recognizable housemounds were mapped and where the most extensive excavations were carried out (Spencer and Redmond 1994: 134).

with the general assumptions of the locational model discussed here. The sites located in each polygon are closer to their respective center than to any other, thus fulfilling the theoretical ideal of minimization of costs and maximization of movements.

As a result of the analysis, I obtained five different units or "administrative districts." Each district has a secondary center as its capital and almost all of the settlements were assigned to a specific district (Figure 7). Then, the population of each district was estimated by adding up the average population of all the settlements included within its borders.

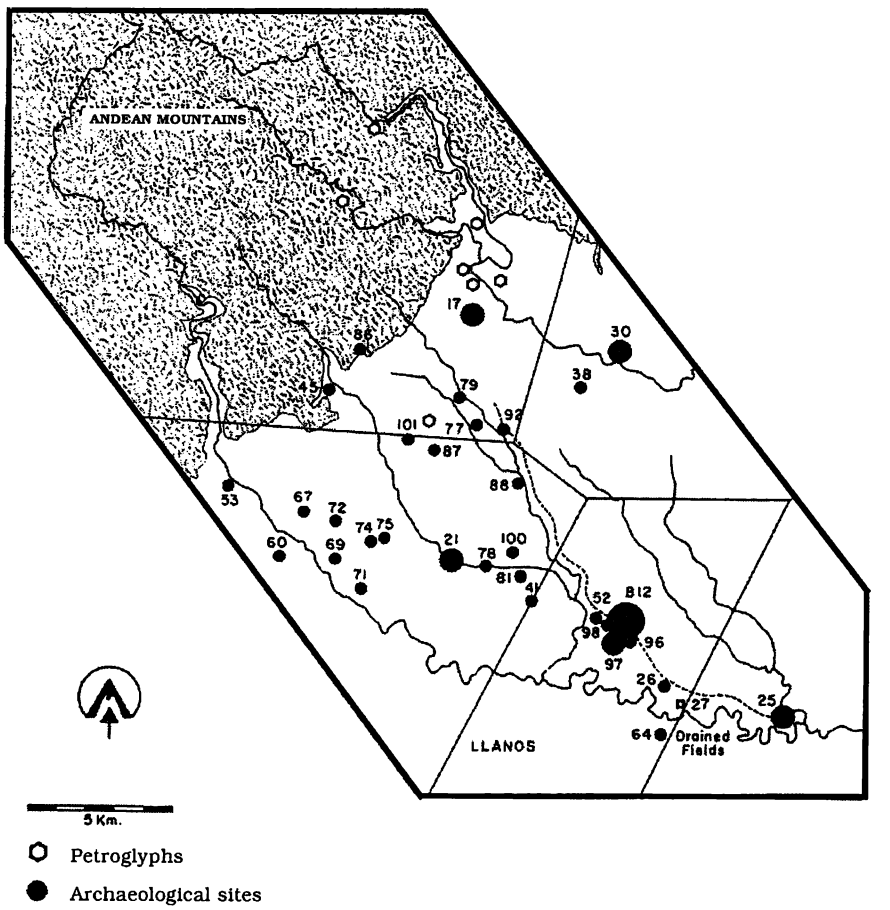



FIGURE 7
ADMINISTRATIVE DISTRICTS OF THE GAVÁN REGION

Defining administrative districts based on habitation sites raises a number of potential questions with respect to the number of sites recovered and the assigning and distribution of sites in the administrative districts because the number and distribution of sites affect the shape and "weight" of the administrative districts. First, it is likely that not all the sites of the Late Gaván phase (or of any other phase) have been discovered. The discovery of absolutely all the sites in a given region is frequently difficult (if not impossible) due to problems in site preservation and sampling strategies. In addition, the total recovery of all the small sites is not necessarily a pre-condition. Much can be done with a good sample of small sites since we are more interested in variations in populations at the subregional level than in their absolute numbers. The scope of the survey was intensive and regional (Spencer 1991; Spencer and Redmond 1992; Spencer, Redmond and Rinaldi 1994) and combined both informant and systematic ground examination (Redmond 1989). Although geomorphologic processes and vegetation could have affected the visibility of archaeological remains, we should note that most of the sites were actually recovered near the main rivers where natural processes are more active. In summary, although it is probable that all the sites were not discovered, the sampling problems were evenly distributed throughout the region. Thus, we have a balanced and representative sample of the number of sites (local populations per district).

