AN ABSTRACT OF THE THESIS OF

Virginia Marie Betz for the degree of Master of Arts in Interdisciplinary Studies in the co-departments of Anthropology, Anthropology and Geography presented on March 13, 1987 .

Title: Measurement and Meaning of Archaeological Diversity

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Abstract Approved: ______________________________
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Archaeologists use diversity as one way of characterizing their assemblages. Diversity refers to both the number of artifact classes present (richness) and the proportional representation of classes (evenness). Numerical diversity indices measure one or both components. Archaeologists use assemblage diversity to infer behavior of prehistoric cultures.

Archaeological inferences about behavior occur at two levels of analysis: (1) micro-scale analyses in which diversity is an attribute of artifactual assemblages, and (2) macro-scale analyses in which diversity is an attribute of the culture. This study evaluates theories used to

justify behavioral inferences based on macro-level diversity of material culture. Assumptions about behavior made on the basis of the diversity of archaeological assemblages are compared with information about behavioral diversity drawn from ethnographic sources. The ethnographic analysis considers four macro-scale models that establish archaeological correlates for systemic cultural behaviors. All the models infer behavioral diversity from artifactual diversity. They are: (1) a group size model that relates artifactual diversity to population density, (2) a niche width model that relates archaeological diversity to subsistence practices, (3) a complexity model that relates archaeological diversity to social organization, and (4) a stress-response model that relates archaeological diversity to systemic perturbation.

Four behavioral variables from the Human Relations Area Files Standard Cross-Cultural Sample are recoded to represent each behavioral diversity model. The results of a rank-order correlation procedure indicate that the behaviors associated with group size, niche width, complexity, and stress-response basically occur independently of one another in culture groups. This finding validates the archaeological approach which uses functionally-specific systemic behavior sets.

Archaeological sites often do not yield the artifactual and contextual data to use behavioral models.

The generalized diversity of artifactual forms is interpreted therefore as diversity of many behavioral responses. A general diversity variable (the sum of the four individual behavioral variables) produces the list of sample cultures ranked by generalized diversity. Because the diversity concept is not drawn from anthropological theory, archaeologists frequently interpret generalized diversity in terms of ecological or evolutionary models. The data show that biological models of diversity do not explain the general diversity rankings. The direct analogic application of theoretical biological diversity models to explain behavioral diversity needs reassessment in terms of ethnographic observations. Archaeologists should work towards building a distinctly anthropological theory which accommodates a generalized concept of behavioral diversity.

MEASUREMENT AND MEANING OF ARCHAEOLOGICAL DIVERSITY

by

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Associate Professor of Anthropology in charge of co-field

Redacted for Privacy

Assistant Professor of Anthropology in charge of co-field

Redacted for Privacy

Professor of Geography in charge of co-field

Redacted for Privacy

Chairman of Department of Anthropology

Redacted for Privacy

Dean of Graduate School

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Chapter 1

ARCHAEOLOGICAL USE OF BIOLOGICAL MODELS OF DIVERSITY

Introduction

Gumerman and Philips (1978:186) claim that "archaeologists seem to have little use for much of the research results of sociocultural anthropology and are increasingly turning to other disciplines for inspiration." These authors further assert that, rather than try to incorporate concepts from other disciplines into an anthropological framework, (what they refer to as "intellectual scavenging"), archaeologists are better off applying these "borrowed" concepts in "terms of the larger bodies of theory from which they were derived (p. 189)." Just a cursory review of the archaeological literature shows that there are many subscribers to this view. Such a literature review indicates that ecological frameworks are, by far, the most frequently adopted.

The interpretation of diversity measures epitomizes the problems of applying ecological principles analogously to cultural data. The purpose of this paper is to examine ways in which archaeologists define and use the diversity concept to characterize archaeological assemblages and the groups which produced them.

The essential questions addressed herein are: is behavioral diversity an analytical equivalent of biotic diversity, and is archaeological diversity the equivalent of behavioral diversity? The answers to these questions clarify the extent of the equivalency between human behavioral diversity and biotic diversity as an ecological/ evolutionary condition, and between archaeological diversity and behavioral diversity as an empirical condition.

The Meaning of Ecological Diversity

Diversity is not an anthropological concept. Diversity is a formal concept in ecology and refers to the range of variation in a collection (Margalef 1968). Diversity is a feature of a collection of biotic elements (e.g., formation, community, biome). As a measure of variability, diversity numerically evaluates quantitative relationships between countable elements. The biological element is frequently a species, but may be a more particularistic biological trait or a larger taxonomic unit.

Variability emanates from two compositional aspects of a collection: (1) the number of different elements (classes or species) present, and (2) their frequency distribution in the collection (i.e., the relative dominance of elemental types). To differentiate these subcomponents from the general concept, the first component may be referred to as 'richness,' and the second referred to as 'evenness.' The term 'diversity' (sometimes also called 'heterogeneity') is commonly reserved for situations in which a simultaneous consideration of both components is involved (see Peet 1974 for a review of definitions).

The confusion, and sometimes controversy, concerning the vocabulary used to describe manifestations of diversity indicates similar problems associated with diversity measurement. Choosing the most appropriate measure from the many available for characterizing collection diversity tends to be a subjective matter. The choice depends on the researchers' definitional bias, the number and kind of assumptions they are willing to make about the population(s) under consideration, and the appropriateness of a measure for certain statistical treatment.
In the recent archaeological literature, the dual-concept definition for diversity is the most usually cited (Hardesty 1980:164; Reid 1978:198; Jones et al. n.d.).

Numerous indices of diversity have been proposed. Simpson (1949) and Shannon (1948) proposed the foundations for the formulas which have become widely used in ecology, and to some extent in archaeology. Both methods produce values derived from probability functions. The Simpson Index and its variations mathematically define diversity as a function of the probability of different individuals, randomly drawn from a population, being of the same species (Pielou 1969). Summed probabilities are expressed as a ratio between products. Indices pertaining to the Shannon formulation define diversity as a measure of uncertainty, or entropy, H, which is a function of the probability of events under the definitional constraint that the occurrence of simultaneous independent events is the sum of their uncertainties. Probabilities are thus expressed as summed logarithmic functions (Martin and England 1981). Since these are probability-based measures, when actual population parameters (viz., S = total number of species and N = total number of individuals) are not known (the usual ecological or archaeological case), value estimators must be employed. The use of value estimators introduces sampling error into the measure.

A simpler and more straightforward measure is to consider the species richness component only via direct counts of the number of species (S) in samples. To circumvent the problem of unequal sample sizes for comparing S values, richness can be expressed as a rate at which species number increases with sample size, if it is known (or assumed) that a functional relationship exists between the number of species and sample size (Whittaker

1975). Unless species-individual relationships (evenness of representation) are known, this technique is of little value for comparing the richness of different communities using a single index (Peet 1974:290; Figure 1).

The evenness component of diversity is often expressed as the ratio between a calculated diversity value and the maximum possible. The maximally diverse population for a given S value must be that in which all species are represented in equal numbers (evenness = 1). Sheldon (1969) notes that all such evenness measures are dependent to some degree on species count, S. Although this dependency may not be very important "since it operates most strongly when the species count is low, ... most diversity studies include at least some samples with low species counts (Sheldon 1969:467)." Some workers, therefore, shun the use of any scaled indices because of the increased loss of measurement accuracy (e.g., Whittaker 1975:95).

No mathematical index of diversity serves as an absolute for purposes of definition. The different indices do not all measure the same attribute in the same way. Evaluations of the efficacy of measures usually include demonstrations of how various measures differ in their sensitivities to changes in sample composition (e.g., Peet 1974:300).

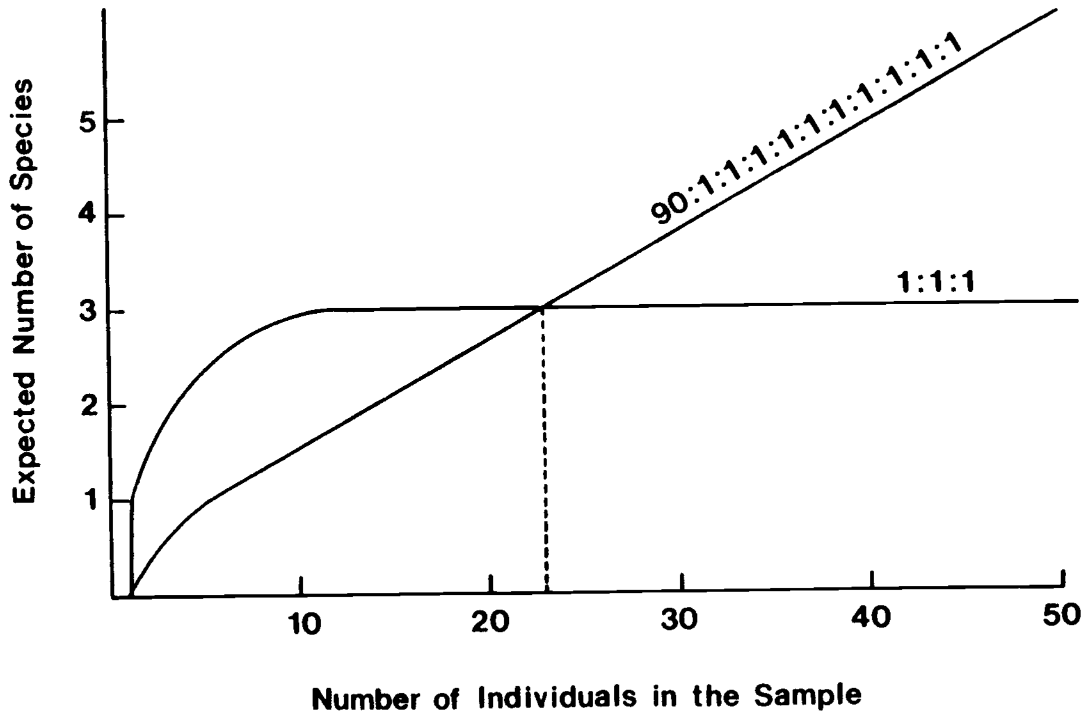


Figure 1. Schematic showing effect of sample size on observed number of species in a collection. This example shows that the collection with low species richness but high evenness (1:1:1) appears richer at small sample sizes (n = 1 through 22) than the other collection with more species but lower evenness.

This brief review of concepts seems adequate to demonstrate that, despite the lack of standardization in nomenclature and measurement (and, thus, ultimately interpretation), ecologists continue to work with diversity indices and to refine their understanding of its components. This effort is sustained due to the potential value of the diversity concept for hypothesis testing. Hill (1973:431) remarks on the extent of the theoretical utility of diversity when he writes:

> "diversity is of theoretical interest because it can be related to stability, maturity, productivity, evolutionary time, predation pressure and spatial heterogeneity ... it should be regarded as a measurable parameter whose observed values may be explained by a variety of theories."

A closer examination of the methodological and theoretical affiliations between ecology and archaeology should clarify the appeal of the problematic and complex ecological concept of diversity for archaeological applications.

The Appeal of the Diversity Measure

The very broadness of the concept of diversity extends its usefulness as an analytical tool. Since no physical or systematic constraints are implicit in its definition, the diversity concept can be used at any hierarchical level of analysis. Archaeology and ecology share a disciplinary approach which must delineate related phenomena in terms of scale, often spatial. Therefore, the adoption of a concept which is relevant at all scales is truly expedient.

While possessing an attractive abstractness, diversity basically describes a numerical relationship between countable things. Diversity, therefore, invites an operational definition based on empirical measurement. The property of quantifiability especially appeals to archaeologists, many of whom would prefer to rely on measures of information derived directly from their data base, rather than derived indirectly from models based on ethnographic observation. "These [latter] constructs may be insensitive to deal with behavioral variability expressed in the archaeological record ... for the data of the archaeologist are the precedents and products of actual behavior, rather than of recorded behavior (Wobst 1978:303)," The flexibility and quantifiability that diversity measures offer permit the objective comparison of like collections in terms of their intrinsic properties.

Diversity measures based on probability allow the estimation of population parameters. This is often desirable in fields like ecology and archaeology in which analyses are often hampered by lack of statistical controls.

Since diversity is a property of an entire collection and not of the individual entities that comprise a collection, a single statistic can characterize the analytical unit of interest. Collections are a fundamental unit of analysis for ecologists and archaeologists, both of whom seek to describe interactive phenomena in which context takes on great importance. Thus, as synthetic concept, diversity -- operationally defined as a relationship between types of elements in a collection -- may be more meaningfully regarded as a state, or condition, that is the consequence of a process.

The identity of interest between archaeologists and ecologists increases since they both accept the condition of diversity as the result of a process. Process implies an explanatory mechanism for generating a condition. For ecologists, the process that generates biotic diversity is genetic transformation (speciation), and the theoretical framework which encompasses it is evolution. Many archaeologists, among other social scientists, find this explanatory framework very attractive and viable for the study of cultural systems.

Archaeology and the Evolutionary Paradigm

The Origin of Diversity

The evolutionary paradigm is certainly not new to anthropology. Its principles have been applied to cultural phenomena since Darwin's time. Sufficiently comprehensive reviews exist on the subject (Alland 1975; Kirch 1980; Harris 1968; Rindos 1985), and there is no need to recapitulate the history of anthropological history here.

The important development to note is how Darwinian evolutionary concepts have been altered for use in different theoretical models. Rindos (1985) details fundamental differences which exist between Darwinian evolutionary principles and the kind of evolutionary principles which dominate in models of cultural evolution. The latter are broadly categorized as 'Spencerian,' or 'progressive,' evolutionary models. The progressive models propagate the notion that evolutionary change is unidirectional, that is, each successive 'stage' in evolutionary development is an improvement over the last. Evolutionary stages of development imply a ranking by organismic superiority according to some pre-established criterion. Clearly, this kind of assumption influences (and has influenced) the interpretation of cultural phenomena, both directly and archaeologically observed.

The advance of ecological perspectives helped liberate anthropology, and especially archaeology, from progressive models of evolutionary change. The genetic mechanism of selection and the problem of identifying its cultural equivalent is downplayed in the ecological perspective which focusses more on the systemic principle of homeostasis (Bennett 1976). The principle of homeostasis contends that the condition of a system (in the form of a single organism or an aggregate of organisms) is maintained in a relatively constant internal state by control and feedback mechanisms in the face of varying external factors (Ricklefs 1973; Whittaker 1975).

The source of biotic diversity, speciation, is, however, a genetic and stochastic phenomena. In that speciation is governed by selection, the process becomes astochastic and functional. It is this aspect of the speciation process which has led Mayr (1974:5) to regard speciation as "the acquisition of ecological compatibility." While the persistence of some species may be due to chance, most variation is considered to persist because it is functional.

A principal theme that arises from an ecological orientation towards evolutionary theory, as opposed to a teleological orientation, is the belief that "evolution occurs only in response to perturbation and has no momentum of its own (Slobodkin 1978:333)." Perturbation, the disruption of homeostasis, activates selection. This statement posits an explanatory cause-effect relationship between environmental circumstances and the responses of affected organisms. A condition of species diversity is somehow induced. Conceivably, if diversification is a regulatory mechanism, then the circumstances under which diversity is enhanced or diminished can be discovered. Thus, diversity has become useful to archaeologists as a theoretical concept, over and above its usefulness as a descriptive one, because the manifestation of diversity is taken to be the result of identical or analogous processes to those responsible for biotic diversity, namely, speciation and selection.

The Cultural Analog

Clearly, an identity of process for biological and cultural systems would be difficult to support, as the units of analysis are so qualitatively different. And, indeed, there is no propensity among cultural theorists to argue for such an identity. The idea advanced by Durham (1976), that cultural evolution is a "complementary" process to biological evolution, has been widely embraced by archaeologists. According to Durham (1976:90-91):

> "... complementary evolution means
> that many of our biological and

> cultural attributes can be analyzed in the same terms even if they result from fundamentally different processes ... it is therefore reasonable to seek a general theory of cultural change which is explicitly compatible with the theory of organic evolution by natural selection."

Unfortunately, despite a basic agreement, in principle, to the above comment by those who accept the paradigm of cultural evolution, there is no real consensus that the methods and measures designed to elucidate biological reality serve as well in elucidating cultural reality. Before examining the viability of diversity as a specific case in which an analogous property is believed to result from an analogous process, the general form of the evolutionary analogy should be clarified.

Analogies are necessitated by dissimilarities in the phenomena being compared. The outstanding point of departure which exists between the biological and cultural evolution centers on the concept of the species and the criteria upon which species are so classified. This is particularly crucial in diversity studies, since species are the units of measurement.

In cultural evolution, there is but one biological species. While racial characteristics have been used for some kinds of studies to subdivide the species, physical attributes are not cultural ones, and are not generally deemed appropriate as the basis for a distinctly cultural classification. Truly cultural characteristics are manifest in the activities of man. They are behaviors, and the "fundamentally different processes," indicated by Durham, are largely distinguishable as the expression and intergenerational transmission of phenotypic (behavioral), as opposed to geneotypic (genetic) traits. Qualitatively, this is a huge distinction. In an evolutionary sense, however, behavioral traits can be likened to genetic traits in that their retention is assignable to their function as a response to external conditions, i.e., environmental perturbation or homeostatic imbalance.

In addition to recognizing that the mode of generating variation is similar for biological and cultural systems, acceptance of the analogy also requires that there exists identifiable units of variability -- species -- which emerge from the process. Cultural groups correspond to individual species in the biological model on the basis that "cultural rules are propagated in social groups," and that "significant differences do exist in the ecology of subspecific groups (Hardesty 1980:163)." Thus, such groups may be said to be unique in their demands of and responses to the environment.

The form of the analogy, in which cultural groups are species recognizable by a particular set of behavioral responses to their physical and social environments, is useful for some kinds of anthropological analyses. For example, Yellen (1977) uses this analogic base in his explanation of the geographic distributions of cultural species, defined by behavioral characteristics, as conditioned by the degree of resource predictability. As do most archaeologists who apply this analogy, Yellen relies most heavily on ethnographic information to test his hypotheses, while archaeological evidence plays only a supportive role to give the models some diachronic validity.

More specifically archaeological frameworks, however, usually consider a much narrower spatial scale and are plagued by considerably greater observational constraints. In these contexts, the operational definition of species, explicit in the cultural evolution analogy as outlined here become difficult because: (1) the behaviors upon which cultural species are to be distinguished are not directly observable, and (2) the numerical or geographic extent of the population sharing a unique set of behaviors are not directly known. Therefore, a distinctly archaeological equivalent of the cultural species is required.

The Archaeological Analog

A guiding precept in archaeology is that behavior can be inferred from the products of cultural activity. If behaviors are the cultural form of evolutionary responses, then, by further analogy, the products of behavior can be likewise considered correlates of evolutionary responses. For the archaeologist, "the differences among human groups that define species equivalents [can be] measured by the similarity in artifact assemblages (Hardesty 1980:163)." In this statement, the human group is the species equivalent as given in the general cultural form of the analogy. However, as will be shown more concretely in the next chapter, this is not the level of cultural differentiation at which most archaeological work is done.

One of the initial problems in archaeology is finding meaningful ways to characterize individual assemblages. This is similar to the task of ecologists who desire to characterize a biotic community, and this is the goal towards which diversity indices are applied. Similarly, archaeologists are also interested in describing the variability within assemblages. At this scale of analysis, in which the single archaeological assemblage is the collection analogous to the biotic community, particular cultural products (rather than the cultural group) become the species equivalents (Figure 2). The behavior-response correlate remains intact, but in a less obvious way. Ultimately, of course, cultural types may be, in part, made identifiable by the criterion of assemblage diversity if archaeologists are able to demonstrate that relationships exist between assemblage diversity and socioenvironmental conditions.

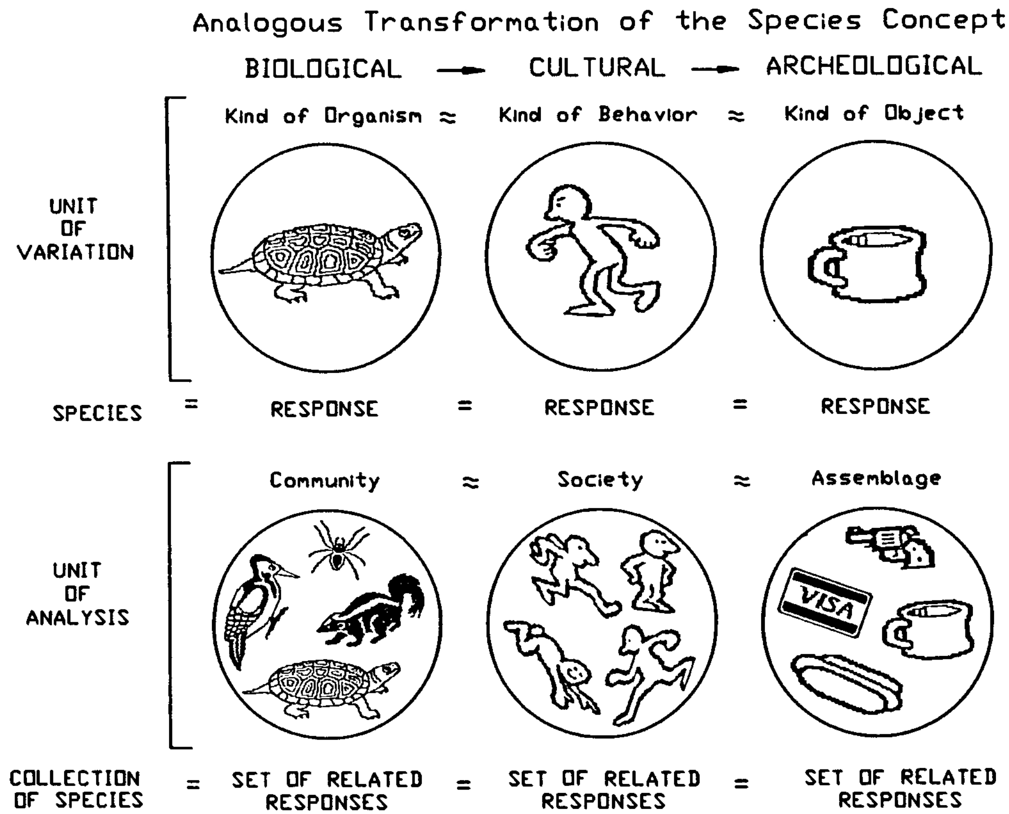


Figure 2. Schematic showing how the concept of a species is transformed in non-biological (i.e., cultural and archaeological) models of evolutionary change.

Ecologists and archaeologists are asking the same fundamental question about their respective collections: why are some collections more diverse than others? Within the ecological framework this question translates as: Under what ecological conditions do communities or groups generate more responses? This ecological approach has been widely utilized by cultural analysts to explain qualitative responses (such as sedentism, warfare, cereal cultivation, etc.). But now, in focussing on diversity, the quantitative number of responses, archaeology is attempting a more empirical and standardized means to establish evolutionary principles of human development applicable to a wide range of archaeological contexts.

Chapter 2

MICRO-SCALE ANALYSES OF ARCHAEOLOGICAL DIVERSITY

Micro-Scale versus Macro-Scale Analysis

Generally, archaeological work employing the diversity concept falls into two categories: (1) that in which diversity is considered at the assemblage level (or micro-scale analyses), and (2) that in which diversity is considered at the cultural level (or macro-scale analyses). In micro-scale analyses, determination of assemblage diversity is primarily a methodological concern. Diversity is an attribute of an assemblage, and diversity indices are applied simply to the measurement of the variation within an archaeological collection.

While the same method of empirical measurement is adopted by macro-scale analysts, the ultimate aim is to apply the attribute of diversity to the cultural group rather than to the products of their actions.

In the analogies with biotic collections, species correspond to types of artifacts in assemblage-level analyses, but correspond to types of behaviors in cultural-level analyses. The behavioral analog may be implicit in setting up micro-scale models, but an argument for the condition of diversity is not necessarily, nor is it usually, bound by theoretical constructs. The distinction between these levels of interpretation will become obvious through the examples of assemblage-level diversity studies given in this chapter and examples of cultural-level diversity given in the following chapter.

Assemblage-Level Diversity And Behavior

At a primary level of analysis, an artifactual assemblage may be described by the apparent diversity of its contents. Diversity is a function of the number and distribution of classes (species) encountered in an assemblage.

Assemblage diversity is often intuitively interpreted as directly relating to the number and prevalence of activities performed. This, in turn, is taken to imply site function and the cultural habits of its occupants, especially in regard to duration of settlement. The following excerpts are typical of those commonly found in the archaeological literature:

> "Residential sites are more flexible in their location and more variable in their content. Special purpose locations are more discrete in their location and more redundant in their use and content (Binford 1978)."

> "...other factors held constant, the measure of morphological diversity of an

> assemblage approximates the range of activities performed at a settlement, which, in turn, is a relative measure of length of occupation (Reid 1982: 196)."

> "A limited range of artifacts should be recovered on special purpose processing camps...A much more diverse range of artifacts should be found on residential bases depending on their occupational duration (Lightfoot 1985: 298)."

These conclusions stem from an effort to develop site typologies which are intended to help define intra-group settlement patterns. These statements imply that assemblage composition is an indicator of both behavioral variety and the degree of settlement permanence.

Delineating site function through assemblage diversity focuses on the descriptive rather than processual aspect of the diversity concept. Still, the usefulness of the diversity concept for interpretive purposes is predicated on the assumed quantitative equivalency between behavioral variety and artifactual variety. Without this imputed equivalency, site typologies based on assemblage diversity become tautologically self-defined by the nature of their content as opposed to their function. As Binford (1983:334) points out, "the form ... is not necessarily determined by the means, but instead derives from the patterns of use to which means are put." Here, the "means" may be considered as the artifacts, and the "patterns of use" as their behavioral contexts.

The assumption of the behavior-artifact correspondence derives support from ethnographic observations, such as Binford's 1978 study of the Nunamiut Eskimo in which he categorized activity areas primarily on the basis of the number of types of activities performed. On the other hand, there is ample evidence to admit that such "direct comparisons have only a limited use for archaeology,..." because "living archaeology [or ethnoarchaeology] can inform us directly only about residue behavior in contemporary societies and only indirectly about prehistoric human behavior (Gould 1980:28,113)."

Methodological Issues

Most assemblage level studies of diversity in archaeology do not challenge the validity of the behavior-object relationship, rather this assumed correspondence serves as one of the guiding principles of these studies. Since micro-analyses provide the basic form of data which are used at successively more comprehensive levels of analysis, there is value in looking more closely at the methods employed at this empirical level of data description. Later, the deficiency of this approach for theory-building will be examined.

Even granting the assumption that behavioral diversity is revealed by artifactual diversity, certain methodological problems must be recognized if a single convenient index, like a diversity index, is to be used to characterize an entire assemblage. These problems center on the nature of the archaeological record and the strategies employed to uncover it.

Artifact Class Richness

Artifacts recovered from an archaeological excavation, regardless of its spatial extent, do not comprise the total possible inventory. Field archaeologists sample space, not the population of artifacts contained therein. A straightforward use of species richness to calculate a diversity value is open to a great deal of criticism. A basic relationship concerning assemblage diversity is that class richness will usually increase with increasing sample size until all designated classes are encountered (Wolff 1975). In figure 1 this relationship is plotted for two populations. The plot also shows dramatically how an inadequate sample size can misrepresent the actual species composition of a population.

As obvious as this relationship between space and class number may seem, the issue of sample size effects is not suggested frequently as a source of difficulty for assigning site function. For example, Stafford (1980) used a mathematical diversity index derived from information theory to characterize the "macro-functional" tool class composition for several sites in Arizona. He expressed surprise that the value for one site, identified as having been seasonally occupied, was higher than for another, identified as a permanent habitation site, because "a seasonally occupied site would be expected to have a lower diversity than permanent habitation sites (p. 52)." In Stafford's discussion, no mention is made of the comparability of sample sizes or artifact densities among the sites analyzed. Neither of these spatial factors are incorporated in the index calculations. Stafford's explanation for the discrepancy in diversity values was that a single category of class types was highly represented in the seasonal site. This explanation may or not be true, however, if it is, the credibility of the diversity index for being able to distinguish site type by duration of occupation is rather lessened.

Sample size and artifact density effects need not be insurmountable impediments to interpreting and comparing assemblage diversity. Systematic investigations of specific geocultural regions suggest that the relationships between diversity and other site parameters may be predictable at a large enough dimensional scale.

In a 1983 paper, Jones et al. produced a linear regression model to describe the species-individual relationship for surface assemblages found in the Steens

Mountains area of southeastern Oregon. By logarithmic transformation (log 10) of the dependent and independent variables (number of species per assemblage and number of individual artifacts per assemblage respectively), the usual curvilinear form of the plotted relationship (as depicted in Figure 1) is made to conform to a straight line function. The major conclusion of Jones et al.'s study was to say that "83% of the variance in stone tool functional class richness may be statistically accounted for by sample size across all of these assemblages (p. 65)," and that "the residuals, the amount of unexplained variance, become the target of detailed analysis as regards artifact class richness (p. 69)."