Next, in relation to the distribution of sites per administrative unit, we sometimes confront problems in assigning a site or sites to an specific district. In this case, the only settlement that was not clearly assigned to an specific district was site B41, which is located exactly on the border of the districts dominated by centers B21 and B97. The population of site B41 was included in the administrative district of center B97 for several reasons. First of all, it will not substantially change the point I am trying to make here, which is the examination of the model under conditions of variation in sub-regional populations. Secondly, I believe that it would have been politically unwise for a paramount chief to have had a secondary district with a population larger than the population of the regional capital. Thirdly, it is possible that the inhabitants of site B41 were more attracted to center B97 because of the proximity of this site to the regional capital and finally, it was desirable to reduce the number of calculations and possible alternatives (like the inclusion of site B41 in the district dominated by center B21), which could make this discussion unnecessarily complex.

**Data Analysis**

In this section, I will first analyze the degree of centralization of the regional settlement pattern. If paramount chiefs were engaged in *general* decision-making at the regional level and if materials, energy and information were regularly exchanged between the main center and the minor centers, then minimization of cost and maximization of movement must have been important in determining the location of minor settlements over the landscape. However, it should be noted that I am neither specifying what kinds of decisions were made nor what was exchanged between centers.

Secondly, I will analyze the relationship between the amount of work invested in each one of the secondary centers with respect to its distance from the primary center. If tribute mobilization was a *primary* determinant in minor center distribution and public work investment, as proposed by Steponaitis, then minor centers located closer to a paramount center should have had a smaller investment in mound construction; suggesting that decision-making was mainly directed to tribute flow regulation.

In order to test the degree of centralization of the Gaván region, I applied the method proposed by Steponaitis (1978:449-451). Since this information is well known and readily accessible, the minutiae of the method will not be explained again here.

Basically, this analysis consists of two steps: (1) the calculation of the Center of Gravity of Minor Centers (*CGMC*) and (2) the Spatial Efficiency Index (*E*) (Massam 1975:22-25; Steponaitis 1978:449-450). The Center of Gravity of Minor Centers is the geographical point at which the cost of movements to and from minor centers is minimized. It assumes that all centers located in the region were effectively related to the regional system. On the other hand, the Spatial Efficiency Index is the degree to which each one of the centers in the region approximates this optimal location. According to the model, the regional capital is ideally located in or close to this center of gravity (Steponaitis 1978:432-433). Therefore, straight-line distances (measured in kilometers) from the middle of B12 to each secondary center were calculated[4] and the weight of each center was based on the population of its respective district.

The general results are shown in Figure. 8. As we can see, the Gaván regional center (site B12) obtained a Spatial Efficiency Index (*E*)

[4] This data was facilitated by Charles Spencer who made the original maps of the survey (Spencer 1994: personal communication).

of 0.68. This index is the highest of the entire region. The*E* for the minor centers are 0.16 (B25), 0.27 (B17), 0.39 (B30), 0.57 (B97) and 0.66 (B21), respectively. Although the index for the regional capital seems to be relatively low, these indexes tend to confirm the general idea that minimization of costs and the maximization of movements were important factors in the location of secondary centers in the Gaván region.

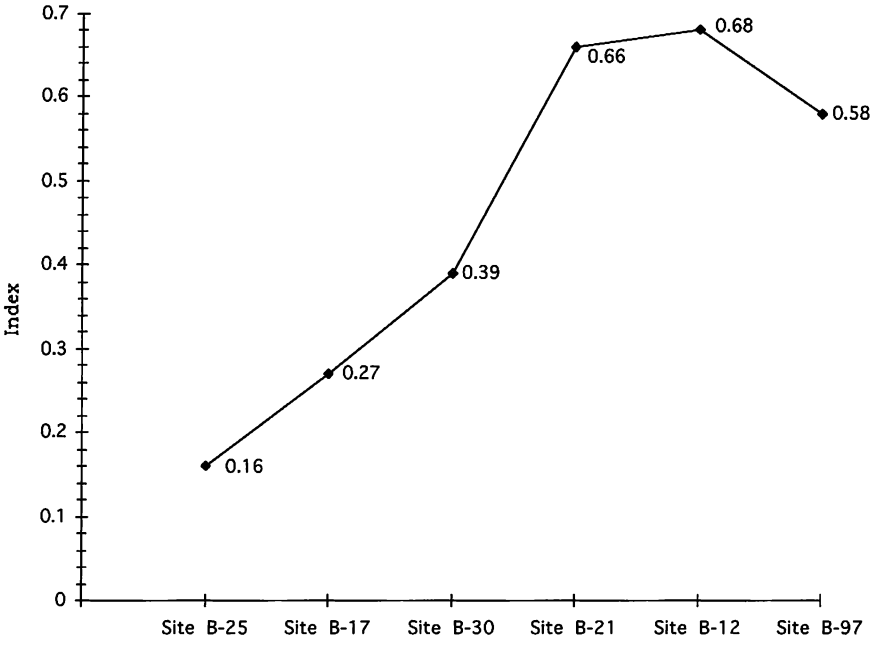



FIGURE 8
SPATIAL EFFICIENCY INDEX

To explore the second proposition, I made a histogram based on the distance between sites and the amount of work invested in mound construction as recommended by Steponaitis (Figure 9). The histogram shows that the closest site has the smaller index and that the farthest sites had a greater investment of work.[5]

[5] It is unfortunate that site B17 is partially destroyed because this site may have had more mounds in the past. In addition, one of the mounds of site B30 was once probably higher (Spencer 1994: personal communication).

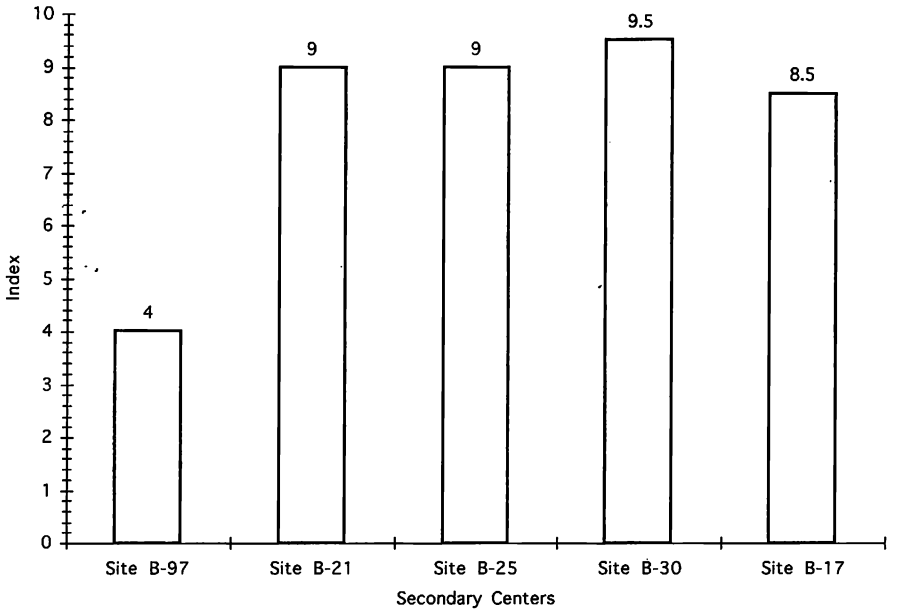



FIGURE 9
CONSTRUCTION INDEX OF MOUNDS
(all centers included

In order to test the degree of correlation between distance and mound's construction index (*MCI*), I performed a regression analysis of the variables construction index and distance. Calculations were made by using the SYSTAT software program (Wilkinson 1990a:146-160). The results were as follows: the squared multiple r= 0.644. This means that 64.4% of the variation in *MCI* is "explained" by the distance of each center to the regional capital. Since the probability associated with the "F" value was 10.2%, we are 89.80% confident that there is a linear relationship between these two variables. Again, although relatively low, the results do show a general relationship.

In order to test whether the construction might be a mere a function of the population associated with each center I did the regression with the variables MCI and District Population. According to the regression results, only 1.2% of the variation in the construction index was "explained" by the population of each district (squared multiple r= 0.012, probability associated to *F* value 86%). This result indicates that there is an insignificant degree of correlation between populationnum-

ber and mound construction index, and that we have a relatively high level of confidence with respect to this assertion.[6]

In sum these two analyses indicate that there is a relationship between the amount of work invested in public construction and the distance from each center to the regional capital. In addition, the investment seems to be independent of the population of each district. If the presuppositions of Steponaitis with respect to mobilization are correct, these results would indicate that the sites closer to B12 had a minor investment in mound construction because a greater part of the resources of these centers were redirected to the regional capital, B12, regardless of the size of their populations. However, only 64.4% of the variation in construction is "explained" by distance, leaving almost a third to be explained.