Thomas (1984) arrived at similar results by investigating the tool class richness of both surface and subsurface assemblages from his Monitor Valley, Nevada, Project (70% or more of assemblage variability was accounted for by sample size alone). In his analysis of the species-individual relationship, his concern focussed on the "relative degree of diversity within a given system." To this end, he shuns the use of any absolute measure, preferring to gauge relative diversity as the rate at which new species are encountered in an artifact sample of given size. Applying a regression technique like that of Jones et al. to model species-individual relationships, Thomas ascertained that the slope of the regression line "offers a way of assessing relative assemblage diversity independent of absolute sample size -- so long as assemblage size and diversity [i.e., class richness] are found to be highly correlated." Figure 3 is an idealized schematic of how different slopes would indicate site function based on differential rates of encountering new species for given sample sizes.

One archaeologically important factor that is not addressed adequately in the studies of Jones et al. and Thomas is that of artifact density. Artifact density is the number of artifacts encountered per unit area or unit volume of space. In treating the recovered assemblages as the sample population, these authors ignore the archaeological reality that excavated space is the quantitative dimension that serves as the unifying basis of intersite comparability. In speaking of assemblage diversity, they consider the assemblage as the unit of analysis, but what constitutes an assemblage is defined arbitrarily on a case by case basis. This practice impairs the analytical rigor desired of empirical descriptive analyses. In ecological calculations of community diversity, the units of analysis are defined always by spatial constraints.

A study of artifactual yield per unit space for coastal sites in Oregon (Betz 1987) suggests that the space-artifact yield relationship, too, may be described by

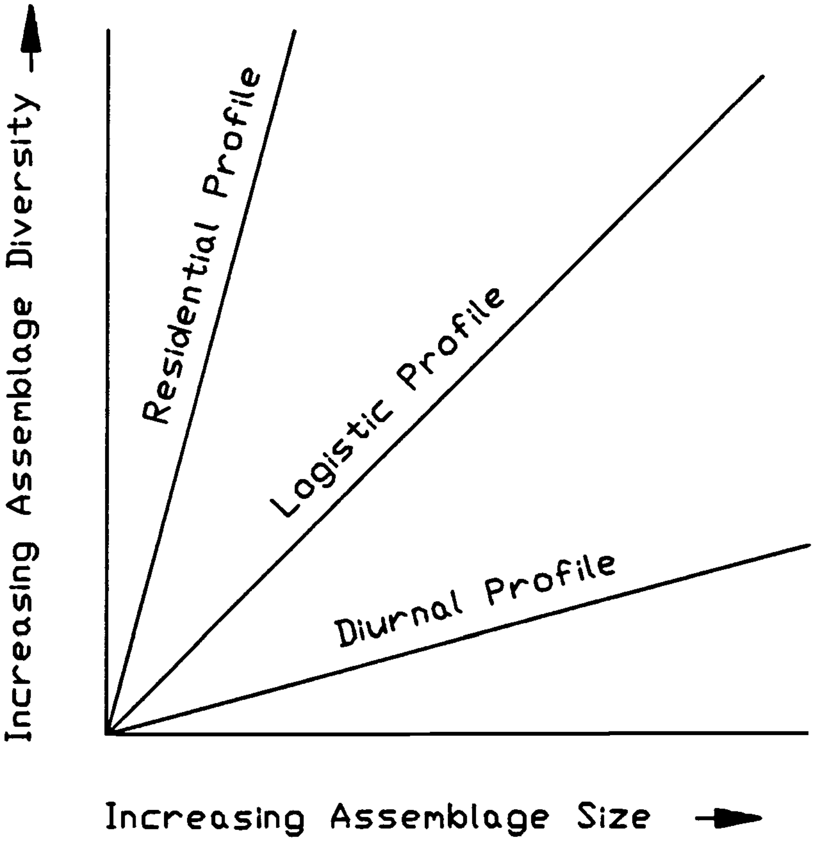


Figure 3. Model for designating site function on the basis of the slopes of the regression lines that define the relationship between artifact class richness and sample size (from Thomas 1984).

a linear model (figure 4). Conceivably, then, a better linear model for the artifactual class richness of an assemblage may be a multivariate model incorporating both the artifact density and class richness of sampled artifacts. Space, as a unit of comparability is also problematic in that rates of deposition vary from site to site.

Of course, none of these proposed models claims to be a definitive one for the specific area in question. They do, however, illustrate a potentially useful way of organizing and interpreting purely quantitative assemblage level data. Data obtained from related sites characterize the diversity of a culturally and/or physiographically defined region. The region is likely to be the more appropriate spatial level of analysis for patterns of overall group diversity.

Budy et al. (1986) attempt to define the limits of artifactual class variability for archaeological sites in a river drainage area in southwestern Oregon by pooling data on class richness from several excavated sites. They suggest that plotting the species-individual curve from these data gives the maximum value for class variability. While the analytical aim and approach are worthwhile, the conclusions are probably premature due to: (1) the low number of sites included, and (2) the lack of data comparability, since the data base included assemblages

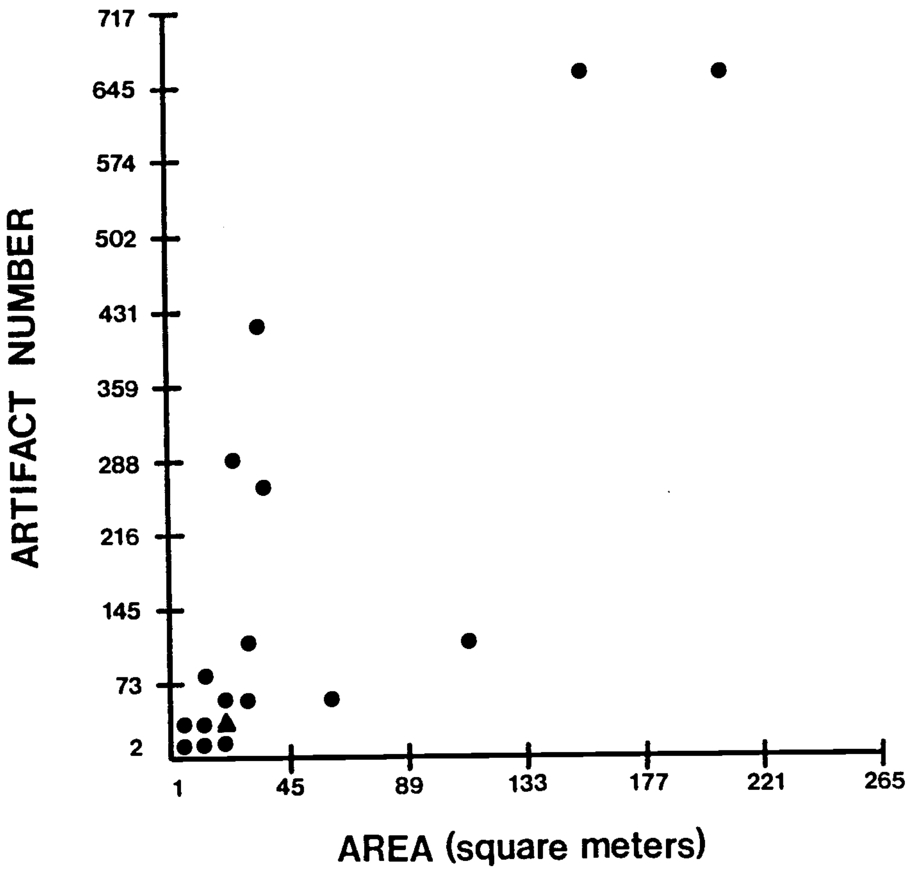


Figure 4. Plotted relationship between artifact yield and area excavated for sites on the Oregon coast.
Pearson's $r = 0.86$ ($R^2 = 0.75$; p less than 0.01; $n = 18$)

from only two well-sampled sites while all other assemblages were recovered from limited test excavations.

Artifact Class Frequencies

In the studies discussed so far, only the species richness component of diversity is considered. Other archaeologists focus on the class distributions within assemblages as well.

The emphasis on distributions is well demonstrated by Stafford's (1980:51) definition of diversity as "the extent to which members of a frequency distribution are evenly dispersed among classes or groups." Stafford and others (Reid 1982; Whittlesey 1982; Lightfoot 1985), have used the more sophisticated 'J' index, instead of using simple species counts. J is sometimes referred to as an equitability index (Pielou 1969; Peet 1974). In the archaeological literature, J is used as a substitute for the dual-concept diversity measure, H (the Shannon-Weaver Index). Since a J value is defined as the ratio between the observed diversity value of an assemblage and the maximum possible diversity for a given S (total species number), J is positively correlated with H (Whittaker 1975).

A J score, then, measures evenness between samples <u>only</u> when all samples contain the same number of classes.

otherwise, the J score will reflect the influence of species number and distributions, as does the diversity value from which it was derived. While other dual-concept diversity indices have also been used by archaeologists, the preference for J may be explained by its ease of interpretation, because it is a scaled value which must lie between zero and one.

Probabilistic diversity indices are influenced concurrently by two independent properties of a collection. Pielou (1969:222) notes that "a collection with few species and high evenness could have the same diversity as another collection with many species and low evenness." In archaeological applications, this may lead to interpretive difficulties, especially in using such an index to characterize site function. The citations presented at the beginning of this chapter suggest that higher evenness in artifactual composition would be expected at limited activity sites ("artifact redundancy"), while higher species numbers should be expected at residential sites. Figure 5 illustrates how sample composition influences the J value.

Jones, Beck and Grayson (n.d.) attempt to eliminate the ambiguity of J by modifying the formula to measure only evenness, in order to compare artifact class distributions in 'site' and 'off-site' assemblages in their study area. Since site assemblages were defined primarily by artifact

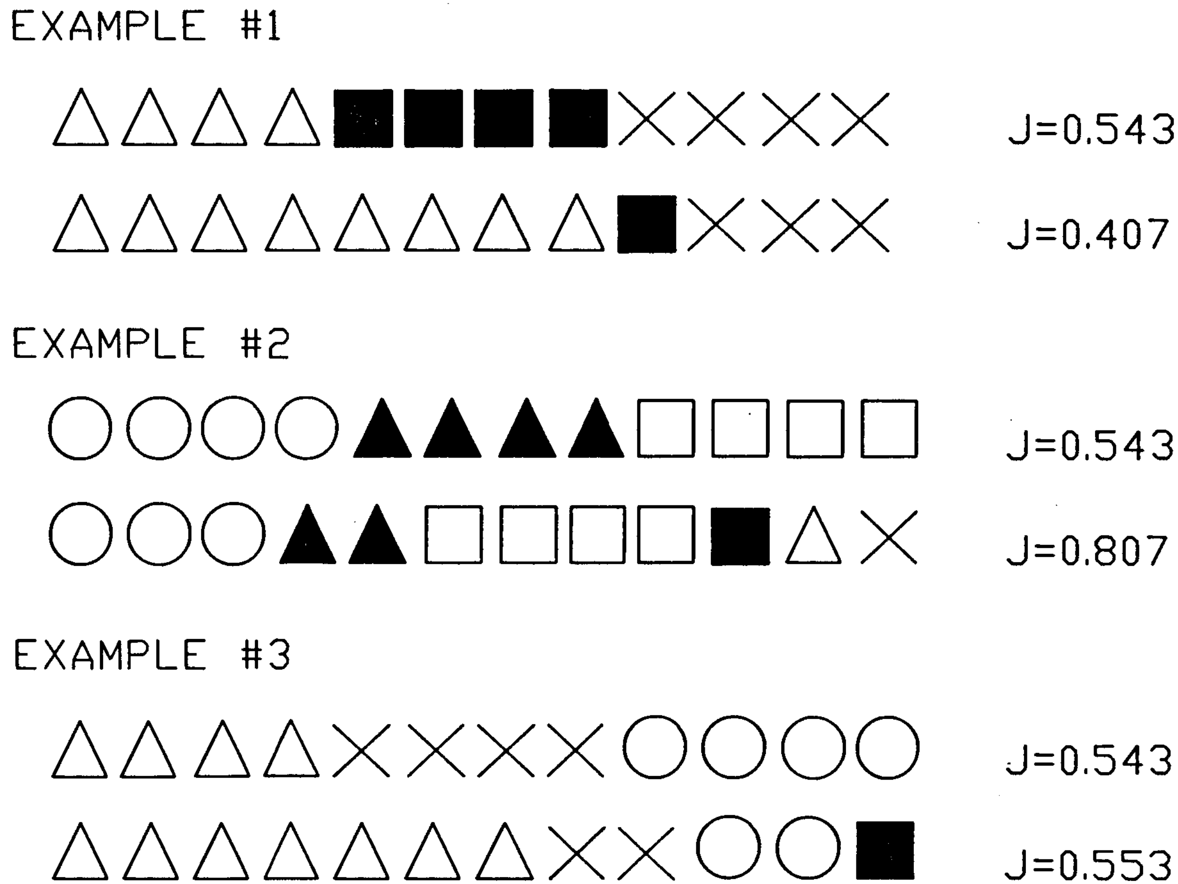


Figure 5. Effect of sample composition on J-index values. Example 1: number of classes is the same for both collections and the collection with the most even composition has a higher J-score. Example 2: the collection with twice as many classes but low evenness has a higher J-score. Example 3: two collections with different class composition in terms of richness and evenness have nearly identical J-scores.

density, total artifact number is bound to be higher in site samples than in off-site samples (Figure 6). Samples with very even class distributions from off-site locations would have very low J scores if few species were represented in the assemblages because these samples are being evaluated in terms of a hypothetical maximum. Jones et al. (1983), however, showed previously that species representation was largely dependent on sample size. The relative independence of the J score from sample size cannot account for assemblage to assemblage differences in sample size. Substituting Hmax, the H value obtained when the maximum number of species is represented, with the actual number of species in the sample for the calculation of J, Jones et al. control for sample size effects on species richness. With this modification, a very even sample will obtain a high J value, regardless of whether few or many species are represented (Figure 6).

Peet (1974) criticizes the accuracy of J values resulting from this approach. He maintains that using the actual number of species in the sample, instead of the hypothetical maximum, will result in an overestimate of evenness (because species number will be underestimated). This criticism is borne out by the results of Jones et al., who co-plotted the values obtained by both methods (Figure 11 in Jones et al. n.d.).

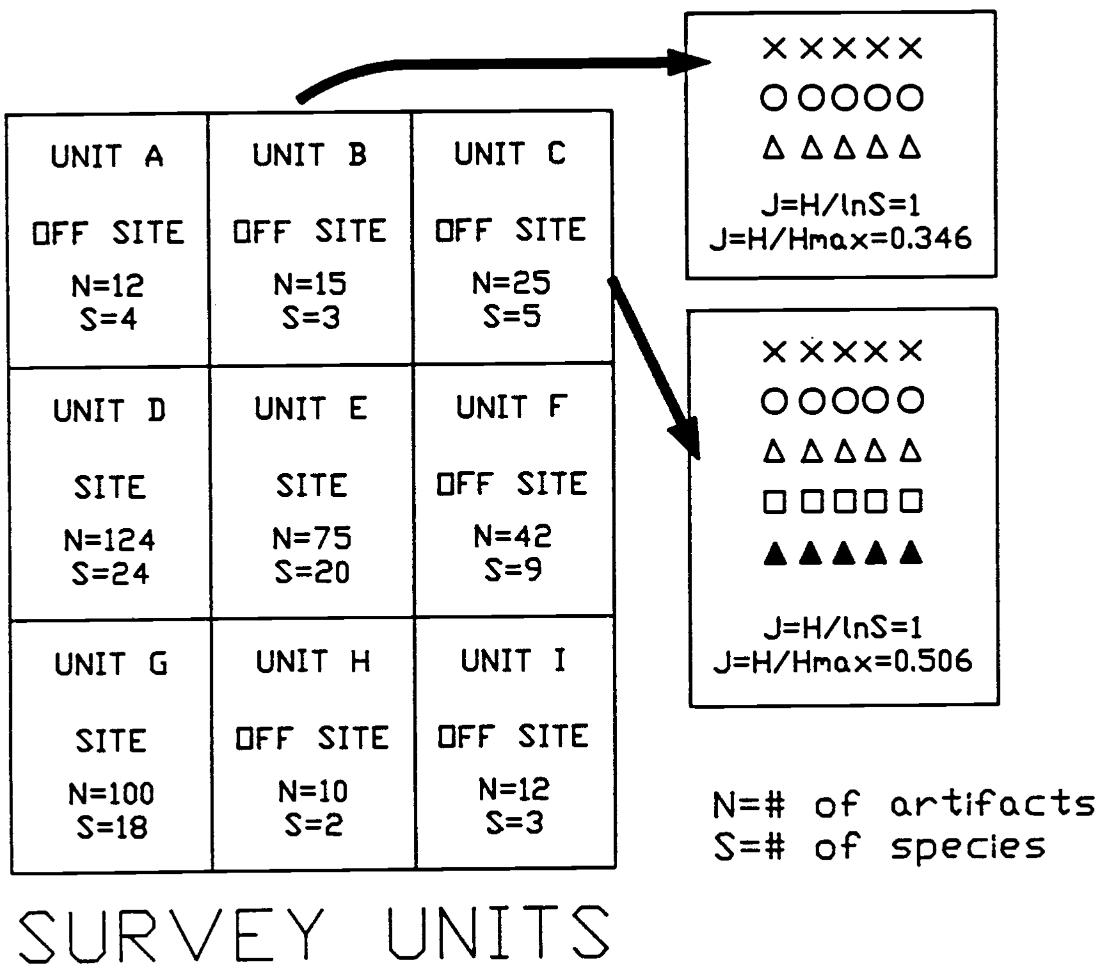


Figure 6. Schematic showing the different information given by two forms of the J-index.
J = H/lnS measures evenness of class distribution only in each unit's assemblage.
J = H/Hmax measures evenness in terms of a hypothetical maximum (which in this example is the number of classes encountered in the entire survey area). Illustration is based on a study designed by Jones et al. (n.d.) and is described in the text.

The more important issue, however, is the information given by the statistic. The modified J of Jones et al. certainly gives more accurate information about the distribution within the assemblage itself. But, a loss of another kind of information accompanies the loss of the referent supplied by Hmax. Consider a comparison of units B and C in the situation displayed in Figure 6. The modified J value, J=H/lnS, precisely describes the actual distribution within the assemblages in terms of evenness, but presumes that, despite the proximity of unit B to unit C, the absence of two artifact classes is not an important consideration in describing the distribution of B. The original J value, J=H/Hmax, while not as clear about distributional properties, does indicate that unit B is more deficient than unit C in terms of what would be expected statistically (considering what is known about the entire range of artifact variability for the area).

In either form, the J statistic is extremely sensitive to sample variation (Peet 1974) and, thus, is not a reliable indicator of real population characteristics with small sample sizes. Reliability increases with increasing sample size, where the number of species in the sample approaches the maximum species number possible, in which case the differences in the calculated values between the two forms of the index become negligible. Spatial constraints on artifact collection may make large enough sample sizes an impossibility in studies like that of Jones et al. Modified J index values are adequate descriptors of individual assemblage evenness if the values' limited statistical applicability are recognized. The original J index, which is superior for purposes of comparison, should be restricted to situations in which "the number of species in the underlying universe is known (Peet 1974:300)." Knowledge of this sort is practically non-existent in archaeology, yet the possibility of approximating it is being pursued.

Estimates of Expected Diversity

Kintigh (1984) has proposed a method for gauging the relative diversity of assemblages which he believes will bypass some of the limitations involved with formulaic indices. His idea is "to generate theoretical expectations for the number of different classes of items that should be found in a collection of a given total size (p. 44)" via computer simulation. The method proposed is fairly simple and straightforward. A hypothetical parent set of artifacts is entered into a computer, and, for a pre-selected constant sample size, a large number of random samples are drawn. Consequently, "the mean and standard deviation of the frequency distribution of the number of different classes found will be reliable estimates of these parameters for the random choice model (p. 45)" for that sample size. Estimates can be generated for the gamut of possible sample sizes.

A like method, known as rarefaction, was introduced to the study of palaeozoological collections by Sanders (1968) and has been subsequently modified. In fact, mathematical formulas were developed which produce values identical to those obtained by simulation, so that actual simulation runs are not necessary (Tipper 1979). In his evaluation of the method, Tipper (1979) verifies the legitimacy of the formulaic equivalents and provides statistical tests for equivalence.

Both Tipper (1979) and Kintigh (1984) are conscious that the fundamental flaw in the rarefaction method is that it is deterministic relative to the decision regarding the composition of the parent population. The statistics derived from the random samples generated are only as justifiable as the composition of the parent population from which they originated. Kintigh (1984:49) does not dwell much on this point, but merely remarks that "the distribution might be theoretically derived or, more likely, could be estimated from relevant data."

The palaeoecologist, Wolff (1975), has dealt with a theoretical procedure for determining representative sample composition. Using ecological concepts about predator-prey interactions, he hypothesized that a relatively standard population ratio should exist between four different classes of animals, categorized by trophic level and size (large predator, small predator, large herbivore and small herbivore). Drawing repeated random samples, as in the rarefaction exercise, he eventually reached a sample size at and above which the proportions between the four animal classes in the sample closely approximated that of the hypothetical parent population. If real samples approximate the same ratio, then the hypothetical population model is validated and a minimum sample size can be established. The adoption of a similar technique to apply to archaeological materials would presume that predictable proportional relationships exist between or among artifact types.

In sum, no method currently employed for measuring archaeological diversity seems entirely adequate, but the serious investigation of the quantitative attribute of assemblage diversity has just begun. The variety of approaches and their possible permutations offer hope that methods of measurement can be devised which are more appropriate to the archaeological data base and are more empirically trustworthy. Still, there is an issue relating to archaeological diversity measurement which is most likely more fundamental than that of _how_ to measure diversity. This is _what_ to measure. The phrase 'artifact class,' which has already been used dozens of times in this report, is the implied answer. However, what constitutes an 'artifact class' has yet to be discussed.

Artifacts as Species Analogs. A Problem of Systematics

The lack of concordance among archaeologists in deciding what to count as distinct classes severely interferes with the potential to make comparisons between assemblage diversity values for different study areas.

Most investigators agree that changing the class structure in the categorization scheme is liable to change the diversity values obtained. Thomas (1984) experimented with calculating the diversity of the same assemblages using different classificatory schemes. He concluded that "different definitions of basic variables produced remarkable similar [diversity] profiles (p. 12)." The similarity in the value profiles obtained for these assemblages does not, however, imply that the distributions of items within assemblages were not substantially altered (this would likely affect dual-concept diversity or evenness measures more than the richness measure that Thomas used). Moreover, Thomas' procedure for reclassification was to collapse a large number of classes into fewer, more general classes. Although he refers to this as "major definitional modification," the basic internal structure of the classification was maintained in both schemes.

Thomas' experiment was intended to show that the extent to which diversity was dependent on sample size was unchanged by reclassification, not that actual diversity values remain absolutely constant. Drastically different classification schemes if applied to the same collection, could produce significant dissimilarities in numbers of species and their frequency distribution. And, indeed, such disparate classifications do co-exist in contemporary archaeology.

The dichotomy which distinguishes the major classificatory approaches is between morphological (or stylistic) and functional criteria for classification. The morphological approach identifies an artifact on the basis of its overall form; the functional approach identifies an artifact on the basis of how it was apparently used.

A most basic requirement for reliable diversity measurement is "a clear and unambiguous classification of the subject matter," in which "all species are assumed to be equally different (Peet 1974: 286)." In an essay concerning this dictum of systematics, Sackett (1973:325) says that the attributes used to define an artifact "can themselves assume but one mode at a time and that, in order to form a meaningful type cluster, they must all agree in the mode they adopt in any given cluster." The term 'mode' here refers to stylistic mode or functional mode (Sackett

1973:320). The choice of either mode has its own appeal and logic.

The idea pursued in chapter one was that the most meaningful way to define diversity was as a collection of responses. This very general notion transcends any particular mode, and thus either classification approach can be justified by the general definition of diversity. Morphological and functional artifact typologies, as well as hybrid typologies which draw criteria from both of the other systems, are all represented in the literature describing applications of diversity indices.

Hybrid schemes are most problematic, especially those which make further class distinctions on the basis of material type used (in such a case, a single morphological type could conceivably appear in two or more categories). When the typological modes are intermixed in one system, the mutual exclusivity of class composition is very difficult to maintain. The resulting diversity measurements based on class composition are usually overinflated.

Another strategy employed has been to calculate separate diversity values for higher-order groupings of object classes (e.g., Reid 1982; Stafford and Rice 1980; Lightfoot 1985). Reid (1982), for example, calculated separate indices for ceramic vessels, groundstone stools, chipped stone artifacts and chipped stone tools. This practice is sound in principle and, in fact, offers a way to monitor whether diversity values for different families of classes reflect similar patterns. The usefulness of Reid's composite-J score, which is the arithmetic mean of the individual scores, is questionable since not all of the categories are mutually exclusive.

The purely morphological or purely functional classifications tend to be much more standardized and replicable from context to context. Due to the obviousness of formal attributes, artifact typologies based on morphology have dominated in archaeology for some decades. But, again, the influence of processual models in archaeology, along with that of the evolutionary paradigm, make classification criteria based on stylistic attributes seem trivial when compared to criteria based on object function. Any unique form of object may be considered a unique cultural response, but, from a functionalist perspective, some types of response have developmental import and others do not. This argument is not unassailable. Nonetheless, the logic of functionalism has had a tremendous effect on archaeological systematics. This impact has largely been responsible for what was referred to herein as the 'hybrid' schemes, more commonly referred to as morphofunctional classifications. As already mentioned, these typologies present special problems for the quantification of assemblage diversity, but they have also been targeted for more severe criticisms by supporters of radical empiricism in archaeology.

The empiricist's complaint against morphofunctional schemes is that they presume a scientifically unproven association between the form and function of an artifact. Despite the fact that many form-function associations are intuitively reasonable and are easily defended by ethnographic analogy, strict empiricists refute any _a priori_ assumptions of function on the ground of intellectual principle. Also, a sufficient number of studies have demonstrated empirically that some traditionally recognized form-function associations are wholly or partially unacceptable (for an extended discussion, see Odell 1981). If the labels usually accompanying formal types are ignored, purely morphological classifications are not truly subject to this particular criticism. However, in archaeology, empiricism and functionalism tend to occur together as a single kind of approach for artifactual analysis.

A system for classifying artifactual materials based on use-wear analysis has become something of a panacea for archaeological systematics. Use-wear analysis appears to satisfy the requirements for a typology that is both empirical and functional. The increasing application of this classification scheme, and its affiliation with evolutionary concepts, make it worthy of some detailed consideration here.

One of the leading proponents of (and probably the most persuasive spokesman for) use-wear classification, R.C. Dunnell, (1978a:57) states that "the object of use analysis is to assess the composition of assemblages in terms of frequency of uses." Clearly, Dunnell regards "uses" as the meaningful units of variability to enumerate in evaluations of assemblage content. Use is neither a type of artifact nor a type of behavior. "Use of an object is that set of attributes which results from its artificial motion (Dunnell 1978a:52)." No one can observe the use of a prehistoric object, but one can observe wear, which is the attribute of motion. If an object exhibits wear, it has been used, and if it has been used, it was functional. Function, then, may be empirically equated with wear. Therefore, specific and unique types of wear (which are, indeed, identifiable on objects) are the best and only criteria of function empirically possible. Certainly, this is a very elegant argument. But, does a use-wear-based typology really avoid any sort of inference, such as those inherent in morphofunctional typologies? And, is this scheme truly more compatible with the evolutionary paradigm than any other?

In Dunnell's argument, function can only be assigned on the basis of wear (i.e., the evidence of use). But even he admits that not all artifacts are "used." There is no necessary logic to saying that what does not evidence use is not functional; rather, the situation is that objects without wear simply cannot be assigned a function by this method. There is a good probability, then, that 'use' alone is an inadequate criterion of function. If one can only define function in terms of use, then obviously some objects or whole classes of objects from assemblages must be omitted from analysis. In doing so, there is a good chance that what remains will be an inaccurate representation of the range of functions extant, unless non-used items are assumed to lack function.

In another paper (1978b) Dunnell elaborates on function as a concept. He defines functional phenomena as those which are evolutionarily significant and stylistic phenomena those which are not. If this definition for function is accepted (as opposed to the 'use' definition), then the argument becomes somewhat tautological, or, at least, not based in empirical logic, but in inference -- inferential because function is no longer an inherent property of an object, but is externally defined by what one <u>believes</u> is adaptive. Function thereby becomes a behavior correlate, albeit not at the level of a specific act.