In general, these results suggest that first, there was a certain degree of centralization in the Gaván polity and second, that there is a general correlation between distance and the amount of work invested in mound construction. But they also indicate that these relationships were probably not too strong, at least in comparison with the results of the analysis done by Steponaitis in the Moundville phase. This raises some questions about the degree of centralization of the Gaván region. The other possibility is that factors other than mobilization affected the distribution of settlements in the Gaván region; factors not included in the model discussed here.

**Discussion**

The picture that emerges from this preliminary analysis is one of relative centralization and economic control at the regional level. The regional capital is ranked the highest and there exists a general correlation between distance and mound construction. This indicates that perhaps an important amount of the energy and resources that could have been invested in monumental construction in local centers were probably redirected to monumental construction in the regional capital. However, the indexes seems to be rather low, which indicates that either the regional system was not highly centralized or that there are

[6] Another interesting question is whether the construction index is related to the population of the secondary center itself. The results of the analysis for secondary centers only were: the squared multiple r= 0.762, with an *F* value of 0.053. If we include the regional capital B12 the results are much higher: the squared multiple r= 0.993 and the *F* value is 0.000. These results cast doubts on the assumed hierarchy. However, the purpose of the paper is more the testing of the model under the conditions set forth by Steponaitis than the reconstruction of the sociopolitical structure in the Gavan region. Since it is important to distinguish between these two different (albeit not contradictory) objectives (Drennan 1992: 71), this second line of inquiry will not be pursued here to an important degree.

factors that were not contemplated by the model such as the inclusion of centers that actually participated in the regional hierarchy in a restricted manner, or were only loosely integrated in that regional hierarchy. Can archaeological record of the area identify some of these problems?

Spencer and Redmond have shown that the local causeway (*calzada*) network could have played an important role in integrating a significant amount (42.2 %) of the regional population (Redmond y Spencer 1995:256; Spencer and Redmond 1998:102). As shown in Figure 4, only four of the five regional centers in the Gaván region are connected to the paramount center (B12) by causeways. Although Spencer and Redmond feel that the only exception (site B30) is subject to doubt, no conclusive evidence of a direct connection of B30 to any other center was found (Spencer and Redmond 1998:105). I believe that some interesting points can be made if we look again at the location and centralization of settlements and take into account the problem of connectedness.

As stated earlier, the Spatial Efficiency Index of the Primary Regional Center was 0.68 which was highest at the regional level (Figure 8). However, if this region was highly centralized, 0.68 seems like a relatively poor index when compared to, for example, Moundville which showed an *E* of at least 0.94 (Steponaitis 1978:441).

A *sine qua non* condition of the model proposed by Steponaitis (and most, if not all, locational models) is that all the centers included in the analysis have to be effectively related. Therefore, I decided to calculate the *MGMC* and the *E* again considering only the districts connected by a causeway (B17, B97, B21 and B25). As a result, the spatial efficiency of most of the centers increased and the (E) of the paramount center B12 increased to 0.75 (Figure 10). The *E* of B97 increased to 0.64, the *E* of B21 to 0.72, while the *E* of B25 diminished from 0.16 to 0.15. The most important change was in site B17, which diminished from 0.27 to 0.18. This is not surprising since site B17 is the more distant center of the entire region.

The next step was to re-test the relationship between the mound construction index and distance. If tribute mobilization was the primary force determining the distribution of settlements, it is likely that, for centers connected by a causeway network, the correlation between distance and mound construction index (in other words, the amount of tribute), should be stronger. The histogram (Figure 11) of the sites shows that in general, sites close to the regional capital seem to have had a minor investment in mound construction, with the exception of site B17. However, the regression analysis shows that the squared multiple r= 0.590, that is now only 59% of the variation in mound's index is explained by the distance of centers connected by causeway to the re-