At a more practical level, the use-wear classifications developed so far, although often very complex, reveal the nature of only very general kinds of activities (e.g., scraping, grinding, cutting, pounding). Furthermore, there is no reason to suppose that any single wear type represents only a single function, or that it necessarily even implies any function (see discussion of Patterson 1984 on "pseudo-tools"). Artifact species defined by wear do not, at this point, offer any advantages for diversity measurement than species defined by other classification systems.

This examination of the logic of use-wear classification demonstrates the unavoidability of inference in the archaeological interpretation of assemblage composition.

The Limits of Empiricism

With the methodologies currently employed, a research strategy that utilizes multiple approaches to the description and classification of assemblage components seems the most desirable. The studies focussing on assemblage-level diversity, while contributing important insights to non-cultural biases in the archaeological record and to devising objective measures of assemblage contents, do not make a direct connection with the cultural meaning of diversity from a theoretical perspective. Assemblage diversity, even as defined by functional classes which attest to evolutionary significance, only indicate the number of discrete activities performed in an artificially imposed spatial domain. Being able to operationalize theoretical concepts is of great importance in evaluating the worthiness of a measure as a tool for interpretation.

For those subscribing to an evolutionary paradigm, the importance of an eventual object-behavior connection must be acknowledged, since the units of variability in the paradigm are behavioral traits and not cultural products. Whether such a behavioral trait is referred to as seed-grinding or use-wear type 153 does not differentiate this basic behavioral connection. Failure to name behaviors in other than abstract and uncertain terms is a failure to incorporate assemblage data into what is known about real functioning cultural systems, and does not permit the eventual evaluation of any classification scheme for archaeological materials.

What assemblage level studies do show is that there is an holistic compositional attribute, diversity, that can be quantified. Assemblage-level studies only address the methodological issues of how to count responses and which responses are culturally meaningful. They do not sufficiently supply explanations as to why they are culturally meaningful.

Chapter 3

MACRO-SCALE ANALYSES OF ARCHAEOLOGICAL DIVERSITY

The review of archaeological literature on diversity presented in the preceding chapter suggests that micro-analyses do not in themselves offer enough information to aid in developing theories to explain assemblage content as an integrated cultural phenomenon. About this scientific predicament, Alland (1975:65) writes:

> "The exclusive use of radical empiricism in anthropology has already shown its weaknesses for the analysis and prediction of behavioral systems. Its concentration on directly observed [or, in the case of archaeology, objects that imply behaviors] at the expense of structural models has led to a theoretical impasse in the field of social structure."

Structure here refers to how a system is held together. A knowledge of individual behaviors does not reveal much about social maintenance or development unless they can be regarded as systemic behaviors that support a structural entity (i.e., a cultural system). The implication of Alland's statement is that to enter the realm of systemic, or macro-scale, analyses requires the abandonment of reliance on a chain of empirical logic, and to elaborate it with inferences based on theoretical models.

Some archaeologists investigating the diversity of material culture have taken a more deductive, theoretical approach to infer culture process in more explicitly evolutionary sense than the micro-analysts. Most of these researchers employ a strategy in which a model is developed to explain prehistoric behavior patterns. Researchers then demonstrate that the quality, quantity and distribution of cultural products in the archaeological record conforms to expected or predicted patterns. Thereby, the diversity concept becomes elevated from the role of merely describing numbers of objects to the role of describing a cultural behavior set which invites systemic explanation for its manifestation.

While an abundance of empirical and statistical methods to describe assemblages are also employed by macro-scale researchers, an essential message is that the artifacts do not speak for themselves. Making the connection between what is observed to a theoretical construct necessarily involves an inferential bias (Schiffer 1975:838). For those who study diversity at the cultural-level, the inferences usually center on the correlation of the condition of diversity with some systemic behavioral phenomenon. Advancing such correlations always involves intellectual risk, but their value to archaeologists, who would use them to explore the possibilities for the establishment of nomothetic principles for cultural development, is immense. Schiffer (1975:838) comments:

> "Correlates embody relationships between behavior and organizational variables of a sociocultural system and variables relating to the material culture and environment of that system. Correlates are powerful conceptual tools for the archeologists; without them, there could be no knowledge of the past."

This passage provides an appropriate introduction to the following three sections. Each section presents a different model which establishes archaeological criteria to be used as indicators of a structural behavior set. In each case, a specific kind of artifactual diversity is used to infer systemic cultural response(s).

These three macro-scale diversity models each pose a different set of behavioral correlates for the condition of diversity. All of the correlates are extremely plausible and are argued persuasively by their originators and/or defenders. Nonetheless, the question must be asked whether three different models of behavioral phenomena purporting to explain the same material phenomenon can all be valid, or whether they are competing theses.

Niche Width as Diversity

Subsistence strategies are a major basis for the classification of prehistoric culture types. Archaeologists derive information about subsistence practices from fossil fauna and flora at archaeological sites (Lyman 1982; Thomas and Mayer 1983), as well as from technological artifacts (Goodyear 1975). Notwithstanding the many criticisms aimed at inferring subsistence behavior from these data, assemblage variability in the form of resource diversity is the assemblage attribute most frequently reported to indicate the range of subsistence activities performed. Cultural groups are often referred to as 'generalists' or 'specialists' on the basis of the variety of resources upon which them are dependent (Orquera 1984).

A prime example of this type of subsistence categorization scheme is the "focal-diffuse" model proposed by Cleland (1976). In this model, he advances a universal principle underlying such a subsistence typology. Cleland contends that the diversity of cultural resource procurement will vary as a function of the diversity of available resources which, in turn, vary as a function of geographical latitude. That overall biotic diversity decreases with increasing distance from the equator is an established biogeographical fact (Pianka 1966), and dietary diversity is, indeed, limited by what is available. Like most global generalizations, this proposition rests on an underlying truth, but the scale at which the truth is evident makes it basically nonutilitarian for deriving local expectations. Yesner (1977:19) identifies one of the main weaknesses of the focal-diffuse gradient concept as failing to take into account the unequal distribution of resources along any given line of latitude, so that "even broadly similar biomes, such as forests and sea-coasts, can have very different local ecologies."

Yesner does, however, share with Cleland an environmentally deterministic outlook concerning the relationship between availability and utilization. For example, Yesner (1977:28) remarks that "as a result of the abundance and diversity of resources ... the region supported a large human population in prehistoric times." The logic of Yesner's explanation for demographic shifts on Umnak Island in the Aleutians (supported by a correlation of length of occupation with degree of local diversity) is marred by its ultimate reliance on his deterministic premise between availability and utilization.

Examining the same phenomenon (resource utilization) at vastly different scales (macro- versus micro-environmental), both Cleland and Yesner fail to consider that all cultural groups in a designated biotic zone may not exploit resources in an identical manner. While neither author explicitly denies this possibility, their respective models do not accommodate it. An essential kind of distinction not made in these models of exploitation practices is that between the complete range of possibly exploitable resources and the actual range of resources exploited. This distinction is clarified in a model proposed by Hardesty (1972; 1975; 1980), which evaluates human subsistence behavior in terms of the ecological niche.

The 'niche' concept has found wide application in ecology, and Hardesty regards it as an appropriate and flexible concept for characterizing cultural subsistence behavior. In a 1972 paper, Hardesty presents of review of how niche-like concepts have crept into anthropological analyses, and refines the definition that he feels has the most cultural relevance. Of the various definitions proposed to describe the highly abstract notion of ecological niche (e.g., position in the total environment, an organism's way of life, adaptive zone), Hardesty (1972; 1975; 1980) advocates the Hutchinsonian definition of niche as "a multidimensional hypervolume, i.e., an imaginary space of many dimensions in which each dimension, or axis, represents the range of some environmental condition or resource that is required by the species (Brown and Gibson 1983:47)." This definition, although perceptually less tangible and operationally more complex than most others, is considered more attractive to Hardesty primarily because it does not oversimplify the niche concept.

A most useful distinction that can be made using the niche concept is that between the 'fundamental niche' (the complete range of environmental conditions in which a species can survive and reproduce) and the 'realized niche' (the actual environmental conditions in which a species survives and reproduces; Brown and Gibson 1983). Because Cleland and Yesner have implicitly equated these two domains, their models ignore some dynamic factors, besides availability, such as competition, which may affect dietary resource selection.

According to Hardesty (1975:72), "the usefulness of the niche concept to studies of man-environment interaction lies precisely in its implications for defining ecologically distinctive human groups." Because the concern of the anthropologist is with the distinctiveness of human groups, niche dimensions shared by all members of the species can be taken as constant and eliminated from further analysis. Among those dimensions which do indicate distinctiveness are the number and kinds of dietary resources selected, as well as their acquisition in time and space. All of these niche dimensions have received the attention of archaeologists, though not usually in the same conceptual framework as Hardesty's.

The dimensionality of niche conponents implies that they are measurable and, of course, for purposes of comparison they must be. Niche 'width' is the usual measure, and is defined as the total range of resource values used by the organism (Hardesty 1975:72). According to this definition, the realized niche is what is measured. The limits of perception and methodology generally produce niche width measurements based on one or a few niche dimensions selected on the basis of their behavioral observability (for purposes of data collection) and distinguishability (for purposes of intraspecific comparison).

Roughgarden (1972:683) defines niche width specifically as "the variety of resources a population exploits." However, any dimension chosen to represent niche width -- number of resources, biomass, nutrient content, toolkit, space, etc. -- may be considered as having its range of values represented by a resource axis (the x-axis in Figure 7). A more refined notion of resource exploitation patterns can be gotten by adding a utilization measure (the y-axis in Figure 7) to the model. Figure 7 shows how a distinctive resource utilization curve results from the combination. Obviously, the shape of the curve is bound to vary for the same population depending on how one chooses to operationalize the resource and/or utilization variables. A resource utilization curve, whose

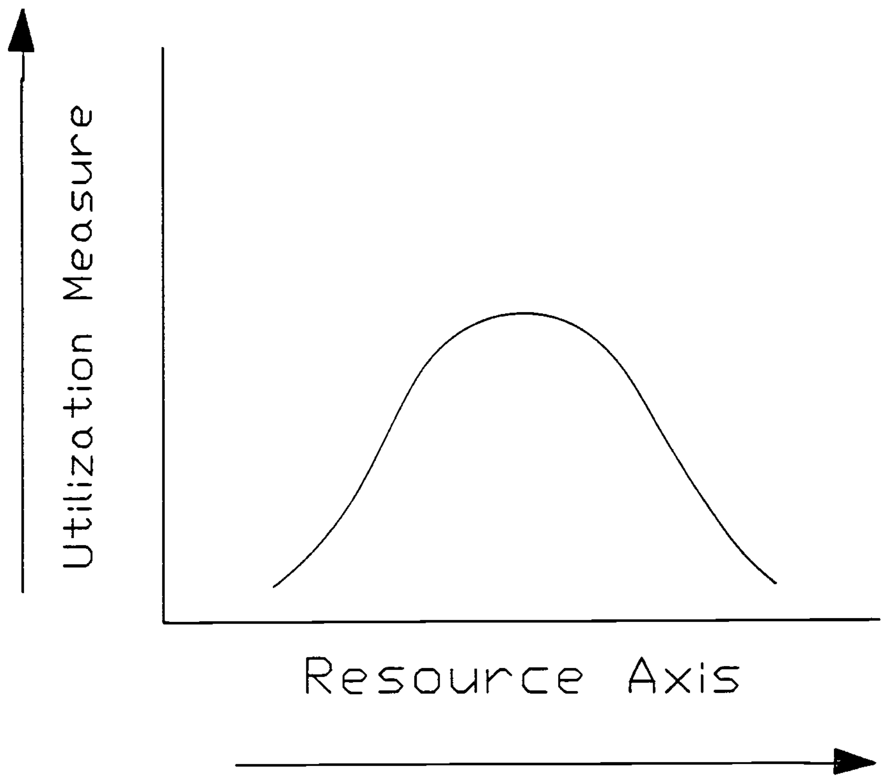


Figure 7. Generalized resource utilization curve. The curve represents the niche width as defined by the relationship between a single resource dimension and a utilization measure.

resource axis is based on protein content per resource taken, will differ from one based on number of resources taken. Likewise, a utilization measure based on capture rate will produce a different curve from one based on biomass consumed.

Resource variety (number of kinds of resources) is the niche dimension most accessible for archaeological discernment, as mentioned previously, and, the degree of utilization of each resource is inferred generally from the proportional representation of resources in the assemblage. Number of kinds of things and their distributions are the components of assemblage diversity. A diversity measure is exactly what Hardesty (1975) uses to calculate niche width for the dimension of resource variety. The measure, of course, can also be used for other suitable dimensions.

While the diversity measure is more or less identical to those employed in assemblage-level studies, the more important aspect of the niche width model is the interpretive framework in which the niche concept is enmeshed. Accepting the multi-dimensional character of the niche means realizing that variability along a particular resource dimension need not be the only meaningful source of variability. For example, for the cases of the nomadic hunter-gathering group of Australia and the sedentary hunter-gathering group of the Northwest coast of North America resource variety may be the same. The dimension truly differentiating their respective realized niches would be resource density. If one hypothesizes that a niche dimension is capable of distinguishing groups on the basis of subsistence strategies, one can test such a hypothesis by demonstrating that meaningful variability exists in that dimension by making comparisons between groups in which other dimensional variables are fairly similar. Hardesty (1975) warns that the cultural niche width in terms of resource variety cannot be properly interpreted without knowledge of both the environmental distributions of resources and cultural groups. Therefore, archaeologists, who often lack good contextual data, must take especially great care in interpreting diversity of resources exploited as an absolute measure of niche width.

Despite the stringency of the data requirements and the interpretive complexity of the niche width model of subsistence diversity, the model offers archaeology a means to determine the significant variables that will reflect behavioral variability in resource acquisition. Appropriate interpretation of niche width measurements demands a systemic view of man-environment interactions.

Complexity as Diversity

The concept of cultural complexity has received a great deal of attention in both general anthropological and archaeological literature. The phenomenon of social complexity has been researched and evaluated well by cultural anthropologists, and their theoretical explanations for it have been applied frequently to archaeological contexts. From a traditional anthropological perspective, the notion of diversity might be equated easily with that of complexity. But, if archaeologists wish to reserve the diversity attribute for material culture, then the relationship between diversity and complexity must be specified as a behavior-product correlate. The logic of the connection is this: more complex societies are distinguishable by having more behavioral responses than less complex groups, and the greater number of behavioral responses results in a greater diversity of cultural products. Cultural anthropologists have long concerned themselves with establishing the former criterion of complexity and archaeologists with the latter.

In textbook cases, the diversity of material culture as a function of social complexity seems self-evident: the simple material culture of leaderless, mobile, band-level societies versus the elaborate material culture of hierarchically-structured, sedentary, agricultural societies. But, a society's acquisition of a complex structure is a gradual process, and, archaeology, which examines such diachronic processes, must have some finer-grained criteria for elucidating the process of complication. New archaeological nomenclature for social types indicate the inadequacy of the conventional, discontinuous scale of complexity for interpreting archaeological evidence. The "complex foragers" of Price (1981), the "egalitarian agriculturists" of Sherratt (1982), and Binford's (1980) "forager-collector" distinction are examples of the specifically archaeological terminology which has been created to fill the gaps.

Peebles and Kus (1977), for example, are displeased by the qualitative definition of a ranked society, or chiefdom, as one based on redistribution practices (Pasternak 1976:19; Fried 1967:115; Service 1975:75). To them, a chiefdom is better considered an attained grade of complexity which can be relatively measured against other societal types. This can be accomplished through a mathematical assessment of the "quantity of information that can be processed by cultural systems," because, "where the capacity of the individual components can be held constant, it is the structure and organization ... that are the critical elements in the ability to process information (Peebles and Kus: 428)." Peebles and Kus (1977) recommend several archaeologically discernable variables which may be used to measure the degree of information processing ability extant in a culture. They identify "five major areas of variability distinctive of chiefdoms (p. 431):" (1) the ranking of persons, which may be quantitatively evaluated from mortuary practices, (2) a hierarchy of settlement types and sizes, (3) local subsistence autonomy, which would be evaluated in terms of ecological diversity, (4) the organization of suprahousehold production, evaluated in terms of evidence for craft specialization and projects requiring organized labor, and (5) the presence of social strategies for mitigating systemic perturbation (e.g., storage for possible resource shortages, or defense works to stave off invasion).

Ames (1985), while in full agreement with the information processing hypothesis, feels that the complexity criteria established by Peebles and Kus are constrained by their directed applicability to the agriculturally-based chiefdom case. Ames modifies the criteria somewhat, so that they are more appropriate for the cultures of Northwestern North America. Ames' criteria consist of: (1) logistical organization, or site differentiation within settlements, (2) domestic organization, whose complexity is particularly evidenced by architectural style, (3) elaboration of material culture beyond subsistence requirements, (4) mortuary practices, and (5) intensity (i.e., more efficient methods) of resource exploitation and storage.

The two presentations are quite similar and most of the behavioral criteria can be thought of in terms of production of more kinds of things. Sometimes a greater number of product classes is not the obvious basis for a judgment of greater complexity, such as the substitution of one architectural style for another. In such a case, behavioral variation may be inferred, perhaps, on the basis of the social organization consonant with building size and layout, or on the basis of the cooperative labor requirements for construction.

The local resource autonomy criterion of Peebles and Kus, is a sufficiently documented circumstance and one that provides an easily quantifiable variable. The establishment of such a criterion, however, begs the question of whether a culture group, that pools and/or redistributes resources not uniformly available to all, is less likely to be as complex as cultures in which resource access is more equalized. They stress this point in their 1977 paper in order to dispel the myth of redistribution, and it is a legitimate argument for their Moundville case. Nonetheless, designating a locally diverse resource base necessary for complexity seems inconsistent with the other criteria which emphasize that "structure and organization ... are the critical elements." Ames' criterion of intensification in terms of production methods and productivity (which may involve resource diversification) is more straightforward as regards behavioral complexity. Intensification is, in fact, implied by Peebles and Kus in their other criteria indicating resource production beyond subsistence demand.

Neither Peebles and Kus nor Ames develop a numerical measure for cultural complexity in their papers. The archaeological correlates for complexity which they offer, however, do seem conducive to measurement using artifact and feature diversity. To apply a quantitative diversity measure to the archaeological manifestations of the complexity phenomena, there should be a simplification (or homogenization) of the units of variability so that some value equivalency exists between the units of variability. Although these authors do not explicitly deal with the processual uniformity which underlies each of their complexity correlates, this uniformity may be considered as behavioral differentiation.

Since differentiation can be defined as the process by which partitioning takes place ("evolution from multi-functional role structures to more specialized ones," Smelser 1963:106), and the condition of complexity defined as "that which is composed of many interrelated parts (Price and Brown 1985:7)," the relationship between the process and its consequences is self-evident. Thus, differentiation is the inferred process which links the products of the archaeological record with a theory of cultural development circumscribed by a condition of complexity.

Plog (1974) uses just this concept of differentiation as one of the "dimensions" (variables) in his cultural growth model. Plog feels that he can operationalize cultural differentiation as a measurable variable in the archaeological record by defining the differentiation process in terms of its consequences in the form of material remains. Plog (1974:58) posits the following definitions of differentiation at various behavioral levels:

> "a. Differentiation is the number of different activities performed in a given place in a given time.
> b. Specialization is a measure of differences in magnitude and discreteness of different activities within the aggregate.
> c. Individual specialization is the percentage of activities that a given individual performs in relation to the aggregate of activities performed by the group of which he is a member."

All three of Plog's definitions rely on a quantitative attribute ("number of," "measure of differences in," "percentage of") of activities performed, thus supporting a behavior-product correlate. Moreover, in ascertaining that differentiation occurs at several social levels, Plog helps to make the broad concept of complexity more manageable for purposes of measurement (although differentiation in the form of "individual specialization" would be difficult to verify archaeologically).

The archaeological investigation of cultural complexity has led to attempts by investigators to identify sub-systemic components which reveal the process of social complication. A universal result of this method has been to identify increasing variability in a number of components as a key criterion by which to measure relative complexity. A major problem in quantifying cultural products as processual correlates is that a one-to-one correspondence is not necessarily implied. That is, a single class of behavioral differentiation may result in a variety of cultural products, or a single cultural product may be contingent upon the cooperation of several orders of behavioral differentiation. In order to synthesize individual component measurements of variability into an overall measure of cultural complexity, decisions must be made at a theoretical level regarding how to evaluate the scale of differentiation required to produce various archaeologically visible phenomena.

Stress-Response as Diversity

The complexity and niche width models focus on diversity as a criterion for drawing conclusions about an attained systemic condition which defines a societal group along some attribute continuum. This section describes a behavior-product correlate that is phenomenologically distinct from the other approaches. Reid (1978) uses macro-scale diversity to establish the occurrence of intrasystemic fluctuations which represent episodic responses of a cultural group, rather than generalized developmental responses.

Reid's perspective arose from a diachronic analysis of occupation events at a pueblo site in the Southwestern United States (Grasshopper Ruin, Arizona; Reid 1978). The phenomenon examined was the founding, rapid growth, and eventual abandonment of the pueblo occurring within a 125 year time span. Reid believed he would be able "to isolate two contrasting sets of behavioral data, one representing procurement behavior and artifacts of the aggregation period, and the other representing those of the abandonment period (p. 202)." The basis for distinguishing the two behavior sets was the change in the diversity of assemblage content through time. The fact that assemblage diversity was greater for the aggregation period led Reid to reason that the systemic condition which promotes diversification is also responsible for the aggregation phenomenon. The hypothesis that Reid ultimately tests is that the aggregation phenomenon is a response to stress, and is predicated on the assumption that assemblage diversity is a measure of stress-response.

The idea that diversification is a response to stress emanates from Reid's "general systems-ecological framework." A widely held opinion among ecologists is that diverse biotic systems, such as tropical rainforests, are also stable systems (Harris 1972:182). This precept has been adopted avidly by culture theorists. Yellen (1977) and Yesner (1980) regard mobility in hunter-gatherer groups as a stabilization feature of their subsistence strategy because, through it, the resource base is diversified. Even authors who view more specialized economies as viable adaptations agree that diversification is an inevitable, albeit temporary, response to unusual stress (Cohen 1977; Cleland 1976). Peebles and Kus (1977) also state that the diversification that accompanies increasing complexity also has the function of allaying stress. This diversity/ stability principle is also supported by Hardesty (1975), although his niche width model does not depend on it.

To test his hypothesis, Reid (1978) had to equate characteristics of assemblage variability with stress behaviors. He selected the following as archaeological correlates of stress-related behaviors:

> "(1) the diversity of animals procured for food
> (2) the diversity of plants procured for food
> (3) the use of normally unused domestic animals as food resources
> (4) the use for food of 'scrubby' animals, those with a lower ratio of usable meat to total biomass
> (5) the diversity of implements and facilities used in food procurement and processing (Reid 1978:203)."

These archaeological variables are rather similar to those that would be applied to a determination of niche width along the dimension of resource variety. The crucial distinction is, again, a conceptual one. The assumption underlying Reid's (1978:200) approach is that only stress causes diversity. The niche width measurement does not place the qualifying constraint of necessity on subsistence diversification behavior, as is implied in the stress model. Diversity as a result of environmental opportunism, or from imposed cultural values, is not admitted in Reid's model.

The results of Reid's analysis of the Grasshopper Pueblo data was disappointing in view of his conscientiousness in developing the testing strategy and the general acceptability of his basic hypothesis. Using a form of the ecological diversity index to obtain values for each of the five above-named variables, only two of the variables had clearly greater diversity in the aggregation period than in the abandonment period. While these results are equally as inadequate for demonstrating that the stress/aggregation hypothesis is false, they do suggest that stress (i.e., perturbation) as a single cause for diversification is too extreme a viewpoint. Moreover, there is an inherent lack of specificity in the particular criteria chosen by Reid to represent stress responses in the archaeological record. Refinements in both theoretical justification and methods of measurement are necessary to determine "whether variations in diversity actually reflect variations in human behavioral responses (Reid 1978:209)."

Behavioral Diversity Measures: Conflicting or Complementary?

Each of the cultural-level approaches to diversity builds on the fundamental aspects of meaning and measurement addressed in the assemblage-level studies. But, the structural frameworks introduced in the macro-scale analyses heighten the awareness of the inadequacy of isolated assemblage data to give much information about systemic behavior. The efficacy of the cultural-level diversity measures is not only dependent upon inferring structural linkages to interpret evidences of behaviors, it also requires a substantial contextual scope. Archaeologically, however, the advantages of the systemic approaches to understanding assemblage diversity may be offset by the difficulty involved in controlling for sources of error and ambiguity.

Diversity as a correlate for complexity is defined in terms of social structure; diversity as a correlate for niche width is defined in terms of ecological structure; and diversity as a correlate for stress-response is defined in terms of structural stability. The intention, clearly, is for each of the respective measures to evaluate some discrete cultural attribute, the discreteness of which is apparent, at least, in an ideological sense. This discreteness, however, is not so evident in the archaeological record. Some sorts of artifactual materials are obviously more appropriately counted as manifestations of one behavior type more than others, but, in just as many other instances, unambiguous assignments cannot be made. The appearance of agricultural implements in a cultural assemblage may be taken as an indication of increasing complexity, an altered niche width, demographic stress, or all three in combination. The interrelatedness of all three behavior sets is undeniable, and this situation, in fact, may be more helpful for interpretation in the long run. The niche width concept, for example, could add a great deal more analytical flexibility to the diversity-stress hypothesis. Likewise, Reid's stress model suggests that short-term temporal variation may occur within a larger cultural trend, the ignorance of which could lead to archaeological misinterpretation.

If archaeologists wish to pursue the quantitative meaning of assemblage diversity in terms of qualitatively different components of systemic cultural behavior, they must be able to determine to what extent, if any, the effects of structurally different behaviors can be separated in the archaeological record. Before doing so, however, a more expedient method might be to examine the relatedness between the structural behavior sets in terms of producing relatively more diverse cultural inventories. If diversity across behavioral domains can be shown to be positively correlated phenomena, diversification can then perhaps be seen as a more general behavioral process which transcends the processes described in the individual behavior set models. If the opposite is true, and variability across behavioral domains is not predictably correlated, then, at least the search for distinctive behavior-product correlates can be pursued with more confidence.

Because of the uncertainty which surrounds the correlation of assemblage diversity with behaviors, the testing of these propositions in archaeological contexts may not be very productive. A more sound tactic is to bypass the material culture correlate and examine the relationship between behaviors imputed to produce artifactual diversity. To do this requires the use of data derived from ethnographic sources.

Chapter 4

BEHAVIORAL DIVERSITY IN THE ETHNOGRAPHIC RECORD

The Independence of Systemic Behavior Sets

This investigation of archaeological assemblage diversity began with the consideration of diversity simply as a quantitative attribute of collections. As a descriptive device alone, a measure of diversity has little utility for archaeological interpretation unless diversity can be regarded as a behavioral phenomenon. The assumption of a more or less one-to-one correspondence between behaviors and products provides the basis for assigning site function in micro-scale analyses, but is a limited way to characterize cultural groups. The more theoretically-grounded arguments in Chapter 3 associate scale of product diversity with systemic behaviors.

All of the diversity approaches measure types of artifacts and their distributions directly, and assume an ultimate correlation between artifacts and behavior. An assumption common to all of the studies is that the diversity of artifactual assemblages may be inferred as resulting from any one of, or several, structural behavior sets.

Inference is an important component in archaeological interpretation. Yet, all of the archaeological diversity models suffer from a dependence on inference for which there is little observational justification. Very little is actually known about the relationship between behavioral diversity and its effects upon product diversity. On what basis is a particular behavioral cause for assemblage diversity deduced from assemblage content?

In the discussion of the archaeological models of cultural-level diversity at the end of Chapter 3, the suggestion is made that structural behavior sets, which produce artifactual diversity, may be interrelated. In the models, however, different structural behavior sets are assumed to produce unique, identifiable sets of artifactual evidence. The models do not consider that other kinds of structural behavior may produce the same effects in the archaeological record. A review of the artifactual criteria presented for the archaeological models of diversity clearly indicates that the criteria often overlap.

One of the first steps to clarifying this dilemma is to explore the question of whether diversity-producing behaviors occur independently of one another. To examine this proposition effectively requires that behaviors be evaluated first-hand, since the legitimacy of the behavior-product correlates is what is being called into question.

In archaeological studies of diversity, the assumption is made that artifacts imply certain behaviors. In the following analysis, the assumption is reversed, namely, that behaviors produce artifacts. With this approach, the kinds of artifacts produced does not matter. The countable units of diversity change from objects to cultural traits. This corresponds to the cultural analogy of the evolutionary process of diversification outlined in chapter one (Figure 2). In the cultural analogy, behavioral responses are the analog of biological traits.

The review of the archaeological models of cultural diversity permitted the realization that the attribute of diversity can be a legitimate substitute measure for the more conventionally used attributes of group size, complexity, subsistence, and stress-response. Initially, behavioral diversity was inferred from artifactual observations on the basis of the correlates between behavioral and product diversity. The strategy applied in the following analysis is to avoid inferential reasoning by using ethnographic observations to define and measure behavioral diversity. If the ethnographic variables are deemed acceptable as measures of the kinds of behavior linked with artifactual diversity, then the results of this analysis should provide some useful insights for interpreting the archaeological record.