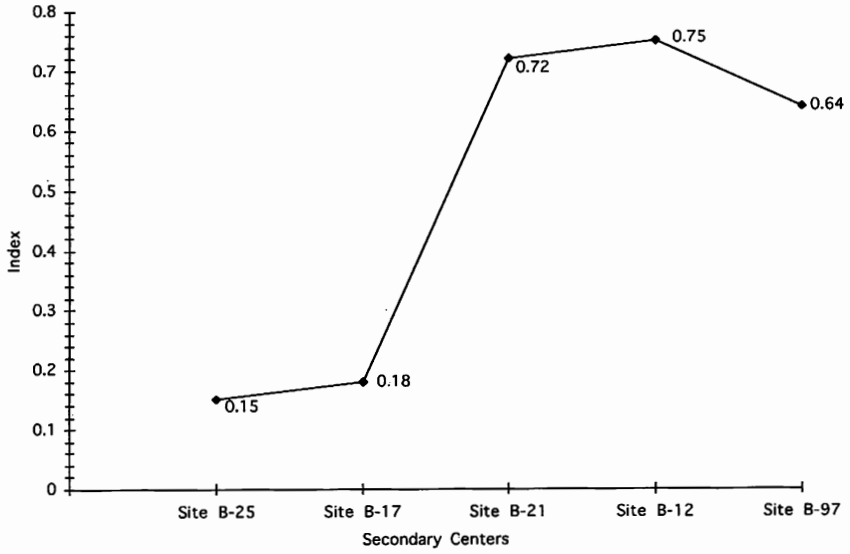



FIGURE 10
SPATIAL EFFICIENCY INDEX
(site B30 excluded)

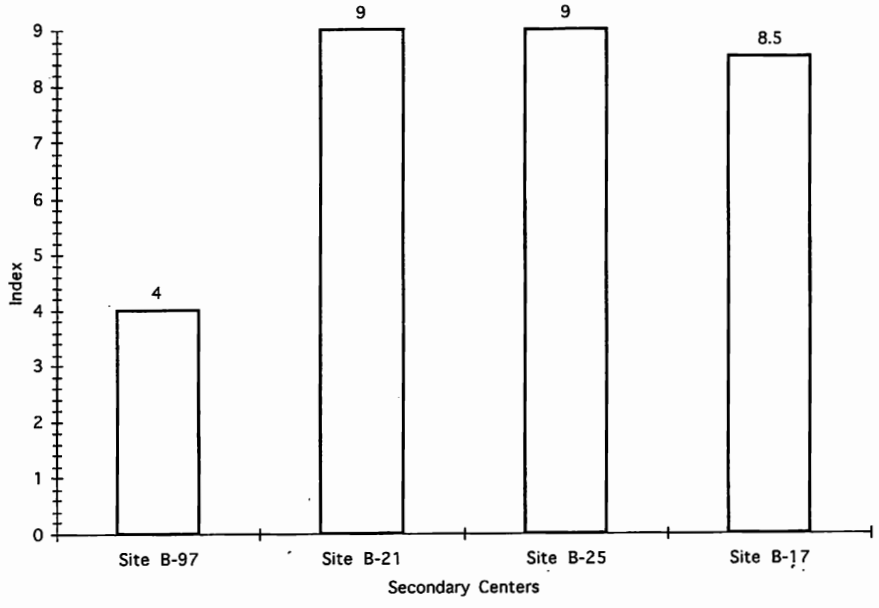



FIGURE 11
CONSTRUCTION INDEX OF MOUNDS
(site B-30 excluded)

gional capital. This is even less than the original 64.4% of explained variation; taking into account all the centers.

Therefore, if we consider only the centers connected by causeways, the Spatial Efficiency Index of most of the sites (including that of the regional capital) is higher, but the correlation between distance and mound construction index is lower. Hence, I believe that the consideration of tribute mobilization control as the only cause of centralization and secondary centers' distribution in the Gaván case is in need of closer examination.

If mobilization was not necessarily the only force determining the distribution of settlements at the regional level, why then does B12 show a relatively high index of spatial efficiency? It seems to me that other variables, *in addition* to economics, could account for the observed distribution.

For instance, as indicated by Spencer and Redmond, it seems that the causeway network did play an important role in the implementation of a variety of control strategies which included war, prestige-good exchange, the sanctification of authority as well as mobilization (Redmond y Spencer 1995; Spencer and Redmond 1998)[7] However, it is unlikely that this network was developed solely in response to the needs associated with tribute collection. As we know, there are a number of alternative tribute collection strategies including periodic collecting during religious ceremonies and rites of passage etc. that did not require a technology so specialized or costly as a causeway to reach their goals. As explained by Spencer and Redmond, the development of the causeway network could have been associated with the necessity of mobilizing manpower over an extensive region in a short time for special purposes such as war and/or religious ceremonies (Spencer and Redmond 1998:107). If tribute collection was the only cause that promoted regional integration, then less expensive strategies to legitimize the relationship between the regional elite and the local populations could have been developed.

In addition, it seems that not all of the secondary centers participated in the regional hierarchy in the same way. Let us examine briefly

[7]The analysis of *location-allocation* problems (the arrangement of sites and facilities in a region to maximize their accessibility) can be done with or without information on the transportation network (the systems of roads and trails developed to facilitate and institutionalize transit and communication). There is also a third approach based on computer simulations (Gorenflo and Bell 1991: 83-85). Steponaitis made addtional calculations for sites connected by rivers, which increased the Spatial Efficiency Index of Moundville up to .996. (Steponaitis 1978: 441), which indicates also that aspects of the natural landscape were determinant in the location of centers. However, since causeways are *artificial* facilities for transportation, they are likely to be more sensitive indicators of connectedness among sites.

the other secondary centers and their districts. A closer look reveals that there were not only important differences in population and geographical location, but also in the type of local resources and external contacts that each one had access.

For instance, site B17 had a relatively small population in regional terms and a Spatial Efficiency Index of only 0.27. This index is even smaller if we take into account only those centers connected by *calzada* (0.18). However, it also seems that B17 was the only center directly related to the petroglyphs that probably marked a trade-route that connected the Llanos with the piedmont and the Andean mountains. This may either indicate a certain control over this route or its function as a "collection" area for Andean goods. Indeed, imported polished stones were recovered at B17, albeit in relatively low quantities, which perhaps was a consequence of the few excavations conducted at that site (Spencer and Redmond 1998:105).

Center B30 had the more isolated district in the area, did not control any resource other than its local land and population (concentrated in the center itself and in only one more settlement), and was not connected by *calzada* to the rest of the regional hierarchy. In contrast, center B21 had the largest district population and territory. The characteristics of B30 in terms of its size and population may well be consequences of the artificial limits of the study area; the problems related to this "boundary effect" have been frequently discussed in the literature (Hodder and Orton 1976).

However, the limits of the study area do not explain the absence of causeways. In regional terms, B30 seems to be an exceptional case. It probably had a more limited capacity to generate surplus to be actively engaged in external trade or to efficiently contribute manpower to the regional hierarchy. I therefore suggest that the inhabitants of site B30 could have chosen not to be connected to the regional hierarchy by a *calzada*. The effect would have been a loss of some privileges but, on the other hand, it would also have lessened the obligations of having an institutionalized relationship with the paramount elite of B12. This admittedly speculative idea is subject to archaeological testing, but it should wait until a more detailed analysis of the archaeological material from B30 and all the other sites is completed. The other alternative is even simpler; site B30 did not belong to the regional system. Again, further excavation and analysis is needed to test this idea.

Finally, centers B97 and B25 were closer to the paramount regional center and were probably related to the direct exploitation of the alluvium of the Canaguá River (and perhaps one of them was related to

the drained fields systems). Given its position immediately adjacent to the primary center, B97 had a rather peculiar situation. At first sight, it would seem that competition between centers would preclude a close spatial proximity. However, if the functions of site B12 were more ceremonial and civic than economic (Flannery 1976:170), then this narrow spacing would not be surprising, since competition was not only economic in character or, at least, it was probably concealed by ideological mechanisms like the sanctification of authority (Spencer 1991; 1994). It is important to emphasize that even spacing among centers within a systems is more likely to occur in situations of market competition which is not the economic behavior characteristic of chiefdoms (Flannery 1976:170-171; Steponaitis 1978:426). Therefore, there is no reason why B97 should not have been close to the regional capital. This proximity probably implied, however, that B97 was more closely controlled by B12, or perhaps that B12 was a paramountcy, in Taylor's terms (Taylor 1975).[8]

In conclusion, we have a regional system that was relatively centralized, but one in which mobilization does not seem to have been the only factor in this centralization. Additional factors, like connectedness, could have changed the degree of centralization of the regional system. In addition, there is an important amount of variability among secondary centers. Finally, not all of the secondary centers seem to have had an institutionalized relationship to the regional hierarchy. Although the inclusion of factors like connectedness represent only alternative interpretations, they support the idea that there were factors other than mobilization affecting the distribution of secondary centers. The characteristics and spatial distribution of sites like B17 and B30 would indicate some degree of competition or independence of the local rulers in relation to the B12 ruler. Internal competition among members of the chiefly elite for access to a relatively small number of political offices and the related privileges is currently recognized as one of the mechanisms related to the rise and fall of centralized, hierarchical leadership in the area (Redmond,Gassón and Spenser [in press], Wright 1984-50-51). This suggests also that we need to know more about the relationships between regional centers, secondary centers and the populations that were supposedly under their control.