The idea of counting behaviors directly, however, is not as straightforward as the one-to-one association between artifact type and behavioral response assumed in the archaeological analogy. Cultural traits are best thought of as sets of related behaviors. As the countable units is a diversity measurement, the trait or traits present must be treated as a fraction of the total number of traits possible. The calculation of this ratio for the range of possible human behaviors is practically impossible. Therefore, operationalizing a diversity measure for behavioral traits necessarily entails the introduction of an appreciable degree of artificiality. This does not destroy the logic underlying the measure, but does limit the opportunity for very precise numerical treatment.

The archaeological diversity models in Chapter 3 provide the basis for choosing the behavioral traits to be analyzed. Selecting these traits supplies a reasonable foundation for presuming that cultural possession of these traits produces archaeologically visible products. The method adopted for quantifying behavioral diversity, which must conform to the character and limitations of the data base, is described next.

Description of the Method

Because of the universality of questions surrounding the general interpretation of archaeological assemblage diversity, the cultural behaviors selected to investigate the behavior-product correlates also should have a universal character. Furthermore, the units with which the behavioral traits are associated should have a broad geographic representation in order to avoid problems of similar effects resulting from cultural or environmental similarity. These requirements invite the use of what is referred to as a hologeistic (whole-world) cross-cultural (comparative) method, also called the 'holocultural' method (McNett 1979:40). The basic strategy adopted in the holocultural method is to measure theoretical variables in a world-wide sample of human cultures in order to examine statistical correlations among those variables (Naroll et al. 1974:121). The questions addressed in this kind of analysis are usually stated in the form of a scientific hypothesis to be rejected or accepted depending on the values of correlation coefficients. The intention in the present study of behavioral traits as indicative of response diversity is primarily exploratory in nature. Nonetheless, the basic proposition tested can be presented in the form of the null hypothesis as follows: cultural behaviors, to which product diversity is attributed, occur independently in cultural groups.

Nature of the Data Base

The data requirements of the holocultural, comparative method are immense, and to assemble the appropriate information on a study-by-study basis is generally beyond the capability of individual researchers. To date, the largest single compilation of systematically organized ethnographic data is that contained in the Human Relations Area Files (hereafter referred to as the HRAF). The HRAF has served as the data bank for most statistically-oriented hologeistic studies in anthropology since its inception in the 1930's, and, in fact, makes such studies feasible (McNett 1979; Lagace 1974). The summary information on world cultures contained in the HRAF are most accessible for statistical analysis in a form suitable for direct computer processing. The 1170 culture World Ethnographic Sample, a numerically-coded data set of the HRAF data base, is comprised of information about cultural traits. The World Ethnographic Sample is simply a compiled data bank and is not a representative sample in any more refined statistical sense.

The Standard Cross-Cultural Sample, consisting of data for 186 cultures, most of which are included in the World

Ethnographic Sample, is the data base employed in this study. The Standard Cross-Cultural Sample was created to facilitate inter-study comparability, which is impaired if researchers independently choose their own samples from the larger data set (Murdock and White 1969:331). The cases included in the Standard Cross-Cultural Sample have been selected on the basis of the quality and duration of the ethnographic work from which the data was derived, geographic representativeness, as well as culture 'province' representativeness (for details of selection criteria, see Murdock and White 1969). Considering the limitations of the data base from which it was drawn, the Standard Cross-Cultural Sample is regarded as a sufficiently representative sample of world cultures containing the most complete and trustworthy data available. A list of the 186 cultures in the Standard Cross-Cultural Sample and maps showing their geographic distribution are given in Appendix A.

Despite the care taken in the derivation of the Standard Cross-Cultural Sample, it is not ideal in every respect. Some of the shortcomings may be resolved by the acquisition of more data and improved data quality, as well as by increased consistency and accuracy in data coding procedures. Other weaknesses, however, are due to inherent ambiguities in anthropological definitions, and in the method of statistical comparison itself. The problems of cross-cultural sampling methods have been frequently reviewed, and Naroll (1970) summarizes what he believes are the major problem areas. His list is duplicated in Table 1.

Using the Standard Cross-Cultural Sample means accepting the unit of analysis defined by the data base. In this case, the unit of analysis is the cultural group. A cultural group, identifiable on the basis of shared activities and residential proximity, is a subset of a larger cultural entity. The larger 'culture' is usually defined by some broader criterion/criteria, e.g., a linguistic family and/or some other inter-group similarities. Although a group selected for inclusion in the Standard Cross-Cultural Sample is assumed to be somewhat representative of a larger cultural entity, the information recorded is for that particular group and is not pooled from a larger set of observations.

Several researchers advocate the cultural group as the appropriate unit of analysis for investigating behavioral variability. Although Kirch (1980:118) asserts that behavioral variation originates at the level of the individual, he recognizes that "human groups characteristically act as functional units both in decision making and carrying out those decisions," so that "individual behavior is constrained by the group as a whole." Hardesty (1975:74) likens the local cultural group

Table 1

Summary of Problems Encountered
with the Cross-Cultural Survey Method

* Sampling
* Societal Unit Definition
* Data Accuracy
* Conceptualization, Classification, and Coding (e.g., emic vs. etic, etc.)
* Galton's Problem (cultural diffusion)
* Causal Analysis of Correlations (e.g., direction of causality)
* Paucity of Relevant Data
* The "Dredging" Problem (chance correlations)
* General Problem of Statistical Significance
* Regional Variation
* Deviant Case Analysis

Rewritten from Naroll (1970:1229-1230)

to the "'cultural species' with distinctive ecological characteristics" that is "equivalent to the ecological population at simple cultural levels." In addition, most archaeological sites represent the activities of localized groups. The assignment of archaeologically-known groups to larger culture 'types' is often tentative and obscure. The ethnographically known culture group is probably the best analog for the social units presumed to have created archaeological assemblages. Thus, from a number of different perspectives, the cultural group is a desirable analytical unit.

In sum, the Standard Cross-Cultural Sample provides an acceptably representative collection of ethnographically documented cultural groups. The organization of the data by cultural group is most appropriate for both the method and the goal of this analysis. Furthermore, adequate behavioral information for each group in the form of coded variables is present.

Variable Selection and Operationalization

Descriptive traits for the culture groups in the Standard Cross-Cultural Sample are drawn from the HRAF. In computer processable form, the traits are coded as nominal or ordinal level variables. The traits examined in this analysis are those which archaeologists have theoretically correlated with product diversity. Based on the contents of Chapters 2and 3, four prominent traits are selected: (1) group size, (2) subsistence base, (3) organizational complexity, and (4) stress responses.

A major criterion for variable selection was that the levels of behavioral diversity operationalized should be consistent with levels of diversity that are archaeologically discernable. All of the cultural traits chosen for measurement are presumed to be associated with the production of artifactual variety. The following sections define each of the four variables in detail, offer a justification for their selection, and explain their operational forms.

The Group Size Variable

Empirical, assemblage-level studies of archaeological diversity show that artifact sample size accounts for much of the variety observed in archaeological assemblages. The spatial positions of artifacts, however, cannot be characterized as entirely random. To the extent that artifact sample size is attributable to density, artifactual diversity due to sample size is also a behavioral effect. Other things being equal, greater artifact density implies greater intensity of production (in terms of users or duration of use) which, in turn, implies a larger number of producers. An increase in number of individuals behaving also increases the likelihood for behavioral variability. Group size, therefore, influences diversity, and group size is a structural trait of a cultural group.

Two important demographic factors contribute to diversity: the size of the population and its organization in space. A numerically large population with limited interaction may affect variability to the same degree as a small population that consistently interacts. A variable that combines the effects of both factors is considered most desirable.

The sample data base includes two variables for group size: population size (number of individuals) and population density (mean density of population in the territory controlled or exploited by the group). The density variable was chosen to indicate group size because it incorporates a spatial component and its estimate requires less specific knowledge of the group than the population size variable. This latter feature makes the measure more compatible with the kind of information available for prehistoric groups.

The organizational component of the new group size variable was supplied by a relative measure of 'settlement compactness.' This variable defines four degrees of settlement compactness: (1) dispersed, (2) partially dispersed, (3) partially compact, and (4) compact.

The originally assigned values for the population density and settlement compactness variables are given in Figure 8. The new composite variable for group size is the sum of the values of both for each case. However, since some of the density values are represented by few or no cases in the sample, the original seven categories were collapsed into three. The lowest value, 1, was assigned to the least dense populations. The numerical values for the compactness variables were adjusted so that each different pairing of the two values results in a distinct sum. Dispersed groups receive lower values than more compact groups. The procedure used to construct the new composite variable is schematically shown in Figure 8.

The values for the composite variable for group size range from two to thirteen with low-density/highly-dispersed groups at the bottom of the scale, and high-density/highly-compact groups at the top of the scale. Cases with high values for this variable are interpreted as being more diverse than those with lower values, based on the premise that larger and residentially more integrated populations exhibit greater behavioral diversity.

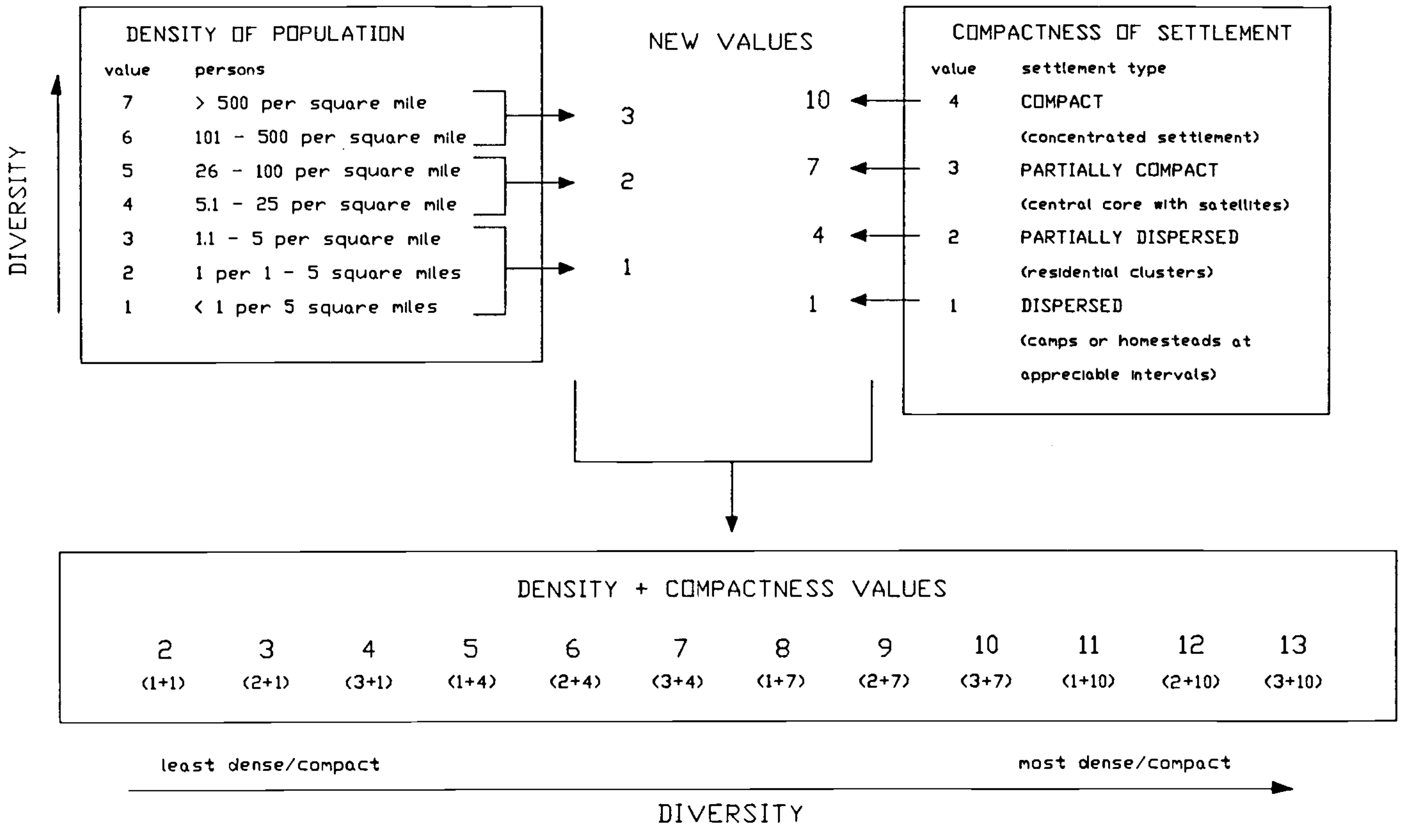


Figure 8. Schematic showing how coded variables for population density and settlement compactness were recoded as a single variable that simultaneously records both traits.

The Subsistence Variable

Niche width is a useful concept for defining the diversity of a group's resource base. The assumption is that groups utilizing more kinds of resources practice more different kinds of behavior in relation to them. Archaeologically, the persistent problem is how to evaluate resource utilization practices. Ethnographically, this is not so difficult. HRAF contains much information on subsistence practices, and several coded variables record specific subsistence-related traits.

The subsistence economy variable selected from the coded data is one that evaluates a group's dependency on a few generalized subsistence strategies. The five subsistence strategies considered are: gathering, hunting, fishing, animal husbandry, and agriculture. These five constitute the major types of subsistence activities, with the notable exception of trade. The range of activities considered does not have to be exhaustive to evaluate some degree of behavioral diversity. Nonetheless, a group highly dependent on trade for subsistence goods will most likely have a low score in this category. This is an inherent weakness of measuring niche width as direct procurement behaviors rather than as resources utilized. In using this variable, then, an important fact to keep in mind is that behavioral diversity is what is being measured, not resource diversity.

The form of the subsistence economy variable code presents an opportunity to operationalize separately the richness and evenness components of subsistence behavior diversity. Each case in the sample is assigned a value (from 0 to 9) for each of the five subsistence activities. The value corresponds to approximate percent dependence of the group on that activity for subsistence needs (e.g., a value of 5 for an activity means that 50% of a group's subsistence behavior is devoted to that activity). A value of zero indicates that the activity is not practiced by the group to any appreciable extent (i.e., less than 10% dependence); a value of 9 indicates that the group almost exclusively practices one kind of subsistence activity (i.e., greater than or equal to 90% dependence). The sum of all five values for any case is always equal to ten. Therefore, values for all activity categories is always the same. The summed value for all five activities cannot be used as originally coded.

Two new forms of the variable were devised for use in this study. The first measures number of subsistence strategies practiced (richness) by converting the percentage values to denote presence/absence only (0 or 1). Presence/absence values are then summed for all activities for each case. The total richness value for any case will fall within the value range of one to five, indicating total number of subsistence activities practiced by the group.

The other new variable measures the degree to which subsistence behavior dependence is distributed among the subsistence strategies practiced (evenness). Groups whose dependence is more evenly distributed across behavior types are, by definition, more diverse. The measure of evenness was mathematically defined as the standard deviation of a group's dependency values from that group's mean dependency value. The mean dependency value was calculated on the basis of the number of strategies employed in each individual case. The standard deviation formula used was:

$$\sqrt{\frac{\sum(\bar{x}_i - x_i)^2}{n}}$$

where: $\bar{x}_i$ is mean of the five dependency values for a given case; x_i is the dependency value for activity category for a given case; and n is the number of subsistence activities practiced for a given case. Groups with smaller standard deviations have greater behavioral evenness. As in other measures of evenness only, groups that practice a small number of subsistence practices equally will obtain values as low as those for groups that practice a larger number of strategies equally.

Dividing the subsistence economy variable into two measures of behavioral diversity allows the relationship between the richness and evenness components to be evaluated for subsistence-related behaviors (chapter 5).

The Complexity Variable

As discussed in Chapter 3, many behavioral correlates for cultural complexity have been proposed. Ten coded HRAF variables are offered as indicators of a cultural group's relative complexity (e.g., sedentism, population density, distribution of wealth and/or power, etc.). Many of these traits, however, do not measure complexity as degree of behavioral differentiation. Instead, they measure an apparently conjunctive condition (e.g. sedentism). Others do measure structural differentiation, but usually in terms of very specific behaviors which are unlikely to be archaeologically discernable (e.g., level of political integration). Moreover, the baseline for building the scale of increasing differentiation often starts with a fairly complex form, and is not appropriate to many prehistoric contexts (e.g., writing and records, agricultural development).

A focus on degree of structural differentiation as the key component of cultural complexity restricts trait selection to purely behavioral traits as opposed to contextual ones, such as population density. Also, to accommodate as many cultural contexts as possible, a primary level of differentiation should be considered. These requirements led to the use of the coded data for number of technological activities performed and the degree to which sex-role specialization occurs for those activities. Two levels of behavioral differentiation are measured simultaneously.

The choice of technological behavior categories is consonant with the views that behavioral complexity involves the "elaboration of technology." in which "new materials and techniques are employed (Price 1981:69)," and that "differentiation is the number of activities performed at a given place at a given time (Plog 1974:58)." Division of labor by sex is a primary form of functional differentiation (along with age-specific task differentiation) in production activities. Although sex-specific behavior cannot be empirically known in the archaeological record, archaeologists sometimes interpret discrete activity areas as evidence of functional differentiation of a similar structural order of complexity. In some cases, the spatial discreteness of specialized activity areas suggests that specific task groups performed the activities.

Coded sample data exists for fifty technological activity traits, and includes information about the division of labor by sex for each activity. Both activity presence and degree of sex-role specificity are combined in a single variable. Zero values are assigned to culture groups that do not perform an activity. If the activity is present, the group is assigned a value corresponding to participation by sex. In the original coded form, degree of sex-role specificity is a nominal variable in which different numerical values only distinguish different proportions of male-female participation in the activity (Figure 9). Since the component of interest is the degree to which behavior is differentiated by sex, and not which sex does the behaving, the coded values were changed to denote an ordinal scale of sex-role specialization. Figure 9 shows how the nominal scale was altered to reflect an ordinal scale of complexity. The result was to create a variable whose values ranged from zero to four with the most differentiated groups assigned the highest values.

Of fifty technological activity variables available, six were selected for creating the new complexity variable. The six are all production activities, namely, the production of mats, baskets, clothing, houses, wooden objects, and metal objects. Their selection was based primarily on their being well-represented by cultures in the sample. Furthermore, the six traits selected are not apparently biased against any or most groups on grounds of impracticality (e.g., boat-building), or availability of raw materials (e.g., hide-working, although local extraction of materials is not a prerequisite for manufacture). Another reason for emphasizing manufacturing activities is because manufactured goods are recoverable archaeologically. Overall, the set of manufactured items

ORIGINAL CODING FOR TECHNOLOGICAL ACTIVITY VARIABLES

0 = ACTIVITY NOT PRESENT
1 = EXCLUSIVELY MALE
2 = PREDOMINANTLY MALE
3 = EQUAL SEX PARTICIPATION → 1* 2* 3*
4 = PREDOMINANTLY FEMALE
5 = EXCLUSIVELY FEMALE

NEW CODING FOR TECHNOLOGICAL ACTIVITY VARIABLES

1* = NO BEHAVIORAL DIFFERENTIATION ON THE BASIS OF SEX
2* = SOME BEHAVIORAL DIFFERENTIATION ON THE BASIS OF SEX
3* = COMPLETE BEHAVIORAL DIFFERENTIATION ON THE BASIS OF SEX

Figure 9. Schematic showing how the nominal variable for sexual division of labor was recoded as an ordinally ranked variable indicating degree of sex-specificity in labor organization.

chosen here may not be encountered frequently archaeologically, but the idea of different kinds of production behaviors is transferable to other contexts. Many other technological traits in the data base refer to behaviors, such as fetching water, fuel gathering, meal preparation, etc., which would be difficult to detect archaeologically.

In this study, three types of complexity scores are computed. A dual-concept complexity measure was computed as the sum of the values for the six technological activity variables for each case. By this measure, the groups performing the most number of activities exhibiting a high degree of sex-specificity are assigned the highest values.

A second complexity measure was an evenness measure. Evenness in structural behavior here means the extent to which a sexual division of labor rank is a ubiquitous attribute of technological activities for the group. This variable was defined as the standard deviation from the mean of the six activity values for each case (the same procedure used to determine subsistence evenness. To do this required values for number of activities practiced (richness). A richness measure for complexity was obtained by coding the variable to register presence/absence data only, as was done also for the subsistence variable.

The Stress-Response Variable

Response to stress was the most difficult variable to operationalize. Stress is defined as a systemic perturbation. The desired measure, however, is the behavioral response to the perturbation. Measuring a behavioral response is always conditional -- there must be a source of stress. To measure a stress-response cross-culturally, a specific event or condition must be defined as universally stressful. The further assumption must be made that the occurrence of a given kind and magnitude of stress will elicit a behavior of similar kind and intensity from all culture groups. If this reasoning is acceptable, then stress, as an indicator of behavioral response, can be said to increase behavioral diversity.

The coded data for the sample do not contain any variable that is intended to describe a stress-response. The composite variable for food preservation techniques characterizes cultural groups, in a nominal fashion, on the basis of resource stability and food storage practices. Stability of the resource base is defined by the degree to which the availability of subsistence resources fluctuates on a temporal scale. Five conditions are defined that comprise a relative scale for the predictability of resource availability: (1) complete dependence on resources from outside the culture area, (2) resource fluctuations occur on an annual basis, (3) resource fluctuations occur on a seasonal basis, (4) resource fluctuations occur on a diurnal basis, and (5) no resource fluctuations. These categories are not mutually exclusive, as some of these conditions can exist concurrently. A group is rated by the severest form of unpredictability encountered. Within each of the situationally-defined categories, cases are further assigned to a sub-category that describes storage practices. The storage sub-category contains six ranks of storage behavior indicating the relative importance of storage to the group: (0) none, (1) simple, (2) complex, (3) barely adequate to meet subsistence needs, (4) adequate to meet subsistence needs, and (5) surplus. The coded variable simply identifies each case by the co-occurence of the two independent traits and assumes no relationship between them.

Hayden (1981) identifies unreliability of resources as a leading cause of social stress. He also believes that stress is a major contributor to cultural innovation (i.e., behavioral diversity). Judging from the criteria Reid (1978) uses to define stress responses, he likewise regards food stress as a principal motivator of cultural diversity. Certainly, resource insufficiency is a cause of stress. Less certain is that this kind of stress will elicit a cultural response always characterized by an increase in numbers of cultural behaviors. A societal decision to store foodstuffs is a behavioral innovation. Also, as the scale of storage practices increases, the number of behaviors associated with those activities are sure to increase. Thus, the food storage variable can be a legitimate measure of cultural diversity as response to stress if, indeed, there is reason to believe that food storage activities are correlated with conditions of food stress. Some supportive data exist for this correlation, but the findings are not clear-cut.

Working with the Standard Cross-Cultural Sample in a study of storage practices among hunter-gatherers, Testart (1981) demonstrates that some correspondence exists between severity of resource fluctuation and intensity of storage behavior. Testart (1981:529) notes also that "storage may be practiced for reasons other than immediate subsistence concern, for instance, prestige and exchange," and that there are cases where storage is not practiced, even where "ecological conditions call for intensive storage." Testart does not examine the relationship between resource reliability and storage statistically, since his focus is on subsistence economy as a predictor of storage practices. Furthermore, Testart uses only a sub-sample (n=40) of the Cross-Cultural Sample in his analysis.

Another important point to consider is that storage is not the only behavioral response to food stress. Minnis (1985:32-43) summarizes various observed responses to food

Table 2

Possible Responses to Food Stress

* Diversification of the Resource Base
* Food Storage
* Use of Low Preference Foods
* Conversion of Non-Food Surpluses into Food
* Social Interaction
  (e.g., redistribution or kin obligations)
* Intake Reduction
* Disaggregation or Migration
* Intensification of Food Acquisition Activities
* Raiding and Warfare
* Cannibalism

Compiled from Minnis (1985:32-43).

stress in his book on the subject. A list of the major responses he mentions are reproduced in Table 2. Although a number of the responses imply behavioral diversification, others imply only a qualitative rather than quantitative change in behavioral patterns, and some even imply a decrease in behavioral variety (e.g., conservation of food intake). As mentioned previously, however, the lack of comprehensiveness in a variable designed to indicate behavioral variety does not undermine its usefulness. One must simply be cautious in making generalizations predicated on limited tests. Keeping in mind that only one type of response is considered, what remains to be shown is that resource reliability and storage activities are correlated. Demonstrating a correlation would justify the designation of storage behavior as a stress-response.

Recoding the food preservation practices variable was necessary to separate the resource reliability component and storage practices component for each case. The new resource reliability variable retained the same ranked categories as in the original (ranked 1 to 5); and the new storage practice variable also retained the original ranked categories (ranked 0 to 5; Figure 10). The data for the two variables were cross-tabulated via computer (SPSS: Statistical Package for the Social Sciences program). The results of the cross-tabulation are shown in Figure 10. The distribution of the data indicates that intensity of

RESOURCE RELIABILITY

EXTENT OF STORAGE	1 (least reliable)	2	3	4	5 (most reliable)	ROW TOTALS
5 (surplus)	0	3 1.6%	16 8.6%	0	0	19 10.2%
4	0	5 2.7%	46 24.7%	0	0	51 27.4%
3	2 1.1%	6 3.2%	24 12.9%	0	0	32 17.2%
2	0	0	0	0	14 7.5%	14 7.5%
1	0	0	0	2 1.1%	29 15.6%	31 16.7%
0 (none)	0	0	0	8 4.3%	31 16.7%	39 21%
COLUMN TOTALS	2 1.1%	14 7.5%	86 46.2%	10 5.4%	74 39.8%	

Number of cases = 186

raw chi square = 209.4. df = 20. sig < .01

Figure 10. Results of the cross-tabulation procedure between the storage and resource reliability variables. There is a strong negative correlation between storage and resource reliability.

storage practices are inversely related to resource reliability. These data, therefore, support the claim that stress in the form of unpredictability of the resource base results in an increase in storage practices.

The correlation would even be stronger if the two cases distinguished by total dependence on externally supplied resources were eliminated from the analysis. That resource reliability category, represented by only two groups, is somewhat different from the other categories in that resource reliability is not a function of the environment. These two cases (numbers 49 and 114) are the Imperial Romans (data recorded A.D. 110) and a Chinese village (data recorded 1936). These two cases serve to illustrated one weakness of using the group as the unit of analysis, and how imputed cause-effect relationships, such as the food stress-storage response, may not explain situations very well for less autonomous cultural groups.

Figure 10 shows that storage practices are most intensive for groups with seasonal fluctuations in resource availability. This may be partially due to the lower representation of groups located at higher latitudes in the sample (where resource fluctuations may be more severe), and/or the large number of agriculturists in seasonally fluctuating resource areas.

Even considering these problems of interpretation, none seems to discredit the general validity of the measure. Therefore, on the basis of the good statistical correlation between storage behaviors and lack of resource reliability, the new storage variable was used as the diversity measure for response to stress.

Number of Sample Cases Analyzed

Many coded HRAF variables do not include information on all the cases in the Standard Cross-Cultural Sample. A distinction is usually made in the variable categories between a trait not present in a culture group and the instance in which no data is available for recording the trait. When no data was available for any case, the value was declared 'missing,' and missing value cases were excluded from the analysis. To maintain comparability of sample size and composition, cases eliminated because of a missing value for one trait were also eliminated from the list of cases for every other variable. This procedure is known as listwise deletion.

The strategy of listwise deletion caused 57 of the 186 cases to be excluded from the analysis. As shown in the top line of Table 3, 55 of the 57 cases deleted lacked information in one or more of the technological activity categories used to compute the complexity variable. Since the traits selected to measure complexity were among those

Table 3

Comparison of the Mean Values of Variables
between the Set of Cases Included and the Set of Cases Deleted
from the Analysis

VARIABLES:	STORAGE	COMPLEXITY	GROUP SIZE	SUBSISTENCE
# of cases missing	0	55	2	2
# of cases deleted	57	2	55	55
$\bar{x}$ for deleted cases	2.42	14.00	5.65	3.11
$\bar{x}$ for 129 included cases	2.44	13.04	5.81	3.24
range for deleted cases	0 - 5	14	2 - 13	2 - 5
range for included cases	0 - 5	6 - 18	2 - 13	2 - 5

traits most well-represented in the sample, case representation would not be improved by the use of different traits. In order to retain the complexity variable in the analysis, some justification must be offered for the representativeness of the remaining 129 cases.

Two tests were made to evaluate the effect of the loss of 57 cases. The first was to check whether case values, deleted from all other variable sets because they had missing values for only one variable, would have altered the value distributions for the traits for which they did have values. This was examined by comparing the mean values of excluded cases against the mean values of included cases for each of the four variables. The mean values for both sets of cases are given in Table 3. The mean values for the excluded cases are sufficiently close to those of the included cases to justify the belief that the deletion of the 57 cases does not significantly affect the value distributions within each variable set.