[8] A paramountcy is "when a separate regional center is established in a new location (often in response to considerations of regional administrative efficency), and a paramount chief administers the districts that comprise that region from the new capital, not from one of the district centers" ( Spencer 1982: 11).

**Summary and Conclusions**

The discussion about the importance of economic control is an important part of the literature on chiefdoms, or ranked societies. On one hand, traditional models such as those of Service (1962) and Fried (1967) have emphasized the lack of substantial economic inequality (either by controlling resources or by restricting access to such resources). On the other hand, economic inequality and resource control has been viewed by some, (), "as a matter of general principle" (Drennan and Quattrin 1994:1; see also Earle (1991), Gamble 1982:100 and Gilman (1991).

This analysis does not conclusively support either one or the other approach and it is unlikely that a discussion based on such extreme propositions will be productive in the future. What is important to assess are the roots and the specific mechanisms of the processes of social inequality, control, and resistance at the regional and sub-regional level in specific cases. These non-economic and external variables are now thought to be critical to the development of chiefly polities (Brumfiel 1994). As stated by Earle:

> To understand the evolution of chiefdoms requires understanding the household and community as semi-autonomous units that may exist in competition with each other and in opposition to the overarching polity. Thus the centralization of the chiefdom should always be seen as a fragile, negotiated institution that is held together by an economic interdependence, a justifying ideology, and a concentration of force(Earle 1991:13).

However, we should stress that Steponaitis indicated the limitations of his model, particularly in relation to the restricted set of variables examined (tribute flow and administrative decision-making). For that reason, he left the model open to other possible variables like intensive warfare and interpolity alliances (Steponaitis 1978:449).

In this paper I have shown that regional centralization should be interpreted as the result of a number of economic and non-economic variables of which mobilization is but one among many. In addition, the data of the Gaván region suggests that it is unwarranted to assume that secondary centers are similar in population, economic and/or political strategies. This in turn, poses some questions to the uncritical application of locational models. Secondary centers are not necessarily clone-like replicas of each other and much more research on the differ-

ences among secondary centers is required. This assertion is at odds with one of the most important and inner assumptions of most locational models: that all places are populated by "standard" people, with identical needs, tastes and contacts (Crumley 1979:141). An effort should be made in trying to isolate and specify specific characteristics and strategies of each one of the secondary centers in order to understand how the overarching polity might have functioned.


***Abstract***

*This paper discusses some propositions made by the locational model developed by Vincas Steponaitis in order to analyze regional settlement patterns of complex societies or "chiefdoms"; particularly the role of redistribution on regional centralization. Data analysis from the Gaván region, in the western Llanos of Venezuela, suggests that redistribution, specifically tribute mobilization, is not necessarily the main factor that determines regional centralization in societies of this degree of organization. A more realistic perspective of the causes of regional centralization should consider other variables such as subordinate population size and distribution, and local variation in activities like war or exchange. Due to the variability of local groups, chiefly polities are better understood as fragile institutions in a continuous process of negotiation at different levels.*

***Resumen***

*En este trabajo se discuten algunas proposiciones del modelo locacional desarrollado por Vincas Steponaitis para analizar los patrones de asentamiento regionales de las sociedades complejas o "cacicales", particularmente el papel de la redistribución en la centralización a nivel regional. El analisis de los datos de la región de Gaván, en los Llanos Occidentales de Venezuela, sugiere que la redistribución, especificamente la mobilización de tributos, no es necesariamente el factor fundamental que determina la centralización a nivel regional de sociedades con este grado de organización. Una perspectiva más realista de las causas de la centralización regional debe contemplar otras variables, tales como el tamaño y distribución de las poblaciones subordinadas, asi como la variación local en actividades como el intercambio o la guerra. Debido a la variabilidad de los grupos locales, la centralización de las sociedades cacicales podría ser observada como una institución frágil en proceso continuo de negociación a diferentesniveles.*

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