The second test was to examine the effect of the deletions on the geographic representation of cultures. Figure 11 shows a plot of the world-wide distribution of the 57 deleted cases. The latitudinal distribution of deleted cases is consonant with the distribution of cases in the Standard Cross-Cultural Sample, which contains a greater number of cultures located at lower latitudes. The

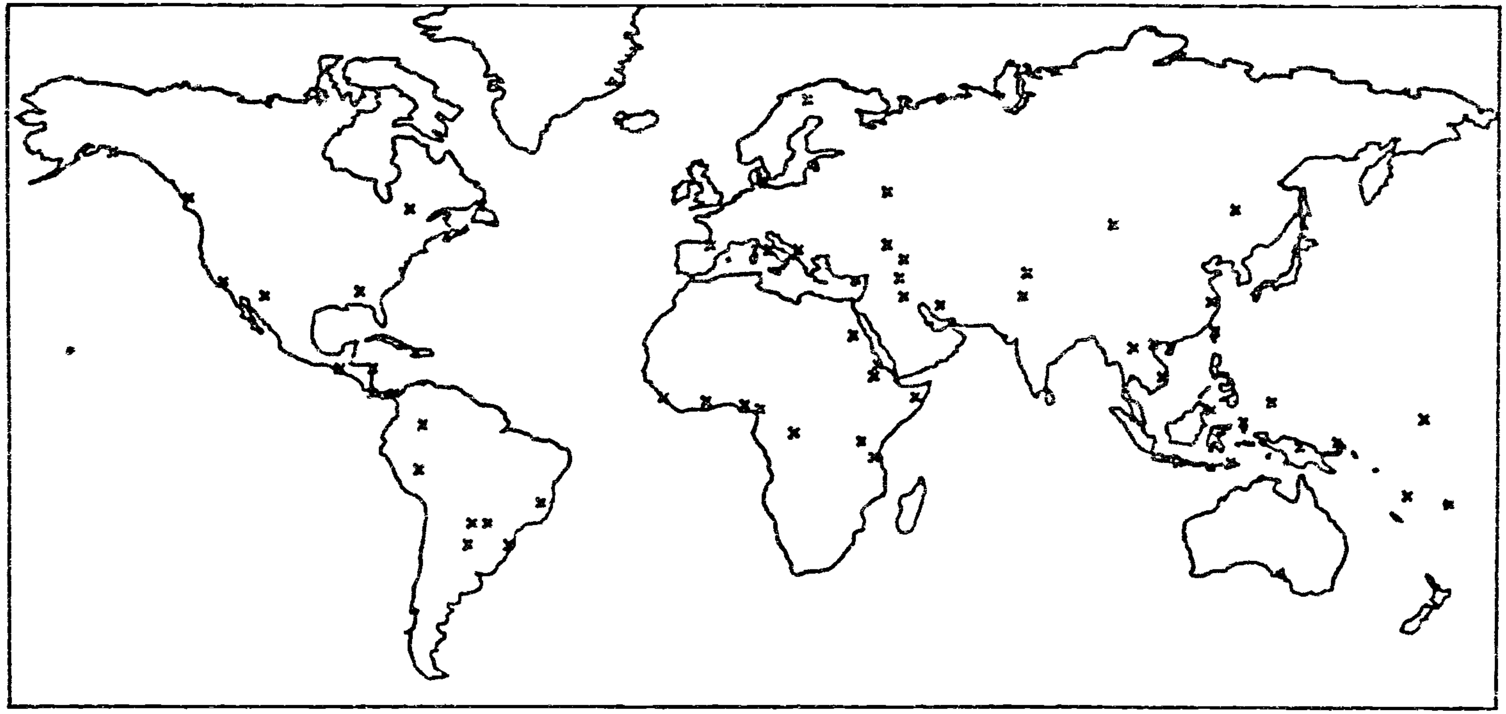


Figure 11. World map showing geographic distribution of the 57 cases from the Standard Cross-Cultural Sample eliminated from the analysis.

longitudinal distribution of cases is also fairly even, with the notable exception of the five cases in western Asia lying between 40 and 45 degrees east longitude. These five culture groups (Babylonians [45], Russians [54], Abkhaz [55], Armenians [56] and Kurds [57]; see Map 2, West Eurasia, in Appendix A) are only five of the 28 groups representing the Circum-Mediterranean Sampling Province in the Stand Cross-Cultural Sample. Three other culture groups (Gheg [48], Romans [49] and Basques [50]) from the Circum-Mediterranean Province are also among the excluded groups. These eight groups comprise almost 30% of all the Circum-Mediterranean cultures. This is reasonable in view of the fact that the 57 excluded cases are 30% of the entire Standard Cross-Cultural Sample. Still, the eight groups excluded in this province are 62% of the non-African Circum-Mediterranean groups (n=13). This deficiency is unfortunate, but not serious enough to justify eliminating the complexity variable from the analysis.

Overall, the evidence offered here supports the contention that the reduction in sample size to 129 cases does not affect the quality of the results obtained from the analysis.

The Method of Rank-Order Correlation

The coded trait data for all Standard Cross-Cultural Sample cases used in computing the diversity variables were entered into an SPSS program file (Nie et al 1975). Original coded forms of the variables were transformed, as described in preceding sections (Appendix B). SPSS was used to perform all the statistical correlations.

Spearman's rank-order correlation coefficient (rho) was chosen as the most appropriate statistic to describe the correlation between variables, since each variable consists of ordinally-ranked value categories. This correlation coefficient is based on the calculation of differences in paired ranks of two variables. Spearman's rho is a measure of association and, as such, "is a measure of the degree of correspondence between the ranks of the sample observations rather than between the observations themselves (Daniel 1978:301)." This is the essential information needed to test the hypothesis concerning the co-occurrence of behavioral diversity traits. Furthermore, the test data meet all the assumptions required for the use of Spearman's rho (see Daniel 1978:300 for list of assumptions). Calculations of Spearman's rho are obtained via the SPSS procedure for nonparametric correlations ("NONPAR CORR," Nie et al. 1975:288-292).

Results: Correlations between Behavioral Diversity Variables

Tests for rank-order correlation were performed on all possible pairs of the four behavioral diversity variables: group size, subsistence (the richness measure), complexity (the dual-concept measure), and storage. The Spearman's rho values obtained from the procedure are reproduced in Figure 12.

All but one of the correlation coefficients are extremely low and insignificant ($p>0.10$). These data confirm the null hypothesis which states that the diversity value of a behavioral trait is independent of the diversity value of any other trait.

The correlation between storage and complexity is 0.36 (Spearman's rho), considerably higher than that between any other pair. It is also significant at $p = 0.001$. The positive rho value is interpreted to mean that there is some tendency for groups with a higher value for storage behavior to also rank higher for sex-role differentiation (complexity). Because Spearman's rho only evaluates the association between ranks, and not values, there is some difficulty in assessing the degree to which one type of behavior is dependent on the other. While the correlation is good, it is not so high as to suggest that storage practices are a sufficient condition for the manifestation of sex-role differentiation and vice versa.

	GROUP SIZE	SUBSISTENCE	COMPLEXITY	STORAGE
GROUP SIZE		-0.06 p=0.451	0.08 p=0.339	0.09 p=0.271
SUBSISTENCE			0.12 p=0.151	-0.02 p=0.801
COMPLEXITY				0.36 p=0.001
STORAGE				

n=129 cases

Figure 12. Matrix of Spearman's rank-order correlation coefficients between all possible pairs of the four behavioral diversity variables: group size, subsistence, complexity, and storage.

At the degree of association indicated by the Spearman's rho of 0.36, sex-role differentiation and storage practices may still be regarded as cultural phenomena that can occur independently of each other.

On the basis of the interpretation of these data, the null hypothesis, that the four measures of diversity are independent, is not rejected. The diversities in the four kinds of group behaviors, as represented by the selected variables, are presumed to occur independently of one another.

Discussion

The independence of the behavior sets, defined as group size, subsistence, complexity, and storage justifies the approach adopted in cultural-level diversity analyses which assess behavioral diversity within particular systemic structures. However, the demonstration of their independence was made possible by selecting discrete activity traits. As direct behavioral observations, one does not confound house-building with agriculture, or large-scale storage with residential spacing, etc. Archaeologically, the discrete association of product types with specific behavior traits is not so easily accomplished.

So, while the ethnographic data support the principle behind the behavior-product correlates of cultural-level diversity, they do not specify that the products are behavior-specific. The independence of structural behavior sets does not imply that readily distinguishable sets of artifacts accompany them. This means that the same artifactual criteria may be correctly used as evidence for more than one structural behavior type. For example, Reid (1978) contends that the presence of small mammal remains (e.g., rodents) indicates a food stress-response. It is also a niche breadth component. While a widening of the niche breadth via the consumption of low-yield resources is a stress response in some instances, in other cultural contexts the inclusion of such species in the diet is a matter of ease of capture or acquired taste. The results of the behavioral variable correlations only indicate that stress-response behaviors are not necessarily linked to subsistence procurement activities, not that they must have mutually exclusive effects.

The deficiency of cultural diversity models which posit behavior-product correlates lies not in the assumption that such a correlate exists, but in the inability to identify behavior-specific products. Some archaeological correlates, of course, are better than others. Differences in burial patterns in contemporaneous grave-sites, for instance, is convincing evidence for the existence of status differentials (Alekshin 1983; Peebles and Kus 1977; Ames 1985). Niche width as resource variety can be a straightforward measure of behavioral diversity if organic remains from food items are recovered archaeologically. Oftentimes, however, resource variety is inferred from more durable food processing equipment. Seed-grinding equipment may imply gathering, horticulture, or agriculture.

These criticisms are not delivered to negate the possibility of establishing reliable behavior-product correlates, but to emphasize the difficulty of producing unambiguous ones. Limiting the context in which criteria are applicable is one way to improve correlates. Ames' (1985) paper on archaeological correlates for cultural complexity suggests that analysts can devise more certain criteria to scale cultural complexity by limiting their culturo-geographic scope. Reid's (1978) approach with the Grasshopper Pueblo data shows that good chronological control is useful in isolating behavioral episodes. The relative impermanence of a behavioral trait is a reasonable basis for identifying behavior as a stress-response. Information on palaeoenvironments enhances the credibility of inferences concerning resource utilization. In short, there are means by which behavior-product correlates can be convincingly established. But, the quality of the correlates is highly constrained by what is recovered, and what is recoverable, from the archaeological record.

The quality and quantity of artifactual materials recovered from archaeological sites varies situationally. Sites, whose artifactual yields meet the compositional and regional specificity, as well as the temporal control requirements for the use of cultural level diversity models, constitute the minority. The lists of archaeological correlates for systemic behavior sets are generally designed for prehistoric culture groups whose archaeological remains are both numerous and accessible. The three North American examples cited in chapter 3 are typical, namely, the Mississippian of the Southeast, the Late Archaic of the Northwest, and the Basketmaker/Pueblo of the Southwest. These are all cultures of the relatively recent past, and with relatively elaborate material cultures, including substantial agglomerations of physical structures.

Many more archaeological contexts do not yield such a wealth of material culture. The paucity of cultural materials at archaeological sites precludes the evaluation of systemic behavioral diversity at the cultural-level. Artifactual assemblages in limited contexts and/or of a more homogeneous nature (e.g., comprised of mostly lithic materials), are not conducive to analyses involving the division of materials into structurally-related behavior sets, such as those relating to social organization.

Finer-scale behavioral correlates are established sometimes for archaeological materials from assemblages of limited content. The determination of lithic manufacturing techniques from debitage analysis is a good example. The ability to detail certain cultural acts is interesting, but its contribution to understanding broader processes of cultural development is often obscure.

Archaeologists, who deal with limited assemblages, have had to devise original ways (i.e., less dependent on conventional anthropological concepts) to interpret cultural products as developmental phenomena. The cultural-level diversity models are drawn from conventional anthropological concepts. The conversion of group size, subsistence, complexity, and stress-response to diversity measures showed that one conceptual characteristic, diversity, is applicable to many behavior types. The ability to identify several distinct behavioral processes as specific manifestations of a more general process of diversification is important to archaeologists who study assemblage-level diversity. As discussed in Chapter 2, diversity is a recent focus for archaeological interpretation.

Chapter 5

THE ETHNOGRAPHIC ANALOGY AND ARCHAEOLOGICAL DIVERSITY

Cultural-level models of archaeological diversity define the development of systemic behavior sets in terms of scales of behavioral diversity. Archaeologically, the scale of behavioral diversity is judged by an increase in types of cultural products. Unfortunately, not all archaeological sites contain enough artifactual data to infer specific structural behaviors. Nonetheless, some relationship still exists between assemblage composition and the behaviors which produced it.

The review of studies concerned with assemblage-level diversity in Chapter 2 attests to the interest of archaeologists in applying the general relationship between behaviors and products to the interpretation of assemblage content. Again, an examination of the ethnographic record provides a more concrete way to evaluate the kind of information assemblage-level diversity reveals.

The General Diversity Variable

The group size, subsistence, complexity, and storage variables rank the degree of diversity in specific behavior sets for culture groups in the Standard Cross Cultural sample. By summing the values of all four variables for each case, a new variable, general diversity, was created. This combined value represents the cumulative effect of all selected causes for behavioral diversity. The purpose in devising this measure was to test for general trends in the proportional effects of particular kinds of behavioral diversity on overall diversity.

Because the value ranges differ for each of the diversity variables, the values of all variables for each case were standardized. This was accomplished by dividing the individual values by the mean value of a variable for all cases. The procedure standardizes the proportional contribution of each variable to the total diversity score. Each weighted value was multiplied by 100 to improve interpretability of the results on computer output. The final form of the general diversity variable for each case was the arithmetic sum of the weighted values (x100) for the four diversity variables. General diversity values are higher for groups having more diverse behaviors in the greatest number of behavioral categories.

Group size, subsistence, complexity, and storage were tested for rank-order correlation with the general diversity scores. The results of this procedure are shown in Figure 13. Spearman's rho values are higher between each individual behavior variable and general diversity than between any of the pairs of the individual variables

	GROUP SIZE	SUBSISTENCE	COMPLEXITY	STORAGE
GENERAL DIVERSITY	0.65 $p<0.01$	0.18 $p=0.04$	0.47 $p<0.01$	0.73 $p<0.01$

n=129 cases

Figure 13. The Spearman's rank-order correlation coefficients obtained in the correlation of the general diversity variable with the four individual behavioral diversity variables.

(Figure 12). The improved correlations are an expected result, because the individual diversity values are incorporated into the general diversity value. The logic of the relationship is as follows: if the rank values of any behavior category is perfectly correlated with itself (A to A = 1; B to B =1), and the correlation between the rank values of category A and Category B is very poor (A to B = 0), then the sum of their values must be better correlated with either single category than between the single categories (A + B to A > 0; A + B to B > 0).

An unknown but regularized relationship among the four constituent variables could also increase the values of the correlation coefficients. No test was made for such a relationship. The effect of the incorporation of a variable's value in general diversity is deemed the most obvious cause of the improved correlation coefficients.

These data indicate, then, that a combined behavioral diversity measure is a better indicator of behavioral diversity due to group size, complexity, or storage than any individual behavior is for another individual behavior. The correlation between subsistence and general diversity is so weak as to suggest that general diversity, as calculated here, gives little information about the number of subsistence strategies employed.

Assemblage Diversity as General Diversity

The values of the general diversity variables are similar to assemblage diversity values calculated by archaeologists in that the values obtained numerically represent the cumulative effect of various behavior types. The difference is that the number of behavioral components in the general diversity variable is known, although the proportional contribution of each behavioral component to the overall score cannot be deduced from the general diversity score alone. Archaeological assemblage diversity is calculated on the basis of the number and distribution of artifact classes. How many kinds of behaviors are actually represented by these classes is not known.

The single piece of information that a general diversity value gives about a cultural group is the relative degree to which that group is behaviorally diverse. And, by reason of the behavior trait/product trait analogy, archaeologists expect that an assemblage diversity value gives the same piece of information, namely, the relative degree of behavioral diversity represented by an artifactual assemblage. Acceptance of the assumption that more types of artifacts indicate more types of behavior validates the conclusions about behavioral diversity based on an assemblage diversity value. This is a broad conclusion. Still, a broad conclusion about cultural behavior is better than no conclusion, if the limited character of assemblage content does not permit the assignment of artifact classes to structurally meaningful behavioral classes. However, if only the relative degree of behavioral diversity can be assessed from an archaeological assemblage, the important question to address becomes whether a general behavioral diversity measure has any meaning for describing and explaining cultural development. This is the major question surrounding the use of diversity measures in archaeology: what is the potential, if any, for a purely quantitative measure of behavioral variability to inform about culture processes? This is also a question for which anthropological theory provides no answers.

Traditional anthropological frameworks do not theoretically treat generalized behavioral diversity as a quantitative and/or holistic attribute of cultural systems. Ecology, the discipline from which the diversity concept is borrowed, does supply theoretical background and models to interpret diversity. This situation explains the willingness of archaeologists to embrace ecological models as replacements for anthropological models which do not accommodate particular archaeological problems.

A major intent in the present investigation is to demonstrate the need for archaeologists to justify the use of ecological models for explaining cultural phenomena.

This requires validating the human culture/biotic community analogy. So far, the re-definition of behavior sets (which according to anthropologists have developmental significance) in terms of response diversity (the ecological concept) is the only step taken towards establishing their equivalence. The ethnographic data also provide an opportunity to test whether the relationship between the diversity components of richness and evenness is similar in biotic and cultural communities.

Behavioral Richness and Evenness

A common observation in ecological studies of diversity is that the distributional evenness of elements in a collection increases with the richness of elements (Pielou 1969). The difficulty of interpreting a diversity index which uses a single measurement to indicate both the richness and evenness components of a collection has already been discussed (chapter 1). If the ecological relationship between richness and evenness is always true, then a richness measure alone is an acceptable relative measure of dual-component diversity. To determine the truth of this relationship for the behavioral measure of diversity, therefore, is worth exploring.

Two composite variables, subsistence and complexity, were recoded in order to evaluate the relationship between the richness and evenness components of behavioral diversity (Chapter 3). Evenness refers to the distribution of behaviors, and greater evenness implies greater diversity. For the subsistence variable, behavioral evenness is operationally defined as the degree to which subsistence dependence is distributed over the subsistence strategies employed. For the complexity variable, evenness is operationally defined as the degree to which the same level of sex-role differentiation is present in the technological activities performed.

The subsistence-evenness and complexity-evenness variables were designed to evaluate behavioral evenness only in relation to the number of strategies or activities practiced in each case. In this regard, the measure is conceptually similar to (though mathematically different from) the evenness measure used by Jones et al. (n.d.).

For the subsistence data, evenness was calculated as the standard deviation in dependence values from the mean of those values for a given case. Small values for subsistence-evenness mean that dependence values for each subsistence strategy are numerically close, and thus even. So, small values denote greater subsistence-evenness. The Spearman's rho was calculated for the rank-order correlation between subsistence-evenness and subsistence-richness data for 184 cases (only two of the 186 sample cases have missing values). The Spearman's rho obtained was -0.93 ($p < 0.001$), indicating an almost perfectly inverse relationship between subsistence-richness ranks and subsistence-evenness ranks. Since the ranks of the two variables are ordered in opposite directions, the negative value for rho means that subsistence-richness and subsistence-evenness are very well-correlated.

The results of the rank-order correlation procedure for complexity-richness and complexity-evenness were very similar. Complexity-evenness was calculated as the standard deviation in sex-role differentiation values from the mean of those values for a given case. The Spearman's rho was -0.95 with $p < 0.001$ ($n = 131$). These findings uphold the idea that a richness measure is a viable proxy measure for evenness.

The behavioral interpretation for the high correlation between subsistence-richness and subsistence-evenness is that cultural groups employing more kinds of subsistence strategies have a strong tendency to depend equally on all strategies employed; groups employing fewer strategies are less likely to equalize dependency. For example, a culture whose subsistence strategies include hunting, gathering, fishing, and horticulture are very likely to have a 20-30% dependence on each strategy. Groups practicing only agriculture and animal husbandry are more likely to have heavy dependence (80-90%) on one and a marginal (10-20%) dependence on the other. Subsistence generalists are, thus, by definition, more behaviorally diverse than subsistence specialists. This is interesting in view of the fact that subsistence diversity correlates most poorly with the general diversity scores.

The values distributed across the six complexity traits are not dependency values, but represent degree of sex-role differentation. The good correlation between complexity-richness and complexity-evenness means that culture groups practicing the most kinds of technological activities are also groups that manifest the same type of labor organization in terms of degree of sex-specificity across all activity types. A Spearman's rho of -0.87 ($p < 0.001$) for a rank-order correlation between the original complexity variable and complexity-evenness further indicates that the groups with the highest complexity values (due to greater division of labor in most categories) also have the greatest evenness.

Mechanisms of Diversification

The information obtained up to this stage in the analysis reveals some important equivalencies between ecological diversity and cultural diversity measures. As a measure of behavioral response, diversity circumvents the problem of having to make uncertain associations between artifacts and behaviors. The richness and evenness components of behavioral diversity are also shown to exhibit the same relationship that they exhibit in biotic community diversity. A general diversity measure, then, seems to solve some methodological problems for characterizing archaeological assemblages. But, the ability to solve methodological problems does not automatically give the measure cultural significance. To assign cultural significance to behavioral diversity, the measure must yield information about culture processes. Is diversification the result of cultural processes?

Ecology offers a number of hypotheses to explain biotic diversity. Pianka (1966) presents a review of some leading hypotheses. These include: (1) diversity as a function of time (older communities have more species than younger ones), (2) diversity of a function of spatial heterogeneity (diverse environments support diverse communities), (3) diversity as a function of interspecific competition (food and habitat restrictions enable more species to co-exist in the same habitat space), (4) diversity as a function of environmental stability (stability allows the evolution of finer specializations), and (5) diversity as a function of environmental productivity (an increase in available energy increases biotic diversity).

There are two major difficulties in transferring ecological hypotheses for biotic diversity to cultural hypotheses for archaeological assemblage diversity. First is that the species equivalent in the archaeological analogy is the behavioral product, not the cultural group. The concern for archaeology is not with the diversity of human groups, but how behavioral diversity arises within a group. The former is a major concern in cultural ecology (Steward 1955; Barth 1956; Yellen 1977), but is not the immediate concern of the archaeologist examining assemblage diversity. Therefore, some of the hypotheses are not appropriate for the micro-scale analyses, such as the competition hypothesis.

Secondly, to equate the behavioral product with a specific type of response again leads back to the necessity of identifying the types of behavior represented in the artifactual assemblage. Assemblage-level data, therefore, are ill-fitted for testing many ecological hypotheses. If archaeologists can describe only a generalized diversity phenomena, then they must evaluate diversity as symptomatic of a more generalized mechanism.

Chapter 6

DIVERSITY AND ADAPTATION

The analysis presented in Chapter 5 demonstrates that there is some empirical justification for the assertion that archaeological assemblage diversity values are useful as indicators of the relative scale of generalized behavioral diversity represented by a collection of artifacts. As a summary statistic, however, the general diversity value for a whole assemblage says nothing about the quality of those behaviors. An analyst may choose to associate types of artifacts with certain behaviors, but this requires archaeological contexts that provide sufficient information for unambiguous behavioral assignations.

The most common archaeological interpretation of overall assemblage diversity is site function. Site function, based on a knowledge of only the relative diversity of behaviors performed, is a rather safe and reasonable interpretation. The functional names given to sites categorized on the basis of assemblage diversity, however, are as generalized as the criteria on which they are based. Thomas' (1984) "residential," "logistic," and "diurnal" site types are typical examples.

Is assigning site function, then, the limit of the interpretive utility for assemblage-level diversity values? The computation of diversity indices for artifactual assemblages is a method only recently adopted by archaeologists. A number of archaeologists treat diversity indices as a purely descriptive device. Other researchers imply that a significant aspect of artifactual diversity is that its manifestation can be attributed to processes analogous to those which produce biotic diversity.

Ecological theory connects the diversity concept with developmental processes. Diversity in biotic systems is patterned; it is the result of specific systemic conditions and interactions. The material diversity of cultures, too, may be influenced by such systemic conditions and interactions, so that assemblage diversity alone will suggest them.

Many superficial parallels can be observed between the diversity of biotic and cultural collections, but such parallels are insufficient reason to assume that the same underlying processes produced both. To decide whether archaeologists should pursue a non-cultural (i.e., ecological or evolutionary) framework to evaluate the behavioral diversity requires an evaluation of the extent of processual similarity leading to diverse biotic and artifactual collections.

Behavioral Diversity: An Ecological Response?

The processes of biotic community diversification are understood poorly, as evidenced by the many competing hypotheses advanced to explain it. Still, patterns of biotic diversity are clearly linked to ecological conditions. Anthropologists, applying the principles of cultural ecology, make many good arguments for the influence of environment in patterning cultural systems (Steward 1955; Barth 1956; Yellen 1977), but these are qualitative, not quantitative, assessments of man-environment interactions. The general diversity scores, generated for the test described in Chapter 5, permit a quantitative evaluation of behavioral diversity as an ecologically determined cultural condition.

The general diversity values for each of the 129 groups in the sample are given in Table 4. They are ordered in the table from least diverse to most diverse. Examination of the table allows some evaluation of the proposition that behavioral diversity proceeds as an ecological response. The table is somewhat difficult to interpret without some knowledge of the culture groups, but some generalizations can be made.

The values of the general diversity scores range from a low score of 159 to a high score of 657, an approximately 500 point range. This is a deceptively large value range

Table 4

General Diversity Values
for the 129 Cultures in the Sample
(ordered from lowest to highest)

ID#	Culture Name	Diversity Score	Productivity Zone
61	Toda	159	3
2	Kung Bushmen	165	2
13	Mbuti	165	4
96	Manus	182	-
77	Semang	203	4
80	Forest Vedda	206	4
140	Gros Ventre	206	2
185	Tehuelche	211	2
46	Rwala	218	2
176	Timbira	226	3
92	Orokaiva	234	3
177	Tupinamba	236	3
128	Slave	237	1
173	Siriono	242	3
179	Shavante	242	3
166	Mundurucu	243	4
79	Andamanese	244	3
121	Chukchee	259	1
163	Yanomamo	268	4
53	Yurak Samoyed	270	1
110	Yapese	272	4
162	Warrau	273	4
1	Nama Hottentot	274	1
134	Yurok	275	3
175	Trumai	276	3

(continued on following page)

(Table 4 continued)

65	Kazak	283	2
106	Samoans	287	-
34	Masai	291	3
91	Aranda	297	1
174	Nambicuara	315	4
122	Ingalik	316	2
44	Hebrews	317	2
161	Callinago	318	3
165	Saramacca	325	4
6	Suku	331	3
75	Khmer	331	4
8	Nyakyusa	334	3
129	Kaska	334	1
126	Micmac	342	2
90	Tiwi	348	3
71	Burmese	353	3
142	Pawnee	360	2
25	Wodaabe Fulani	361	2
160	Haitians	361	3
120	Yukaghir	366	1-2
186	Yaghan	366	2
24	Songhai	374	1
143	Omaha	375	1
76	Siamese	376	3
62	Santal	377	4
99	Siuai	385	3
7	Bemba	388	3

(continued on following page)

(Table 4 continued)

124	Copper Eskimo	392	1
154	Popluca	393	4
159	Goajiro	397	2
103	Aije	398	3
150	Havasupai	398	1
47	Turks	402	2-3
169	Jivaro	405	3
67	Lolo	406	3
119	Gilyak	408	2
151	Papago	411	2
35	Konso	412	3
81	Tanala	413	4
29	Fur	415	2
78	Nicobarese	417	4
141	Hidatsa	421	2
21	Wolof	422	3
123	Aleut	423	2
135	Eastern Pomo	423	3
139	Kutenai	424	2
84	Balinese	425	4
164	Carib	427	4
40	Teda	430	1
85	Iban	434	4
5	Mbundu	436	2-3
104	Maori	437	3
168	Cayapa	438	3

(continued on following page)

(Table 4 continued)

137	Wadadika	445	2
41	Tuareg	452	1
3	Thonga	453	3
144	Huron	454	3
43	Egyptians	454	1
146	Natchez	455	3
22	Bambara	461	3
60	Muria Gond	464	3
149	Zuni	465	2
117	Japanese	466	3
93	Kiman	468	4
63	Uttar Pradesh	469	3
70	Lakher	469	3
131	Haida	470	2
127	Saulteaux	473	2
147	Comanche	476	2
18	Fon	477	3
69	Garo	480	4
100	Tikopia	482	3
26	Hausa	487	3
171	Inca	487	3
98	Trobrianders	487	4
87	Toradja	490	4
153	Aztec	494	2
4	Lozi	496	3
32	Mao	500	3

(continued on following page)

(Table 4 continued)

138	Klamath	504	3
109	Trukese	505	4
94	Kapauku	514	4
51	Irish	523	3
12	Ganda	526	3
30	Otoro Nuba	534	3
28	Azande	535	3
82	Negri Sembilan	536	4
23	Tallensi	540	3
33	Kaffa	550	3
68	Lepcha	555	3
31	Shilluk	557	3
172	Aymara	563	3
184	Mapuche	569	2
108	Marshallese	572	4
11	Kikuyu	575	3
112	Ifugao	575	4
118	Ainu	576	3
116	Koreans	577	3
133	Twana	578	2
105	Marquesans	582	-
27	Massa	593	3
16	Tiv	599	4
42	Riffians	603	3
152	Huichol	657	3

since the four standardized values which comprise the general diversity score were multiplied by 100 before they were added togather. More realistically, they represent a scale of 1 to 5. Furthermore, ordinal scaling gives only a relative idea of the distance between values.

Overall, the distribution of cultures over the range of general diversity values is very even. The mean of the general diversity scores for the 129 cases is 403 (standard deviation = 114). The median value of 415 is quite close to the mean value.

The ten top-rated (most behaviorally diverse) cultures are a surprisingly dissimilar set in many respects, and do not, in the majority, consist of what are generally considered 'advanced' peoples, for example, the Huichol, the Marquesans, and the Ainu. On the whole, there is a tendency for sedentary agriculturists to rank higher on the list than mobile hunter-gathering groups. The ten lowest-scoring groups consist almost exclusively of nomadic or semi-nomadic hunter-gatherers or pastoralists. However, agriculturists are well-represented in all ranks above the 300-level, with the Hebrews being the lowest-ranked agricultural group (general diversity = 317), and hunter-gatherers occur frequently throughout the middle range values. Non-agricultural North American Indians, like the Comanche, Saulteaux, and Northern Paiute (Wadadika) score especially high (476, 473, and 445, respectively). An important point to remember is that subsistence diversity is ranked by number and distribution of strategies employed. The conventional nomenclature used here to describe these groups obviously does not do justice to the variety of subsistence strategies they actually represent.

The question of relevance in this study is not whether conventionally-applied anthropological categories explain the distribution of cultures on the relative scale of general diversity. Rather, the intent is to determine whether the general diversity of cultural groups conforms to an ecological model such that general diversity can be described as a patterned interactive process between human groups and the environment. This question was examined by considering the biological productivity of the geographic location of each culture group. Biological productivity was chosen as an environmental variable which may be a determining factor for the level of general diversity attained by a culture group.

Biological productivity is an energy measure often defined as the rate of production of organic matter per unit area (Larcher 1975). It is used here as a relative measure of environmental amenability. The productivity ranking used is based on a computer-simulated model of environmental productivity developed by Leith (1972) which uses mean annual precipitation and mean annual temperature data to predict productivity values on a global scale. The predicted values agree very well with values calculated in the field. The precipitation and temperature factors are the most crucial factors which determine primary productivity, and serve as the basis for the construction of most vegetation maps as well. Figure 14 is a reproduction of the computer-generated map showing the global extent of the four levels of productivity defined by Leith. A value of four is assigned the most productive environments, and a value of one to the least productive. Although these gross categories do not account for the existence of differentially productive micro-environments (such as estuaries or elevational gradients, Figure 15), if a strong relationship exists between environmental productivity and behavioral diversity, some general pattern should emerge.

The Spearman's rho obtained for the correlation of the productivity ranks with the general diversity ranks was 0.12 ($p = 0.18$). The low correlation lends no support to the idea that the behavioral diversity of cultural communities is conditioned somehow by environmental productivity, as are the diversities of biotic communities.

The results of the correlation call into question the applicability of ecological relationships to cultural phenomena. Consider the ecological relationship between environmental stability and diversity. High productivity environments are also stable environments in which climatic

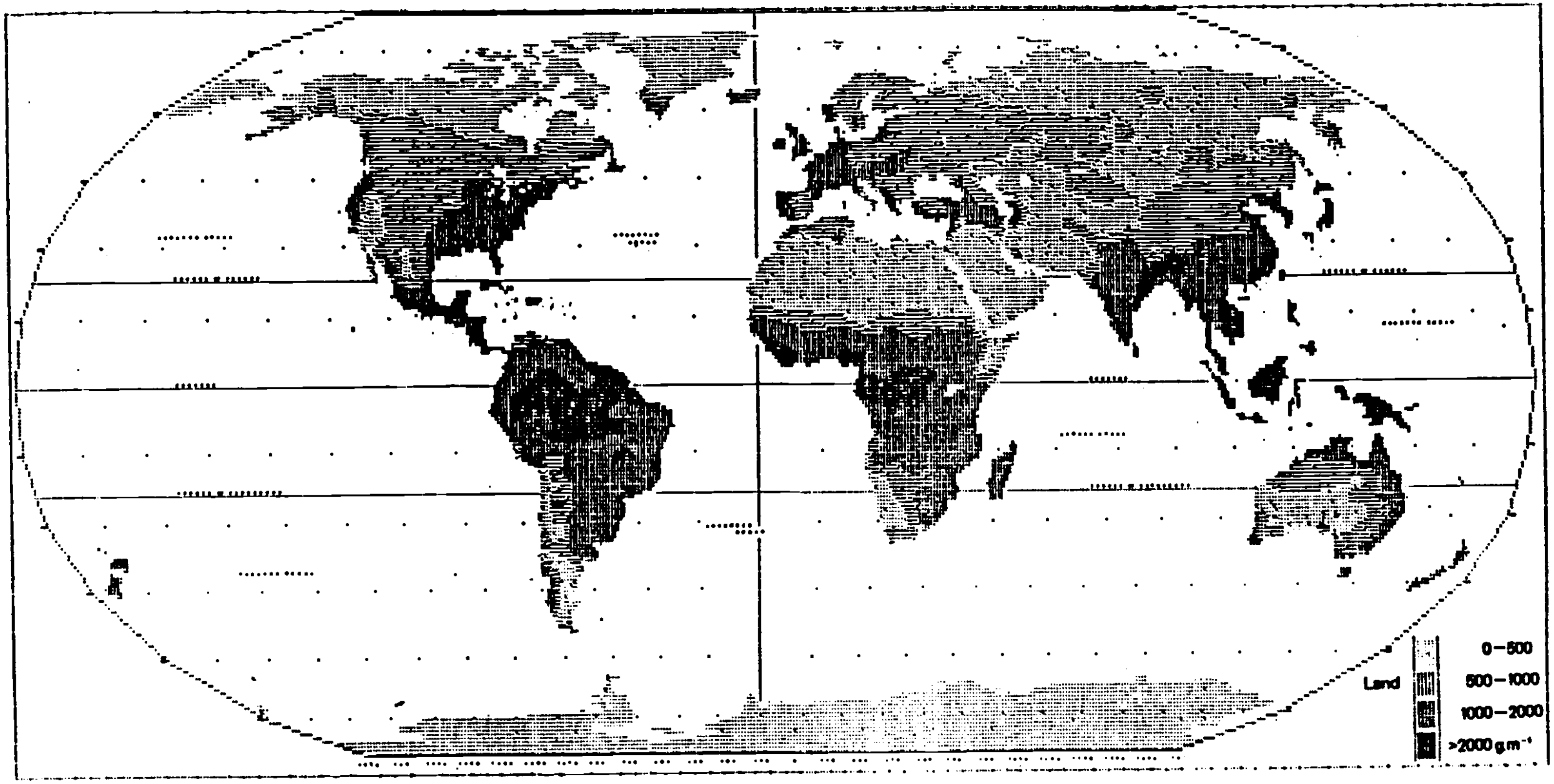
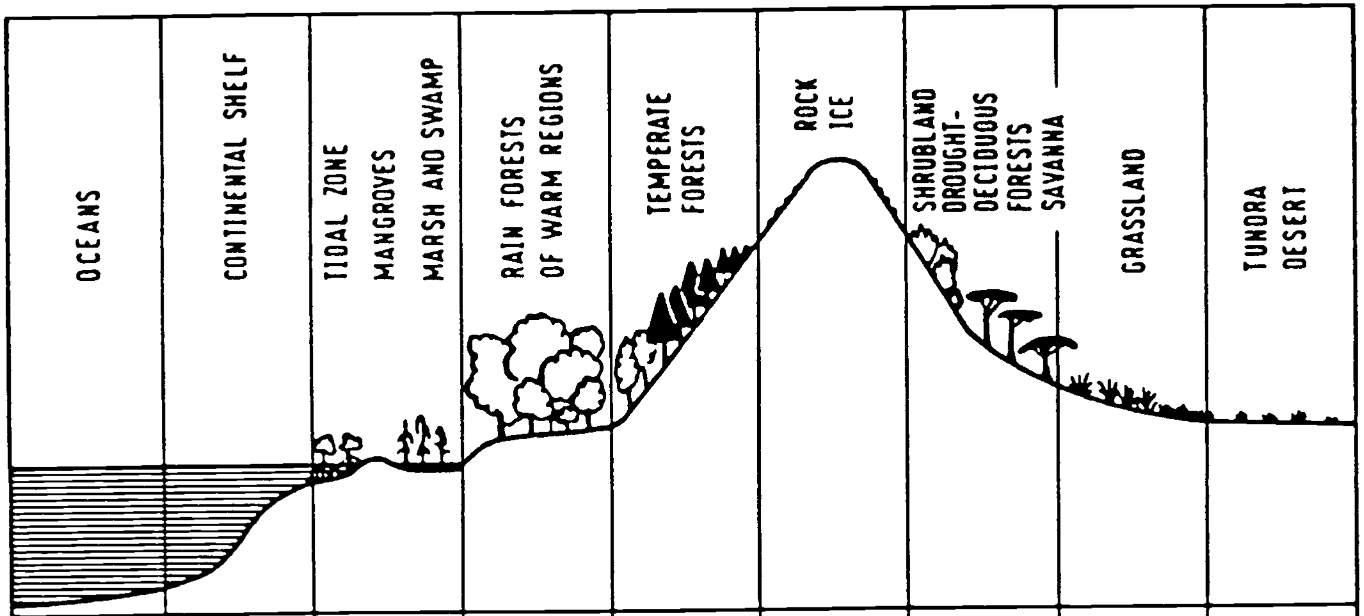


Figure 14. Computer-generated world map showing four geographic zones based on primary productivity (g dry matter x m^{-2} x yr^{-1}). Darkest areas are most productive regions; lightest are least productive. The map and the procedure for estimating primary productivity based on mean annual precipitation and mean annual temperature data were developed by Leith (1972).



P	0.02–4	2–6	20–40	10–30	5–20	0–0.01	2–10	2–10	0.1–4	$t \cdot ha^{-1} \cdot yr^{-1}$
B	0.01–0.4	10	100–200	400–500	200–400	0–3	60–100	20–50	0.1–20	$t \cdot ha^{-1}$

Figure 15. Normal ranges for primary productivity (P) and Phytomass (B) in different biomes. diagram is reproduced from Larcher (1975). t = tons dry organic matter

fluctuations are minimal. Cultures in the most productive regions are well-distributed throughout the entire range of diversity ranks (Figure 16) from the Mbuti with a general diversity score of 165 to the Tiv with a score of 599.

The only obvious trend with the productivity data is that cultures in the least productive regions tend to fall in the lower half of the diversity scale. The Egyptians are the most diverse group (general diversity = 454) in a lowest-ranked productivity zone. This is a clear case in which the simulated productivity model does not account for particular environmental conditions (Leith's use of precipitation and temperature data to calculate productivity would not account for localized flooding in the Nile Valley which increases productivity).

The next highest diversity score in a low productivity area is 452 for the Tuareg of the western Sahara. The lower general diversity ranking for cultures in harsh environments does not support the contention that stressful environments force a greater number of adaptations (Reid 1978; Cohen 1977; Yesner 1977). Neither do the data support the contention that peoples occupying environmentally diverse areas, such as tropical lowlands or coastal areas, are inevitably more behaviorally diverse (Yesner 1980). The geographic locations of the 20 cultures with the highest general diversity scores are shown in Figure 17; the 20 cultures with the lowest general

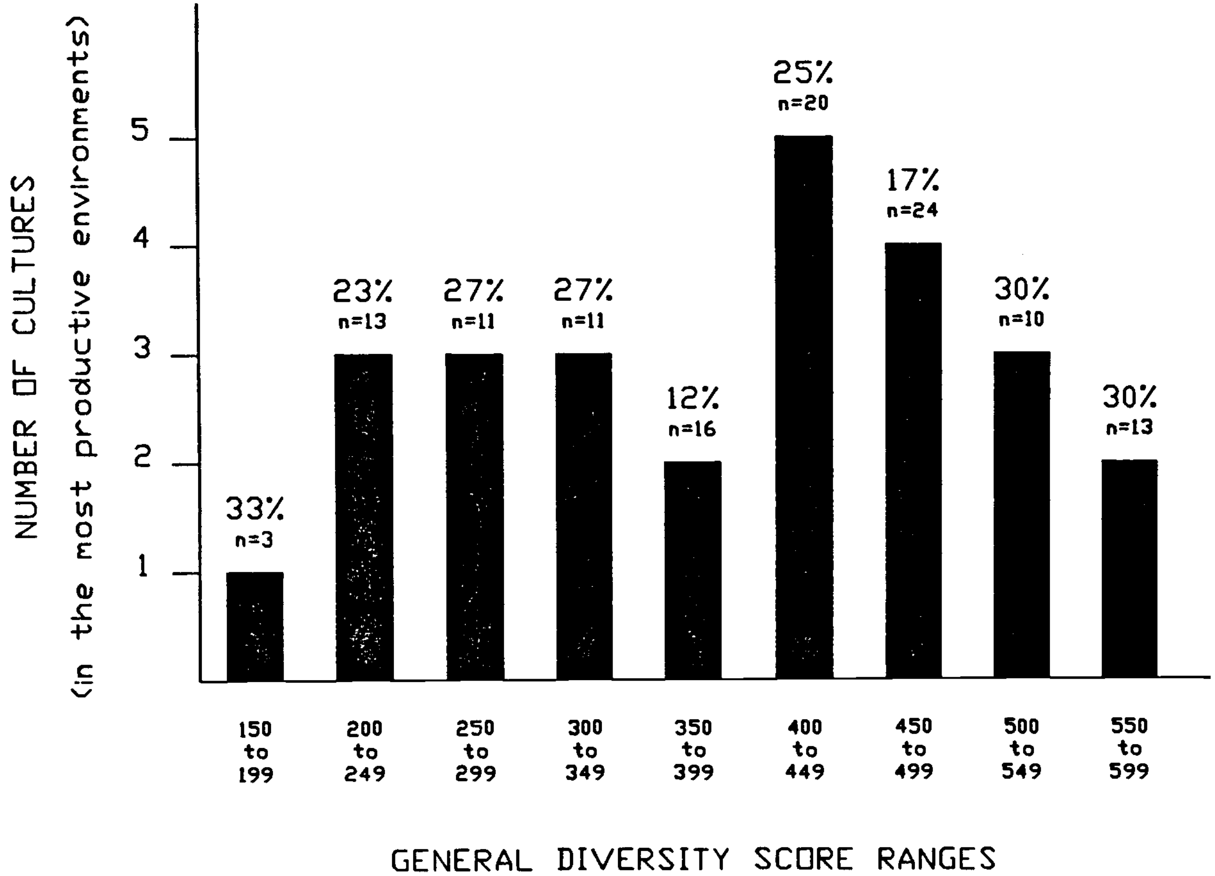


Figure 16. Representation of cultures located in high productivity zones over general diversity score ranges. Percentages refer to the proportion of cultures in a general diversity score range located in a rank-4 productivity zone. n = number of cultures in a given range of general diversity values.

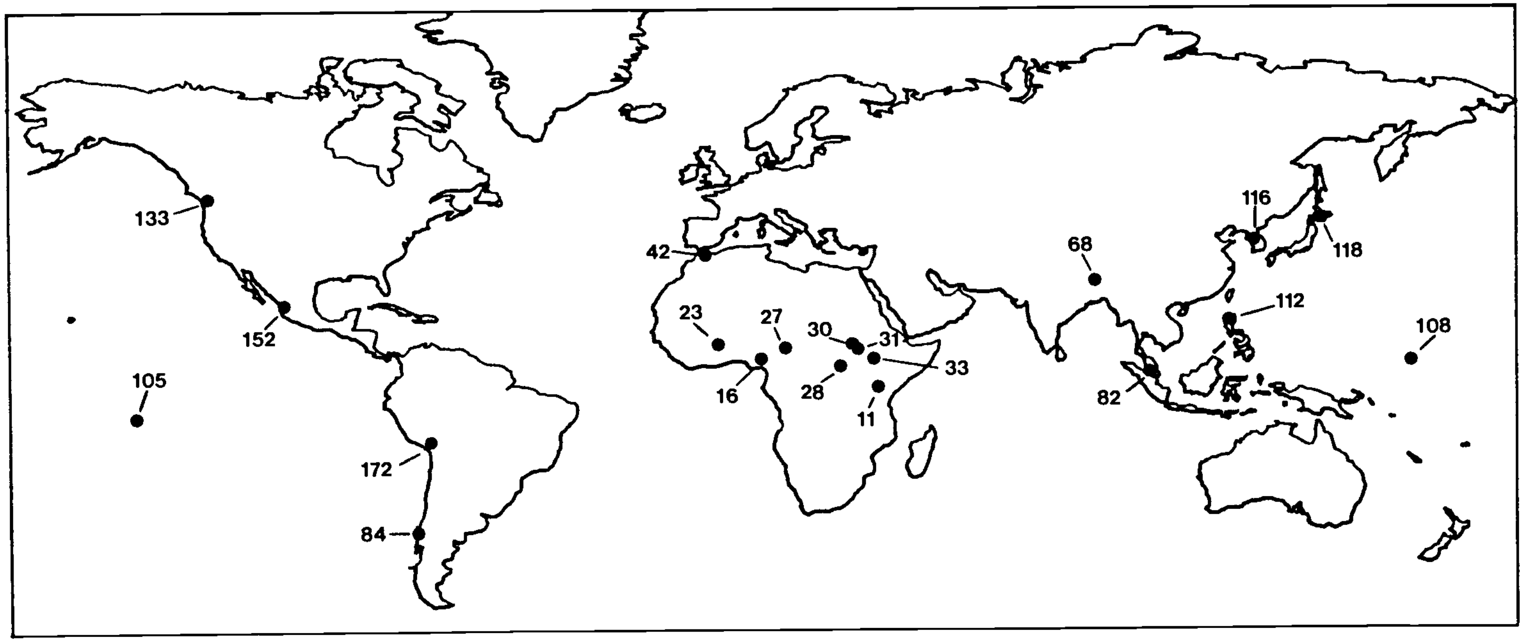


Figure 17. World map showing the geographic distribution of the twenty cultures with the highest general diversity scores. [See Appendix A for culture names]

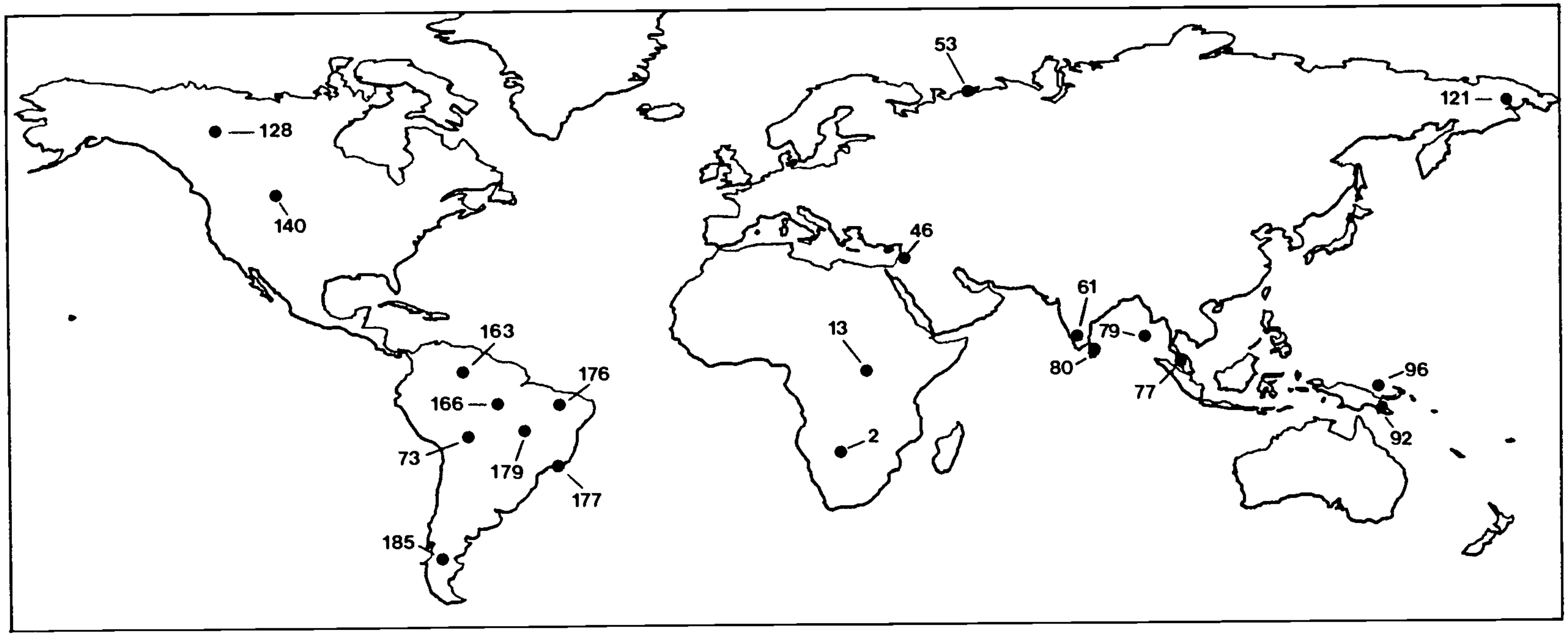


Figure 18. World map showing the geographic distribution of the twenty cultures with the lowest general diversity scores. [See Appendix A for culture names]

diversity scores are plotted in Figure 18. Overall, these data suggest that environmental amenability, measured as environmental productivity, is not a highly deterministic factor is influencing behavioral diversity.

Discussion

One test using one kind of environmental variable does not categorically discredit the idea that cultural conditions are, or can be, ecological responses. And, certainly, that is not the intention here. This test does suggest, however, that the behavioral diversity of cultural groups, as a quantitative phenomenon inferred from the diversity of their material culture, should not be interpreted directly as an ecological response analogous to biotic community diversity.

Archaeologists, who study material culture, should pursue the discovery of processual correlates for assemblage content. The quantitative attribute of general assemblage diversity yet may be assignable to some cultural ecological condition. The nature of this condition, however, is unlikely to be revealed by a consideration of ecological/evolutionary models alone.

The information processing model of Peebles and Kus (1977), for example, suggests that an increase in behavioral differentiation (complexity) in their Moundville case was adaptive, because:

> "societies which were hierarchically organized as chiefdoms survived the climatic changes of the twelfth century; those societies on the western fringes of the Mississippian area which had adopted agriculture but who still maintained their segmentary form of organization disappeared from the archaeological record."

On the other hand, Peebles and Kus dismiss the idea of a direct relationship between increasing differentiation and increasing adaptedness. According to their information processing model, a society can be organizationally over-differentiated to a point at which information processing is impeded. This contrasts with the opinion of Kirch (1980:116) which is that:

> "It is possible to argue that the range of behavioral variation at any point in time may be an index to the degree of adaptedness and/or rate of adaptation of the population."

Adaptation, as the generalized mechanism for behavioral diversity, is frequently used as a 'catch-all' explanation in cultural applications of the evolutionary paradigm. The change in conceptual scale, however, does not explain behavioral diversity any better than more ecologically-grounded models, which at least attempt to specify the interacting variables. The Kung, the Semang, and the Aranda culture groups, who all rate relatively low on the general diversity scale produced here, are frequently cited examples of cultural groups that are extremely well-adapted to their respective environments. If we accept Hardesty's (1977:45) definition of adaptation as "the process of creating beneficial relationships with the environment," then behavioral diversity, as inferred from artifactual materials, is a poor criterion of adaptedness. The general diversity index also does not work as a measure of adaptedness according to criteria of energy efficiency or population numbers. Number of adaptive responses may, in fact, be an unacceptable way to interpret behavioral diversity.

To a considerable extent, the application of the evolutionary paradigm to anthropological/archaeological explanation relies on superficial parallels. Although culture analysts recognize that cultural processes are not mechanistically identical to biological processes, few attempts have been made to refine, or re-define, biological concepts and nomenclature so that they are more culturally relevant. Similarities are emphasized and differences downplayed. Burnham (1973:94) summarizes the basic problem well:

> "no one has yet managed to specify processes operative in culture that are ... realistic equivalents to any of the key components of the biological evolutionary process. For the concept of adaptation to stand in anything more than a metaphorical relation to biological adaptation, phenomena like natural selection, the genetic transmission of traits, and mutation must be shown to have operational parallels in culture process."

One of the most problematic of the parallels advanced in that involving the species concept. This study has focussed on the species analogs proposed because the species concept is tha basis for diversity measurements and evaluating the developmental significance of diversity in collections. The flexibility and speed of human behavioral responses make them qualitatively very different from biological evolutionary responses in the form of new species. The general processes that generate and select for genetic variability are not adequate models for explaining behavioral variability.

This investigation of the ethnographic record to gain insights into the meaning of archaeological assemblage diversity does not come to any definitive conclusions as to how to interpret diversity in the archaeological record. It does, however, lead to questioning the validity of assumptions made, implicitly or explicitly, about the nature of cultural adaptation and the interpretive usefulness of the direct application of biological models to cultural phenomena.

Evolutionary and ecological models do not relieve archaeology from a dependence on anthropological observation. Rather, the interpretive utility of models drawn from outside the discipline must be evaluated in terms of anthropological observation.

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APPENDICES

Appendix A

Summary Data for the 186 Culture Groups in the Standard Cross-Cultural Sample

from

George P. Murdock and Douglas R. White
Ethnology 8: 329-369. 1969.

(descriptions for information codes are given at the end of the list)

* * *

1. Nama or Namaqua (Aa3: 102) of Province 1 (Hottentots). Language: Khoisan (Southern). Economy: D. Organization: J, P. Focus: The Gei//Khauan tribe (27°30′S, 17°E) reconstructed for 1860, just prior to their decimation and loss of independence in the Herero War. HRAF: FX13 (a). Authorities: Schultze, Schapera (secondary).
2. Kung (Aa1: 1) of Province 2 (Bushmen). Language: Khoisan (Southern). Economy: Gh. Organization: I, O. Focus: The Agau Kung of the Nyae Nyae region (19°50′S, 20°35′E) in 1950, when the Marshalls began their study of this still unacculturated group. HRAF: FX10 (a). Authority: L. Marshall.
3. Thonga or Bathonga (Ab4: 104) of Province 3 (Southeastern Bantu). Language: Niger-Congo (Bantoid). Economy: Cd. Organization: K, P. Focus: The Ronga subtribe around Lourenço Marques (25°50′S, 32°20′E) in 1895, at the beginning of Junod's missionary field work. HRAF: FT6 (a). Authority: Junod.
4. Lozi or Barotse (Ab3: 103) of Province 4 (Sotho). Language: Niger-Congo (Bantoid). Economy: Ad. Organization: L, R. Focus: The ruling Luyana (14° to 18°20′S, 22° to 25°E) in 1900, at the height of Barotse political expansion. HRAF: No file. Authority: Gluckman.
5. Mbundu or Ovimbundu (Ab5: 203) of Province 5 (Southwestern Bantu). Language: Niger-Congo (Bantoid). Economy: C. Organization: K, Pm. Focus: Bailundo subtribe (12°15′S, 16°30′E) in 1890, just prior to Portuguese conquest and missionization. HRAF: FP13 (a). Authority: Childs.
6. Suku or Pindi (Ac17: 731) of Province 6 (Western Central Bantu). Language: Niger-Congo (Bantoid). Economy: C. Organization: L, N. Focus: The Suku of Feshi Territory (6°S, 18°E) in 1920, just prior to their loss of independence. HRAF: No file. Authorities: Kopytoff, Torday & Joyce.
7. Bemba or Awemba (Ac3: 105) of Province 7 (Eastern Central Bantu). Language: Niger-Congo (Bantoid). Economy: C. Organization: L, M. Focus: The Bemba of Zambia (9° to 12°S, 29° to 32°E) in 1897, just prior to the advent of British administration. HRAF: FQ5 (b). Authority: Richards.
8. Nyakyusa (Ad6: 208) of Province 9 (Interior Tanzania). Language: Niger-Congo (Bantoid). Economy: Ad. Organization: K, P. Focus: The Nyakyusa around the towns of Mwaya (9°35′S, 34°10′E) and Masoko (9°20′S, 34°E) in 1934, at the beginning of the Wilsons' field work. HRAF: FN17 (b). Authority M. Wilson.
9. Hadza or Kindiga (Aa9: 726) of Province 10 (Rift). Language: Khoisan (Northern). Economy: Hg. Organization: I, O. Focus: The small Hadza tribe as a whole (3°20′ to 4°10′S, 34°40′ to 35°25′E) in 1930, when still unacculturated. HRAF: No file. Authorities: Kohl-Larsen, Woodburn.
10. Luguru or Waluguru (Ad14: 704) of Province 11 (Northeast Coastal Bantu).

Language: Niger-Congo (Bantoid). Economy: C. Organization: I, M. Focus: The Luguru of west central Morogoro District (6°25′ to 7°25′S, 37°20′ to 38°E) in 1925, the last date of the traditional political organization. HRAF: No file. Authorities: Beidelman, Scheerder & Tastevin.

11. Kikuyu or Akikuyu (Ad4: 108) of Province 12 (Kenya Highland Bantu). Language: Niger-Congo (Bantoid). Economy: Ad. Organization: I, P. Focus: The Kikuyu of the Metume or Fort Hall district (0°40′S, 37°10′E) in 1920, prior to intensive acculturation. HRAF: FL10 (a). Authorities: Kenyatta, Leakey.

12. Ganda or Baganda (Ad7: 306) of Province 13 (Lacustrine Bantu). Language: Niger-Congo (Bantoid). Economy: B. Organization: L, P. Focus: The Ganda of Kyaddondo district (0°20′N, 32°30′E) in 1875, just prior to the founding of Kampala and the initiation of significant administrative changes. HRAF: FK7 (a). Authorities: Roscoe, Mair.

13. Mbuti or Bambuti (Aa5: 202) of Province 15 (Pygmies). Language: Niger-Congo (Bantoid). Economy: Gh. Organization: I, O. Focus: The Epulu net-hunters of the Ituri Forest (1°30′ to 2°N, 28°15′ to 28°25′E) in 1950, just prior to Turnbull's field work. HRAF: No file. Authorities: Turnbull, Schebesta.

14. Nkundo Mongo (Ae4: 110) of combined Provinces 14 and 16 (Equatorial Bantu). Language: Niger-Congo (Bantoid). Economy: C. Organization: K, P. Focus: The Mongo of the Ilanga subtribe (0°15′ to 1°15′S, 18°35′ to 19°45′E) in 1930, the approximate date of Hulstaert's description. HRAF: FO32 (a). Authority: Hulstaert.

15. Banen or Banyin (Ae51: 830) of Province 17 (Cameroon Bantu). Language: Niger-Congo (Bantoid). Economy: C. Organization: I, P. Focus: The Ndiki subtribe (4°35′ to 4°45′N, 10°35′ to 11°E) in 1935, at the beginning of Dugast's field work. HRAF: No file. Authority: Dugast.

16. Tiv or Munshi (Ah3: 116) of combined Provinces 29 and 30 (Nigerian Plateau). Language: Niger-Congo (Bantoid). Economy: C. Organization: J, R. Focus: The Tiv of Benue Province (6°30′ to 8°N, 8° to 10°E) in 1920, prior to extensive organizational changes wrought by the British. HRAF: FF57 (a). Authorities: Bohannan, East.

17. Ibo or Igbo (Af10: 643 of Province 18 (Southeastern Nigeria). Language: Niger-Congo (Kwa). Economy: C. Organization: J, P. Focus: The Eastern and Peripheral subgroups of the Isu-Ama division of the Southern or Owerri Ibo (5°20′ to 5°40′N, 7°10′ to 7°30′E) in 1935, near the beginning of Green's field work. HRAF: No file. Authorities: Green, Uchendu.

18. Fon or Dahomeans (Af1: 10) of Province 19 (Slave Coast). Language: Niger-Congo (Kwa). Economy: C. Organization: L, P. Focus: The Fon in the vicinity of Abomey (7°12′N, 1°56′E) in 1890, prior to the conquest of the Dahomean kingdom by the French. HRAF: No file. Authorities: Herskovits, Le Herissé.

19. Ashanti (Af3: 111) of Province 20 (Akan). Language: Niger-Congo (Kwa). Economy: C. Organization: K, Np. Focus: The Ashanti of the state of Kumasi (6° to 8°N, 0° to 3°W) in 1895, just prior to British conquest. HRAF: FE12 (a). Authorities: Rattray, Fortes.

20. Mende (Af5: 211) of Province 21 (Grain Coast). Language: Niger-Congo (Mande). Economy: C. Organization: J, P. Focus: The central Mende around the town of Bo (7°50′N, 12°W) in 1945, at the beginning of Little's field work. HRAF: FC7 (a). Authority: Little.

21. Wolof or Ouolof (Cb2: 21) of Province 22 (Senegambians). Language: Niger-Congo (Atlantic). Economy: Cd. Organization: K, Pm. Focus: The Wolof of Upper and Lower Salum in the Gambia (centering on 13°45′N, 15°20′W) in 1950, the date of the field work of Ames. HRAF: MS30 (a). Authorities: Ames, Gamble.

22. Bambara or Banmana (Ag1: 12) of Province 24 (Mande). Language: Niger-Congo (Mande). Economy: A. Organization: J. P. Focus: The Bambara along the Niger River from Segou to Bamako (12°30′ to 13°N, 6° to 8°W) in 1902,

at approximately the beginning of Henry's field experience as a missionary and Monteil's as an administrator. HRAF: FA8 (a). Authorities: Monteil, Henry, Pacques (secondary).

23. Tallensi (Ag4: 114) of combined Provinces 26 and 27 (Voltaic Peoples). Language: Niger-Congo (Voltaic or Gur). Economy: A. Organization: I, P. Focus: The small Tallensi tribe as a whole (10°30′ to 10°45′N, 0°30′ to 0°50′W) in 1934, at the beginning of the field work of Fortes. HRAF: FE11 (a). Authority: Fortes.
24. Songhai (Cb3: 122) of Province 25 (Songhai). Language: Songhaic. Economy: Ad. Organization: L, P. Focus: The Songhai of the Bamba or central division (16° to 17°15′N, 0°10′E to 3°10′W) in 1940, at approximately the beginning of the field work of Rouch and Miner. HRAF: No file. Authorities: Rouch, Miner.
25. Fulani (Cb24: 1082) of Province 23 (Fulani). Language: Niger-Congo (Atlantic). Economy: D. Organization: J, P. Focus: The Alijam and Degeriji subgroups of Wodaabe Fulani around Adan and Damergou in Niger (13° to 17°N, 5° to 10°E) in 1951, at the beginning of the field work of Dupire and Stenning. HRAF: No file. Authorities: Dupire, Stenning.
26. Hausa (Cb26: 1084) of Province 28 (Hausa). Language: Afroasiatic or Hamito-Semitic (Chadic). Economy: Ad. Organization: L, P. Focus: The Zazzagawa Hausa (9°30′ to 11°30′N, 6° to 9°E) in 1900, just prior to the advent of British rule. HRAF: MS12 (b). Authority: Smith.
27. Massa or Bana (Ai9: 646) of Province 31 (Lake Chad Region). Language: Afroasiatic (Chadic). Economy: Af. Organization: I, P. Focus: The Cameroon Massa around Yagoua (10°20′N, 15°15′E) in 1910, the approximate date of the early field work by von Hagen. HRAF: No file. Authorities: de Garine, von Hagen.
28. Azande or Niam-Niam (Ai3: 117) of combined Provinces 33 and 34 (North Equatoria). Language: Niger-Congo (Eastern). Economy: C. Organization: K, P. Focus: The Azande of the Yambio chiefdom (4°20′ to 5°50′N, 27°40′ to 28°50′E). in 1905, just prior to British conquest and the collapse of the Avongara political system. HRAF: FO7 (a). Authority: Evans-Pritchard.
29. Fur or For (Cb17: 875) of Province 32 (Wadai and Darfur). Language: Furian. Economy: Ad. Organization: L, M. Focus: The Fur of western Darfur around Jebel Marra (13°30′N, 25°30′E) in 1880, prior to effective Egyptian subjugation. HRAF: No file. Authorities: Felkin, Beaton.
30. Otoro (Ai10: 647) of Province 35 (Nuba). Language: Kordofanian. Economy: A. Organization: J, P. Focus: The Otoro of the Nuba Hills (11°20′N, 30°40′E) in 1930, prior to substantial migration into the plains. HRAF: No file. Authority: Nadel.
31. Shilluk (Ai6: 218) of Province 37 (Northern Nilotes). Language: Chari-Nile or Sudanic (Eastern). Economy: C. Organization: J, P. Focus: The politically unified Shilluk as a whole (9° to 10°30′N, 31° to 32°E) in 1910, the date of the field work by Westermann and the Seligmans. HRAF: FJ23 (a). Authorities: C. & B. Seligman, Westermann.
32. Mao (Ai47: 1062) of Province 36 (Prenilotes). Language: Koman. Economy: C. Organization: J, P. Focus: The Northern Mao (9°5′ to 9°35′N, 34°30′ to 34°50′E) in 1939, the date of Grottanelli's field work. HRAF: No file. Authority: Grottanelli.
33. Kafa or Kafficho (Ca30: 860) of Province 39 (Western Cushites). Language: Afroasiatic (Western Cushitic). Economy: A. Organization: L, P. Focus: The politically unified Kafa as a whole (6°50′ to 7°45′N, 35°30′ to 37°E) in 1905, the date of Bieber's field work. HRAF: No file. Authority: Bieber.
34. Masai (Aj2: 119) of Province 38 (Southern Nilotes). Language: Chari-Nile (Eastern). Economy: D. Organization: J, P. Focus: The Kisonko or Southern Masai of Tanzania (1°30′ to 5°30′S, 35° to 37°30′E) in 1900, about the time of Merker's field work. HRAF: FL12 (c). Authorities: Merker, Jacobs.

35. Konso (Ca1: 18) of Province 40 (Galla-Konso). Language: Afroasiatic (Eastern Cushitic). Economy: Ad. Organization: J, P. Focus: The Konso of the town of Buso (5°15'N, 37°30'E) in 1935, the date of Jensen's field work. HRAF: No file. Authorities: Hallpike, Jensen.
36. Somali (Ca2: 19) of Province 41 (Horn). Language: Afroasiatic (Eastern Cushitic). Economy: D. Organization: K, P. Focus: The Dolbahanta subtribe (7° to 11°N, 45°30' to 49°E) in 1900, subsequent to the earliest descriptions but prior to the later and fuller accounts. HRAF: MO4 (c). Authority: Lewis.
37. Amhara (Ca7: 679) of Province 42 (Central Ethiopia). Language: Afroasiatic (Semitic). Economy: Ad. Organization: L, O. Focus: The Amhara of the Gondar district (11° to 14°N, 36° to 38°30'E) in 1953, at the beginning of Messing's field work. HRAF: MP5 (a). Authority: Messing.
38. Bogo or Belen (Ca37: 867) of Province 43 (Central and Northern Cushites). Language: Afroasiatic (Central Cushitic). Economy: D. Organization: J, P. Focus: The small Bogo tribe as a whole (15°45'N, 38°45'E) in 1855, the approximate date of Munzinger's field work. HRAF: No file. Authority: Munzinger.
39. Nubians (Cd1: 24) of Province 44 (Nubians). Language: Chari-Nile (Nubian). Economy: Ad. Organization: Integrated in the large Egyptian state, P. Focus: The Kenuzi or northernmost branch of the Barabra or Nile Nubians (22° to 24°N, 32° to 33°E) in 1900, just prior to their displacement by the first Aswan dam. HRAF: No file. Authority: Herzog.
40. Teda (Cc2: 23) of Province 45 (Tebu). Language: Kanuric or Central Saharan. Economy: Ad. Organization: J, P. Focus: The Teda of Tibesti (19° to 22°N, 16° to 19°E) in 1950, the approximate date of Chapelle's field work. HRAF: No file. Authorities: Chapelle, Le Coeur.
41. Tuareg (Cc9: 880) of Province 46 (Tuareg). Language: Afroasiatic (Berber). Economy: Da. Organization: J, N. Focus: The Ahaggaren or Tuareg of Ahaggar (21° to 25°N, 4° to 9°E) in 1900, prior to the French military occupation of the Sahara. HRAF: MS25 (a). Authorities: Nicolaisen, Lhote.
42. Riffians (Cd3: 125) of combined Provinces 47 and 48 (Berbers of the Maghreb). Language: Afroasiatic (Berber). Economy: Ad. Organization: J, P. Focus: The Riffians as a whole (34°20' to 35°30'N, 2°30' to 4°W) in 1926, at the beginning of Coon's field work. HRAF: MX3 (b). Authority: Coon.
43. Egyptians (Cd2: 124) of Province 49 (Arabs of North Africa). Language: Afroasiatic (Semitic). Economy: Ad. Organization: L, P. Focus: The town and environs of Silwa (24°45'N, 33°E) in 1950, the approximate date of Ammar's field work. HRAF: MR13 (a). Authorities: Ammar, Wilber (secondary).
44. Hebrews (Cj3: 230) of Province 51 (Jews). Language: Afroasiatic (Semitic). Economy: Ad. Organization: K, P. Focus: The kingdom of Judah (30°30' to 31°55'N, 34°20' to 35°30'E) in 621 B.C., the date of promulgation of the Deuteronomic laws. HRAF: No file. Authorities: Old Testament, DeVaux (secondary).
45. Babylonians (Cj4: 413) of Province 53 (Ancient Mesopotamia). Language: Afroasiatic (Semitic). Economy: A. Organization: L, O. Focus: The city and environs of Babylon (32°35'N, 44°45'E) in 1750 B.C., at the end of the reign of Hammurabi. HRAF: No file. Authorities: Pritchard (translation of Hammurabi's law code), Saggs (secondary).
46. Rwala (Cj2: 132) of Province 52 (Arabs of Arabia and the Levant). Language: Afroasiatic (Semitic). Economy: D. Organization: J, P. Focus: The Rwala Bedouin of south central Syria and northeastern Jordan (31° to 35°30', 36° to 41°E) in 1913, early in the periods of field work of Musil and Raswan. HRAF: MD4 and MJ1 (a). Authorities: Musil, Raswan.
47. Turks (Ci5: 653) of Province 54 (Turkey). Language: Altaic (Turkic). Economy: Ad. Organization: L, O. Focus: The Turks of the northern Anatolian plateau (38°40' to 40°N, 32°40' to 35°50'E) in 1950, during the periods of field work of Stirling and Makal. HRAF: MB1 (b). Authorities: Stirling, Makal.

48. Gheg (Ce1: 25) of Province 55 (Balkans). Language: Indo-European (Albanian). Economy: Ad. Organization: K, P. Focus: The Mountain Gheg of northern Albania (41°20′ to 42°N, 19°30′ to 20°31′E) in 1910, just prior to the expulsion of the Turks in the two Balkan Wars. HRAF: EG1 (a). Authorities: Coon, Durham.
49. Romans (Ce3: 126) of eastern Province 56 (Greece and Italy). Language: Indo-European (Italic). Economy: Ae. Organization: L, O. Focus: The Romans of the city and environs of Rome (41°50′N, 13°30′E) in A.D. 110, the twelfth year of Trajan's reign at the approximate zenith of the imperial period. HRAF: No file. Authorities: Pliny the Younger, Carcopino (secondary), Friedländer (secondary).
50. Basques (Ce4: 225) of western Province 56 (Southwestern Europeans). Language: Basque. Economy: Ad. Organization: Integrated in the large Spanish state, O. Focus: The mountain village of Vera de Bidasoa (43°18′N, 1°40′W) in 1934 the date of the field work by Caro Baroja. HRAF: No file. Authority: Caro Baroja.
51. Irish (Cg3: 128) of Province 57 (Northwestern Europeans). Language: Indo-European (Celtic). Economy: Ad. Organization: K, O. Focus: The Irish of County Clare (52°40′ to 53°10′N, 8°20′ to 10°W) in 1932, at the time of the field work by Arensberg and Kimball. HRAF: ER6 (a). Authorities: Arensberg & Kimball, Cresswell.
52. Lapps (Cg4: 129) of Province 58 (Lapps). Language: Uralic (Finnic). Economy: D. Organization: I, O. Focus: The Konkama Lapps of Karesuando parish in northern Sweden (68°20′ to 69°5′ N, 20°5′ to 23°E) in 1950, during the period of Pehrson's field work. HRAF: EP4 (a). Authorities: Pehrson, Whitaker.
53. Yurak Samoyed or Nenets (Ec4: 136) of Province 73 (Ostyak and Samoyed). Language: Uralic (Samoyedic). Economy: Df. Organization: I, P. Focus: The Tundra Yurak (65° to 71°N, 41° to 62°E) in 1894, during the periods of observation by Englehardt and Jackson. HRAF: RU4 (a). Authorities: Jackson, Englehardt.
54. Russians (not in EA) of Province 59 (Northeastern Europe). Language: Indo-European (Slavic). Economy: A. Organization: L, O. Focus: The Great Russians of the peasant village of Viriatino (52°40′N, 41°20′E) in 1955, the date of the field work by Kushner. HRAF: RF1 (c). Authorities: Kushner, Dunn & Dunn (secondary).
55. Abkhaz (not in EA) of Province 60 (Caucasus). Language: Abasgo-Kerketian. Economy: Ad. Organization: J, P. Focus: The small Abkhaz tribe as a whole (42°50′ to 43°25′N, 40° to 41°35′E) in 1880, at about the time of Dzhanashvili's field work. HRAF: RI3 (b). Authority: Dzhanashvili.
56. Armenians (Ci10: 912) of Province 61 (Armenia and Azerbaijan). Language: Indo-European (Armenian). Economy: Ad. Organization: L, O. Focus: The Armenians in the vicinity of Erevan (40°N, 44°30′E) in 1843, the date of the field observations by Haxthausen. HRAF: RJ1 and RJ3 (not included in tabulation). Authority: Haxthausen.
57. Kurd (Ci11: 913) of Province 62 (North Iran). Language: Indo-European (Iranian). Economy: Ad. Organization: K, P. Focus: The Kurd of the town and environs of Rowanduz (36°30′N, 44°30′E) in 1951, the date of the field work by Masters. HRAF: MA11 (c). Authorities: Masters, Leach.
58. Basseri (Ea6: 358) of Province 63 (South Iran). Language: Indo-European (Iranian). Economy: D. Organization: J, P. Focus: The nomadic Basseri (27° to 31°N, 53° to 54°E) in 1958, during the period of Barth's field work. HRAF: No file. Authority: Barth.
59. Punjabi (not in EA) of Province 64 (Indus Valley). Language: Indo-European (Indic). Economy: A. Organization: L, P. Focus: The western Punjabi of the village of Mohla (32°30′N, 74°E) in 1950, during the period of Eglar's field work. HRAF: AW6 (c). Authority: Eglar.
60. Gond (Eg3: 142) of Province 67 (Southeast India). Language: Dravidian.

Economy: C. Organization: J, P. Focus: The Hill Maria Gond (19°15′ to 20°N, 80°30′ to 81°20′E) in 1938, during the period of Grigson's field observations. HRAF: AW32 (a). Authority: Grigson.

61. Toda (Eg4: 143) of Province 65 (Southwest India). Language: Dravidian. Economy: D. Organization: J, Pm. Focus: The small Toda tribe as a whole (11° to 12°N, 76° to 77°E) in 1900, just prior to the field work of Rivers. HRAF: AW60 (a). Authority: Rivers.

62. Santal (Ef1: 42) of Province 68 (Munda). Language: Mon-Khmer (Munda). Economy: A. Organization: J, P. Focus: The Santal of the Bankura and Birbhum districts of Bengal (23° to 24°N, 86°50′ to 87°30′E) in 1940, during the period of Culshaw's field work. HRAF: No file (but one in process). Authorities: Culshaw, Datta-Majumder.

63. Uttar Pradesh (not in EA) of Province 69 (North India). Language: Indo-European (Indic). Economy: A. Organization: K, P. Focus: The village of Senapur in the small kingdom of Dobhi Taluka (25°55′N, 83°E) in 1945, prior to a major shift in the traditional power base. HRAF: AW19 (c). Authorities: Cohn, Opler & Singh.

64. Burusho (Ee2: 139) of combined Provinces 70 and 71 (Afghanistan and Dardistan). Language: Burushaski. Economy: Ad. Organization: J, P. Focus: The Burusho of Hunza state (36°20′ to 36°30′N, 74°30′ to 74°40′E) in 1934, during the period of the Lorimers' field work. HRAF: AV7 (a). Authorities: D. and E. Lorimer.

65. Kazak (Eb1: 35) of Province 72 (Turkestan). Language: Altaic (Turkic). Economy: D. Organization: L, P. Focus: The Kazak of the Great Horde (37° to 48°N, 68° to 81°E) in 1885, the approximate time of Grodekov's field work. HRAF: RQ2 (b). Authorities: Grodekov, Hudson.

66. Khalka Mongols (Eb3: 134) of Province 82 (Mongols). Language: Altaic (Mongolic). Economy: D. Organization: L, P. Focus: The Khalka of the Narobanchin temple territory (47° to 47°20′N, 95°10′ to 97°E) in 1920, the approximate date of Vreeland's reconstruction. HRAF: AH7 (b). Authority: Vreeland.

67. Lolo or Nosu (Ed2: 40) of Province 84 (Southwest China). Language: Tibeto-Burman (Akha-Lahu-Lisu-Lolo subfamily). Economy: Ad. Organization: I, P. Focus: The independent and relatively unacculturated Lolo of the Taliang Shan mountains (26° to 29°N, 103° to 104°E) in 1910, the approximate date of the field work by D'Ollone. HRAF: AE4 (c). Authorities: D'Ollone, Lin.

68. Lepcha or Rong (Ee3: 140) of Province 85 (Tibet). Language: Tibeto-Burman (Tibetan). Economy: Ad. Organization: J, P. Focus: The Lepcha in the vicinity of Lingthem in Sikkim (27° to 28°N, 89°E) in 1937, the date of Gorer's field work. HRAF: AK5 (a). Authorities: Gorer, Morris.

69. Garo (Ei1: 47) of Province 87 (Garo-Khasi). Language: Tibeto-Burman (Garo). Economy: C. Organization: J, M. Focus: The Garo of Rengsanggri and neighboring intermarrying villages (26°N, 91°E) in 1955, during the period of Burling's field work. HRAF: No file (but one in process). Authority: Burling.

70. Lakher or Mara (Ei4: 147) of combined Provinces 87 and 88 (North Burma and South Assam). Language: Tibeto-Burman (Kuki-Chin). Economy: C. Organization: J, P. Focus: The small Lakher tribe as a whole (22°20′N, 93°E) in 1930, the approximate date of Parry's field work. HRAF: no file. Authority: Parry.

71. Burmese (Ei3: 146) of Province 89 (South Burma). Language: Tibeto-Burman (Burman). Economy: A. Organization: L, O. Focus: The village of Nondwin in Upper Burma (22°N, 95°40′E) in 1965, during the period of Nash's field work. HRAF: AP1 (c). Authorities: Nash, Scott.

72. Lamet (Ej1: 49) of Province 90 (Palaung-Wa). Language: Tibeto-Burman (Palaung-Wa). Economy: C. Organization: I, P. Focus: The small Lamet tribe as a whole (20°N, 100°40′E) in 1940, the approximate date of the field work by Izikowitz. HRAF: No file. Authority: Izikowitz.

73. Vietnamese (Ej4: 149) of Province 97 (Vietnam and Hainan). Language: Annam-Muong. Economy: A. Organization: L, P. Focus: The Tonkinese or North Vietnamese of the delta of the Red River (20° to 21°N, 105°30′ to 107°E) in 1930, during Gourou's period of field work. HRAF: AM11 (a). Authority: Gourou.

74. Rhade (Ej10: 456) of Province 96 (Montagnards). Language: Malayo-Polynesian (Hesperonesian). Economy: C. Organization: I, M. Focus: The Rhade of the village of Ko-sier on the Darlac plateau (13°N, 108°E) in 1962, the date of Donoghue's field work. HRAF: No file. Authorities: Donoghue *et al.*

75. Khmer or Cambodians (Ej5: 248) of Province 95 (Cambodia). Language: Mon-Khmer (Khmer). Economy: A. Organization: L, O. Focus: The city of Angkor (13°30′N, 103°50′E), the capital of the old Khmer kingdom at its height, in 1292, the date of the visit and description by Chou. HRAF: AM4 (c). Authorities: Chou Ta-Kuan, Groslier, Aymonier.

76. Siamese or Central Thai (Ej9: 367) of Province 91 (Thai). Language: Thai-Kadai. Economy: A. Organization: L, O. Focus: The Central Thai village of Bang Chan (14°N, 100°50′E) about 1955, the midpoint of the Cornell University research project. HRAF: AO1 (c). Authorities: Sharp, L. & J. Hanks.

77. Semang (Ej3: 148) of Province 94 (Semang-Sakai). Language: Mon-Khmer (Semang-Sakai). Economy: Gh. Organization: I, O. Focus: The Jahai subtribe (4°30′ to 5°30′N, 101° to 101°30′E) in 1925, at the approximate beginning of Schebesta's field work. HRAF: AN6 (b). Authorities: Schebesta, Evans.

78. Nicobarese (Eh5: 244) of Province 93 (Nicobar Islands). Language: Mon-Khmer (Khasi-Nicobarese). Economy: B. Organization: I, O. Focus: The Nicobarese of the northern islands of Car Nicobar, Chowra, Teressa, and Bompoka (8°15′ to 9°15′N, 92°40′ to 93°E) in 1870, near the beginning of Man's administrative experience. HRAF: No file. Authorities: Man, Whitehead.

79. Andamanese (Eh1: 45) of Province 92 (Andaman Islands). Language: Andamanese. Economy: Fg. Organization: I, O. Focus: The Aka-Bea tribe of South Andaman (11°45′ to 12°N, 93° to 93°10′E) in 1860, prior to significant acculturation and depopulation. HRAF: AZ2 (a). Authorities: Man, Radcliffe-Brown.

80. Vedda (Eh4: 145) of Province 66 (Ceylon). Language: Indo-European (Indic). Economy: Gh. Organization: I, M. Focus: The Danigala group of Forest Vedda (7°30′ to 8°N, 81° to 81°30′E) in 1860, the date of the observations by Bailey made prior to intensive acculturation. HRAF: AX5 (a). Authorities: C. and B. Seligmann, Bailey.

81. Tanala (Eh3: 144) of Province 8 (Madagascar). Language: Malayo-Polynesian (Hesperonesian). Economy: A. Organization: J, P. Focus: The Menabe subtribe (22°S, 48°E) in 1925, just prior to Linton's field work. HRAF: FY8 (b). Authority: Linton.

82. Negri Sembilan (not in EA) of Province 102 (Malaya and Sumatra). Language: Malayo-Polynesian (Hesperonesian). Economy: A. Organization: K, M. Focus: The district of Inas (2°30′ to 2°40′N, 102°10′ to 102°20′E), in 1958, the date of Lewis' field work. HRAF: AN5(b). Authority: Lewis.

83. Javanese (Ib2: 54) of Province 103 (Java). Language: Malayo-Polynesian (Hesperonesian). Economy: A. Organization: L, O. Focus: The town and environs of Pare in central Java (7°43′S, 112°13′E) in 1954, during the period of field work of the Geertzes. HRAF: No file. Authorities: C. and H. Geertz.

84. Balinese (Ib3: 152) of Province 104 (Western Lesser Sundas). Language: Malayo-Polynesian (Hesperonesian). Economy: Ad. Organization: K, R. Focus: The village of Tihingan in the district of Klunghung (8°30′S, 105°20′E) in 1958, the date of the field work of the Geertzes. HRAF: OF7 (c). Authorities: C. and H. Geertz.

85. Iban or Sea Dayak (Ib1: 53) of Province 101 (Borneo). Language: Malayo-Polynesian (Hesperonesian). Economy: C. Organization: I, O. Focus: The Iban

of the Ulu Ai group (2°N, 112°30′ to 113°30′E) in 1950, near the beginning of Freeman's field work. HRAF: OC6 (a). Authority: Freeman.

86. Badjau (Ia13: 1099) of Province 100 (Badjau or Sea Gypsies). Language: Malayo-Polynesian (Hesperonesian). Economy: F. Organization: I, O. Focus: The Badjau of southwestern Tawi-Tawi and adjacent islands of the Sulu Archipelago (5°N, 120°E) in 1963, the date of Nimmo's field work. HRAF: No file. Authority: Nimmo.

87. Toradja (Ic5: 254) of Province 105 (Celebes). Language: Malayo-Polynesian (Hesperonesian). Economy: C. Organization: J, O. Focus: The Bare'e subgroup of eastern Toradja (2°S, 121°E) in 1910, the approximate date of the completion of the field work by Adriani and Kruijt. HRAF: No file (but one in process). Authorities: Adriani & Kruijt.

88. Tobelorese or Tobelo (Ic10: 1118) of Province 106 (Moluccas). Language: Papuan (distinct family). Economy: C. Organization: K, O. Focus: The Tobelorese as a whole (2°N, 128°E) in 1900, just prior to the missionary field work of Hueting. HRAF: No file. Authorities: Hueting, Riedel.

89. Alorese or Abui (Ic2: 154) of Province 107 (Southeastern Indonesia). Language: Malayo-Polynesian (Moluccan). Economy: C. Organization: K, P. Focus: The village complex of Atimelang in north central Alor (8°20′S, 124°40′E) in 1938, at the beginning of the field work by DuBois. HRAF: OF5 (a). Authority: DuBois.

90. Tiwi (Id3: 157) of Province 108 (Tropical Australia). Language: Australian. Economy: Gh. Organization: I, M. Focus: The Tiwi of Bathurst and Melville Islands as a whole (11° to 11°45′S, 130° to 132°E) in 1929, the date of Hart's field work. HRAF: OI20 (a). Authorities: Hart & Pilling, Goodale.

91. Aranda or Arunta (Id1: 56) of Province 109 (Central and Southern Australia). Language: Australian. Economy: Gh. Organization: I, Pm. Focus: The Arunta Mbainda of Alice Springs (23°30′ to 25°S, 132°30′ to 134°20′E) in 1896, the date of the early field work by Spencer and Gillen. HRAF: OI8 (a). Authorities: Spencer & Gillen, Strehlow.

92. Orokaiva (Ie9: 457) of Province 111 (Southeastern New Guinea). Language: Papuan (distinct family). Economy: B. Organization: I, P. Focus: The Aiga subtribe (8°20′ to 8°40′S, 147°50′ to 148°10′E) in 1925, at the end of the second period of field work by Williams. HRAF: OJ23 (a). Authority: Williams.

93. Kimam (Ie18: 1101) of Province 112 (Southern New Guinea). Language: Papuan (Kiwai family). Economy: A. Organization: I, O. Focus: The village of Bamol in northeast central Frederick Hendrik Island or Kolekom (7°30′S, 138°30′E) in 1960, at the beginning of Serpenti's field work. HRAF: No file. Authority: Serpenti.

94. Kapauku (Ie1: 57) of Province 114 (Northwestern New Guinea). Language: Papuan (distinct family). Economy: C. Organization: J, P. Focus: The village of Botukebo in the Kamu Valley (c.4°S, 36°E) in 1955, the date of Pospisil's first field trip. HRAF: OJ29 (c). Authority: Pospisil.

95. Kwoma (Ie12: 655) of Province 113 (Northeastern New Guinea). Language: Papuan (Middle Sepik family). Economy: Bg. Organization: I, P. Focus: The Hongwam subtribe (4°10′S, 142°40′E) in 1937, at the conclusion of Whiting's field work. HRAF: No file. Authority: J. Whiting.

96. Manus (Ig9: 373) of Province 120 (Admiralty and Western Islands). Language: Malayo-Polynesian (Melanesian). Economy: Ef. Organization: I, Pm. Focus: The village of Peri (2°10′S, 147°E) in 1929, the date of Mead's first field trip. HRAF: OM6 (a). Authority: Mead.

97. New Ireland (Ig4: 163) of Province 121 (New Britain and New Ireland). Language: Malayo-Polynesian (Melanesian). Economy: Bf. Organization: I, M. Focus: The village of Lesu (2°30′S, 151°E) in 1930, at the time of Powdermaker's field work. HRAF: OM10 (a). Authority: Powdermaker.

98. Trobrianders (Ig2: 62) of Province 122 (Massim). Language: Malayo-Polynesian

(Melanesian). Economy: B. Organization: J, M. Focus: The island of Kiriwina (8°38'S, 151°4'E) in 1914, at the beginning of Malinowski's field work. HRAF: OL6 (a). Authority: Malinowski.

99. Siuai or Motuna (Ig1: 61) of Province 123 (Solomon Islands). Language: Papuan (distinct family). Economy: B. Organization: I, M. Focus: The north-eastern Siuai of southern Bougainville (7°S, 155°20'E) in 1939, at the conclusion of Oliver's field work. HRAF: No file. Authority: Oliver.

100. Tikopia (Ii2: 66) of Province 124 (Polynesian Outliers). Language: Malayo-Polynesian (Polynesian). Economy: Bf. Organization: J, P. Focus: The small island of Tikopia as a whole (12°30'S, 168°30'E) in 1930, at the conclusion of Firth's first field trip. HRAF: OT11 (a). Authority: Firth.

101. Pentecost (Ih3: 164) of combined Provinces 125 and 126 (New Hebrides and Banks Islands). Language: Malayo-Polynesian (Melanesian). Economy: B. Organization: I, P. Focus: The village of Bunlap and neighboring intermarrying pagan villages in southeastern Pentecost Island (16°S, 168°E) in 1953, the date of the first field trip by the Lanes. HRAF: No file. Authorities: R. and B. Lane.

102. Mbau Fijians (not in EA) of Province 128 (Fiji and Rotuma). Language: Malayo-Polynesian (Melanesian). Economy: Bf. Organization: K, P. Focus: The island of Mbau off the east coast of Viti Levu (18°S, 178°35'E) in 1840, the approximate date of the best early descriptions. HRAF: No file. authorities: Tonganivalu, Waterhouse.

103. Ajie (Ih5: 263) of Province 127 (New Caledonia and Loyalty Islands). Language: Malayo-Polynesian (Melanesian). Economy: A. Organization: J, P. Focus: The petty chiefdom of Neje (21°20'S, 165°40'E), reconstructed for 1845, prior to strong European influence. HRAF: no file. Authorities: Leenhardt, Guiart.

104. Maori (Ij2: 167) of Province 130 (Southern Polynesia). Language: Malayo-Polynesian (Polynesian). Economy: B. Organization: J, R. Focus: The Nga Puhi tribe of the nothern isthmus (35°10' to 35°30'S, 174° to 174°20'E) in 1820, prior to European settlement and missionization. HRAF: OZ4 (c). Authorities: Earle, Clarke.

105. Marquesans (Ij3: 168) of Province 131 (Eastern Polynesia). Language: Malayo-Polynesian (Polynesian). Economy: Bf. Organization: J, R. Focus: The Te-i'i chiefdom of southwestern Nuku Hiva Island (8°55'S, 140°10'W) about 1800, at about the time of the earliest reliable descriptions. HRAF: OX6 (c). Authorities: Fleurieu, Forster, Langsdorff.

106. Samoans (Ii1: 65) of Province 129 (Western Polynesia). Language: Malayo-Polynesian (Polynesian). Economy: Bf. Organization: K, R. Focus: The kingdom of Aana in western Upolu Island (13°48' to 14°S, 171°54' to 172°3'W) in 1829, prior to the military defeat of Aana and the beginning of intensive European contact. HRAF: OU8 (b). Authorities: Turner, Stair.

107. Gilbertese (If14: 633) of Province 119 (Gilbert Islands). Language: Malayo-Polynesian (Carolinian). Economy: Bf. Organization: J, R. Focus: The northern Gilbertese of Makin and Butiritari islands (3°30'N, 172°20'E), reconstructed for about 1890. HRAF: No file. Authority: Lambert.

108. Marshallese (If3: 160) of Province 118 (Marshall Islands and Nauru). Language: Malayo-Polynesian (Carolinian). Economy: Bf. Organization: J, M. Focus: The atoll of Jaluit (6°N, 165°30'E) in 1900, the mean date of the early German ethnographers. HRAF: OR11 (a). Authorities: Erdland, Krämer & Nevermann.

109. Trukese (If2: 60) of Province 117 (Central and Eastern Carolines). Language: Malayo-Polynesian (Carolinian). Economy: Bf. Organization: I, M. Focus: The island of Romonum or Ulalu (7°24'N, 151°40'E) in 1947, the date of the Yale field expedition to Truk. HRAF: OR19 (b). Authorities: Goodenough, LeBar, Gladwin & Sarason.

110. Yapese (If6: 260) of Province 116 (Yap). Language: Malayo-Polynesian (Carolinian). Economy: Bf. Organization: J, Pm. Focus: The island of Yap as a

whole (9°30′N, 138°10′E) in 1910, at the close of Müller's period of field work. HRAF: OR22 (a). Authorities: Müller, Schneider.

111. Palauans (If1: 59) of Province 115 (Palau and Marianas). Language: Malayo-Polynesian (Hesperonesian). Economy: Bf. Organization: K, N. Focus: The village of Ulimang in northern Babelthuap Island (7°30′N, 134°35′E) in 1947, the date of Barnett's field work. HRAF: No file. Authorities: Barnett, Krämer.

112. Ifugao (Ia3: 150) of Province 99 (Philippines). Language: Malayo-Polynesian (Hesperonesian). Economy: A. Organization: I, O. Focus: The Central and Kiangan Ifugao (16°50′N, 121°10′E) in 1910, near the beginning of Barton's field work. HRAF: OA19 (b). Authorities: Barton, Lambrecht.

113. Atayal (Ia1: 51) of Province 98 (Formosa). Language: Malayo-Polynesian (Hesperonesian). Economy: C. Organization: J, R. Focus: The Atayal proper (excluding the Sedeq) as a whole (23°50′ to 24°50′N, 120°20′ to 120°50′E) about 1930, when the aboriginal culture was still relatively intact. HRAF: AD4 (c). Authorities: Okada, Li.

114. Chinese (not in EA) of Province 83 (Chinese). Language: Sinitic (Wu dialect). Economy: Ad. Organization: L, P. Focus: The village of Kaihsienkung in northern Chekiang (31°N, 120°5′E) in 1936, the date of Fei's field work. HRAF: AF1 (a). Authority: Fei.

115. Manchu (Ed3: 137) of Province 81 (Tungusic Peoples). Language: Altaic (Tungusic). Economy: Ad. Organization: Incorporated in the large Chinese state, P. Focus: The Aigun district of northern Manchuria (50°N, 125°30′E) in 1915, the date of the beginning of Shirokogoroff's field work. HRAF: AG1 (a). Authority: Shirokogoroff.

116. Koreans (Ed1: 39) of Province 80 (Korea). Language: Korean. Economy: Ad. Organization: L, P. Focus: The village of Sondup'o and town of Samku Li on Kanghwa Island (37°37′N, 126°25′E) in 1947, the date of Osgood's field work. HRAF: AA1 (a). Authority: Osgood.

117. Japanese (Ed5: 237) of Province 79 (Japan). Language: Japano-Ryukyuan. Economy: Ac. Organization: L, O. Focus: The village of Niiike in Okayama prefecture (34°40′N, 133°48′E) in 1950, at the beginning of the University of Michigan Japanese Project. HRAF: No file. Authorities: Beardsley, DeVos & Wagatsuma.

118. Ainu (Ec7: 325) of Province 78 (Ainu). Language: Ainu. Economy: Fh. Organization: J, M. Focus: The Ainu of the basins of the Tokapchi and Saru rivers in southeastern Hokkaido (42°40′ to 43°30′N, 142° to 144°E), reconstructed for about 1880. HRAF: AB6 (c). Authorities: Watanabe, Munro, Batchelor.

119. Gilyak (Ec1: 37) of Province 77 (Lower Amur). Language: Gilyak. Economy: Fh. Organization: I, P. Focus: The Gilyak of Sakhalin Island (53°30′ to 54°30′N, 141°50′ to 143°10′E) in 1890, at the beginning of Shternberg's field work. HRAF: RX2 (a). Authority: Shternberg.

120. Yukaghir (Ec6: 236) of combined Provinces 74 and 75 (Northern Siberia). Language: Yukaghir. Economy: Hf. Organization: I, O. Focus: The Yukaghir of the Upper Kolyma River (63°30′ to 66°N, 150° to 157°E) in 1850, prior to marked depopulation. HRAF: No file. Authority: Jochelson.

121. Chukchee (Ec3: 135) of Province 76 (Paleo-Siberians). Language: Luorawetlan. Economy: Df. Organization: I, O. Focus: The Reindeer Chukchee (63° to 70°N, 171°W to 171°E) in 1900, the date of the beginning of the field work by Bogoras. HRAF: RY2 (a). Authority: Bogoras.

122. Ingalik or Tinneh (Na8: 377) of Province 135 (Yukon). Language: Athapaskan (Northern). Economy: Fh. Organization: I, O. Focus: The village of Shageluk 62°30′N, 159°30′W), reconstructed for 1885, just prior to missionization. HRAF: No file. Authority: Osgood.

123. Aleut (Na9: 458) of Province 132 (Western Eskimo). Language: Eskimauan (Aleut). Economy: F. Organization: I, Q. Focus: The Unalaska branch of the Aleut (53° to 57°30′N, 158° to 170°W) about 1800, prior to intensive acculturation. HRAF: NA6 (a). Authorities: Veniaminov, Sarytschew.

124. Copper Eskimo (Na3: 169) of Province 133 (Central and Eastern Eskimo). Language: Eskimauan (Eskimo). Economy: Fh. Organization: I, O. Focus: The Copper Eskimo of the Arctic mainland (66°40′ to 69°20′N, 108° to 117°W) in 1915, during the period of field work by Jenness. HRAF: ND8 (a). Authorities: Jenness, Rasmussen.

125. Montagnais (Na32: 495) of Province 151 (Cree-Montagnais). Language: Algonkian. Economy: H. Organization: I, O. Focus: The Montagnais of the Lake St. John and Mistassini bands (48° to 52°N, 73° to 75°W) in 1910, near the beginning of Speck's field work. HRAF: NH6 (a). Authorities: Speck, Lips.

126. Micmac or Souriquois (Na41: 504) of Province 152 (Maritime Algonkians). Language: Algonkian. Economy: Hf. Organization: J, O. Focus: The Micmac of the mainland (43°30′ to 50°N, 60° to 66°W) in 1650, midway in the governorship of Denys. HRAF: NJ5 (b). Authorities: Denys, Le Clercq.

127. Saulteaux (Na33: 496) of Province 153 (Ojibwa). Language: Algonkian. Economy: Hf. Organization: I, P. Focus: The Northern Saulteaux of the Berens River band (52°N, 95°30′W) in 1930, at the beginning of Hallowell's field work. HRAF: NG6 (b). Authority: Hallowell.

128. Slave or Etchareottine (Na17: 466) of Province 134 (Northeastern Athapaskans). Language: Athapaskan (Northern). Economy: Hf. Organization: I, O. Focus: The Slave in the vicinity of Fort Simpson (62°N, 122°W) in 1940, just prior to the heavy acculturation following World War II. HRAF: No file. Authorities: Helm (MacNeish), Honigmann.

129. Kaska or Eastern Nahani (Na4: 170) of Province 138 (Carrier-Nahani). Language: Athapaskan (Northern). Economy: Fh. Organization: I, M. Focus: The Kaska of the Upper Liard River (60°N, 131°W), reconstructed for 1900, just prior to intensive missionization. HRAF: ND12 (a). Authority: Honigmann.

130. Eyak (Nb5: 270) of Province 136 (South Central Alaska). Language: Eyak. Economy: F. Organization: J, N. Focus: The small Eyak tribe as a whole (60° to 61°N, 144° to 146°W) in 1890, prior to full acculturation. HRAF: No file. Authorities: Birket-Smith & de Laguna.

131. Haida (Nb1: 70) of Province 137 (Northern Northwest Coast). Language: Skittagetan. Economy: F. Organization: I, N. Focus: The village of Masset (54°N, 132°30′W), reconstructed for 1875, immediately prior to missionization. HRAF: No file. Authorities: Swanton, Murdock.

132. Bellacoola or Bilqula (Nb9: 471) of Province 139 (Wakashan-Bellacoola). Language: Salishan. Economy: F. Organization: I, R. Focus: The central Bellacoola along the lower Bella Coola River (52°20′N, 126° to 127°W) in 1880, shortly prior to the early field work of Boas. HRAF: NE6 (a). Authorities: McIlwraith, Boas.

133. Twana (Nb2: 71) of Province 140 (Coast Salish). Language: Salishan. Economy: Fh. Organization: I, O. Focus: The small Twana tribe as a whole (47°20′ to 47°30′N, 123°10′ to 123°20′W), reconstructed for 1860, prior to missionization. HRAF: No file. Authorities: Elmendorf, Eells.

134. Yurok (Nb4: 172) of Province 141 (Central Pacific Coast). Language: Ritwan. Economy: Fg. Organization: I, O. Focus: The village of Tsurai (41°30′N, 124°W) in 1850, the date of the arrival of Loeffelholz, the earliest ethnographer. HRAF: NS31 (b). Authorities: Kroeber, Heizer & Mills.

135. Pomo (Nc18: 533) of Province 143 (Central California). Language: Hokan (Kulanapan). Economy: Gh. Organization: I, O. Focus: The Eastern Pomo of Clear Lake (39°N, 123°W) in 1850, prior to the inrush of European settlers. HRAF: NS18 (a). Authorities: Gifford, Barrett, Loeb.

136. Yokuts (Nc24: 539) of Province 144 (Southern California). Language: Penutian (Mariposan). Economy: Gf. Organization: I, P. Focus: The Lake Yokuts (35°10′N, 119°20′W) in 1850, prior to the influx of settlers following the gold rush. HRAF: NS29 (a). Authority: Gayton.

137. Paiute (Nd22: 564) of combined Provinces 146 and 147 (Great Basin). Language: Shoshonean. Economy: Gh. Organization: I, O. Focus: The Wadadika or

Harney Valley band of Northern Paiute (43° to 44°N, 118° to 120°W), reconstructed for about 1870, just prior to the establishment of the reservation. HRAF: NR13 (a). Authority: B. Whiting.

138. Klamath (Nc8: 523) of combined Provinces 142 and 148 (Southern Plateau and Northeast California). Language: Sahaptin (Lutuamian). Economy: Fg. Organization: I, O. Focus: The Klamath tribe as a whole (42° ot 43°15′N, 121°20′ to 122°20′W) in 1860, prior to intensive acculturation. HRAF: No file. Authorities: Spier, Gatschet.

139. Kutenai or Kootenay (Nd7: 380) of Province 149 (Northern Plateau). Language: Kitunahan. Economy: Fh. Organization: J, O. Focus: The Lower Kutenai (48°40′ to 49°10′N, 116°40′W) in 1890, the date of Chamberlain's field work. HRAF: No file. Authorities: Turney-High, Chamberlain.

140. Gros Ventre or Atsina (Ne1: 75) of Province 150 (Northern Plains). Language: Algonkian. Economy: Hd. Organization: J, O. Focus: The homogeneous Gros Ventre as a whole (47° to 49°N, 106° to 110°W) in 1880, shortly prior to missionization and the disappearance of the buffalo. HRAF: NQ13 (a). Authorities: Flannery, Cooper.

141. Hidatsa or Minitari (Ne15: 662) of Province 154 (Upper Missouri). Language: Siouan. Economy: A. Organization: I, M. Focus: The village of Hidatsa (47°N, 101°W), reconstructed for 1836, prior to depopulation in a severe smallpox epidemic. HRAF: No file. Authorities: Bowers, Matthews.

142. Pawnee (Nf6: 342) of Province 159 (Caddoans). Language: Caddoan. Economy: Ch. Organization: J, M. Focus: The Skidi or Skiri Pawnee (42°N, 100°W), reconstructed for 1867. HRAF: NQ18 (c). Authorities: Weltfish, Dorsey & Murie.

143. Omaha (Nf3: 179) of Province 155 (Prairie). Language: Siouan. Economy: Ch. Organization: J, P. Focus: The Omaha tribe as a whole (41°10′ to 41°40′N, 96° to 97°W) in 1860, prior to the disappearance of the buffalo. HRAF: NQ12 (b). Authorities: Fletcher & LaFlesche, Dorsey.

144. Huron or Wendot (Ng1: 79) of Province 156 (Northeastern Woodlands). Language: Iroquoian. Economy: Cf. Organization: K, M. Focus: The Attignawantan (Bear People) and Attigneenongnahac (Cord People) tribes of the Huron Confederacy (44° to 45°N, 78° to 80°W) in 1634, the date of the beginning of Jesuit missionary activity. HRAF: No file. Authorities: Brébeuf, Sagard-Théodat, Tooker (secondary).

145. Creek or Muskogee (Ng3: 180) of Province 157 (Southeastern Woodlands). Language: Natchez-Muskogean (Muskogean). Economy: C. Organization: K, M. Focus: The Upper Creek of Alabama (32°30′ to 34°20′N, 85°30′ to 86°30′W) in 1800, prior to Tecumseh's rebellion and removal to Oklahoma. HRAF: NN11 (c). Authority: Swanton.

146. Natchez (Ng7: 385) of Province 158 (Lower Mississippi). Language: Natchez-Muskogean (Natchesan). Economy: Ch. Organization: J, O. Focus: The politically integrated Natchez as a whole (31°30′N, 91°25′W) in 1718, the date of the arrival of the first missionaries and ethnographers. HRAF: No file. Authorities: Dumont de Montigny, Le Page du Pratz, Swanton (secondary).

147. Comanche (Ne3: 177) of Province 160 (Southern Plains). Language: Shoshonean. Economy: Hd. Organization: I, O. Focus: The Comanche as a whole (30° to 38°N, 98° to 103°W) in 1870, just prior to pacification and removal to Oklahoma. HRAF: NO6 (a). Authority: Hoebel.

148. Chiricahua Apache (Nh1: 81) of Province 161 (Apache-Tanoan). Language: Athapaskan (Southern). Economy: Gh. Organization: I, O. Focus: The central band or Chiricahua proper (32°N, 109°30′W) in 1870, immediately prior to the reservation period. HRAF: No file. Authority: Opler.

149. Zuni (Nh4: 183) of Province 162 (Pueblo-Navaho). Language: Zunian. Economy: A. Organization: I, M. Focus: The village of Zuni (35° to 35°30′N, 108°30′ to 109°W) in 1880, approximately the beginning of the field work

of both Cushing and Stevenson. HRAF: NT23 (a). Authorities: Cushing, Stevenson.

150. Havasupai (Nd3: 175) of Province 145 (Yumans). Language: Hokan (Yuman). Economy: Ag. Organization: I, Q. Focus: The small Havasupai tribe as a whole (35°20′ to 36°20′N, 111°20′ to 113°W) in 1918, at the beginning of Spier's field work. HRAF: NT14 (a). Authority: Spier.

151. Papago (Ni2: 184) of Province 163 (Northwest Mexico). Language: Piman. Economy: Ag. Organization: I, O. Focus: The Archie Papago near Sells, Arizona (32°N, 112°W) in 1910, the date of the early observations by Lumholtz. HRAF: NU28 (a). Authorities: Underhill, Lumholtz.

152. Huichol (Ni3: 282) of Province 164 (Western Mexico). Language: Nahuatlan. Economy: C. Organization: I, O. Focus: The small Huichol tribe as a whole (22°N, 105°W) in 1890, at the beginning of Lumholz's field work. HRAF: No file. Authorities: Zingg, Lumholtz, J. & B. Grimes.

153. Aztec or Tenochca (Nj2: 185) of Province 165 (Central Mexico). Language: Nahuatlan. Economy: A. Organization: L, R. Focus: The city and environs of Tenochtitlan (19°N, 99°10′W) in 1520, the date of the arrival of the Spaniards. HRAF: NU7 (b). Authorities: Sahagun, Vaillant (secondary).

154. Popoluca (Nj3: 284) of Province 166 (Tehuantepec). Language: Mizocuavean. Economy: C. Organization: I, O. Focus: The Sierra Popoluca of the town and vicinity of Soteapan (18°15′N, 94°50′W) in 1940, the date of Foster's first period of field work. HRAF: No file. Authority: Foster.

155. Quiche (Sa13: 1166) of Province 167 (Maya), Language: Mayan. Economy: C. Organization: J, P. Focus: The town of Chichicastenango (15°N, 91°W) in 1930, the date when both Bunzel and Schultze-Jena began their field work. HRAF: No file. Authorities: Bunzel, Schultz-Jena.

156. Miskito or Mosquito (Sa9: 390) of Province 168 (Honduras and Nicaragua). Language: Misumalpan. Economy: C. Organization: J, O. Focus: The Miskito in the vicinity of Cape Gracias a Dios (15°N, 83°W) in 1921, the date of the field work by Conzemius. HRAF: SA15 (b). Authority: Conzemius.

157. Bribri (Sa5: 287) of Province 169 (Costa Rica). Language: Chibchan. Economy: C. Organization: I, M. ~~Focus: The Bribri tribe of the~~ Talamanca nation (9°N, 83°15′W) in 1917, the date of Skinner's field work. HRAF: Sa19 (a). Authorities: Stone, Skinner.

158. Cuna or Tule (Sa1: 85) of Province 170 (Panama). Language: Chibchan. Economy: Cf. Organization: J, O. Focus: The Cuna of the San Blas Archipelago (9° to 9°30′N, 78° to 79°W) in 1927, the date of Nordenskiöld's field work. HRAF: SB5 (a). Authorities: Nordenskiöld, Wafer, Stout.

159. Goajiro (Sb6: 391) of Province 172 (Northern Colombia and Venezuela). Language: Arawakan. Economy: D. Organization: I, M. Focus: The homogeneous Goajiro tribe as a whole (11°30′ to 12°20′N, 71° to 72°30′W) in 1947, the date of the field work by Gutierrez de Pineda. HRAF: SC13 (a). Authorities: Gutierrez de Pineda, Bolinder.

160. Haitians (Sb9: 1237) of Province 174 (Caribbean Negroes). Language: Indo-European (Romance). Economy: C. Organization: K, O. Focus: The Haitians of Mirebalais (18°50′N, 72°10′W) in 1935, the date of the field work by Herskovits. HRAF: SV3 (b). Authorities: Herskovits, Métraux.

161. Callinago or Island Carib (Sb1: 87) of Province 173 (Antillean Indigenes). Language: Cariban. Economy: Fa. Organization: I, M. Focus: The Callinago of the island of Dominica (15°30′N, 60°30′W), reconstructed for 1650, shortly prior to missionization. HRAF: ST13 (a). Authorities: Breton, Taylor.

162. Warrau or Guarauno (Sc1: 88) of combined Province 175 and 176 (Orinoco). Language: Warrauan. Economy: Gh. Organization: I, O. Focus: The Warrau of the Orinoco delta (8°30′ to 9°50′N, 60°40′ to 62°30′W) in 1935, early in the period of missionary field work by Turrado Moreno. HRAF: SS18 (a). Authorities: Turrado Moreno, Wilbert.

163. Yanomamo (not in EA) of Province 177 (Southern Venezuela). Language:

Yanoaman. Economy: C. Organization: I, P. Focus: The Shamatari subtribe around the village of Bisaasi-teri (2° to 2°45'N, 64°30' to 65°30'W) in 1965, at the time of Chagnon's field work. HRAF: No file. Authority: Chagnon.

164. Carib (Sc3: 189) of Province 178 (Guiana). Language: Cariban. Economy: C. Organization: I, O. Focus: The Carib along the Barama River in British Guiana (7°10' to 7°40'N, 59°20' to 60°20'W) in 1932, at the beginning of Gillin's field work. HRAF: SR9 (a). Authority: Gillin.

165. Saramacca (Sc6: 392) of Province 179 (Bush Negroes). Language: Indo-European (creolized Romance). Economy: C. Organization: K, N. Focus: The Saramacca group of Bush Negroes in the upper basin of the Suriname River (3° to 4°N, 55°30' to 56°W) in 1928, early in the periods of field work of Herskovits and Kahn. HRAF: SR8 (a). Authorities: Kahn, Herskovits.

166. Mundurucu (Sd1: 90) of combined Provinces 180 and 181 (Amazon). Language: Tupi-Guarani. Economy: Ch. Organization: I, P. Focus: The savanna-dwelling Mundurucu of the Rio de Tropas drainage (6° to 7°S, 56° to 57°W), reconstructed for about 1850, prior to the period of increasing assimilation. HRAF: SQ13 (b). Authorities: Murphy, Tocantins.

167. Cubeo (Se5: 293) of Province 182 (Northwest Amazonia). Language: Betoyan. Economy: Cf. Organization: I, P. Focus: The Cubeo of the Caduiari River (1° to 1°50'N, 70° to 71°W) in 1939, at the beginning of Goldman's field work. HRAF: No file. Authority: Goldman.

168. Cayapa (Sf3: 194) of Province 171 (Highland Colombia and Ecuador). Language: Chibchan (Paezan). Economy: H. Organization: I, O. Focus: The Cayapa in the drainage of the Rio Cayapas (0°40' to 1°15'N, 78°45' to 79°10'W) in 1908, at the beginning of Barrett's field work. HRAF: SD6 (a). Authorities: Barrett, Altschuler.

169. Jivaro or Xibaro (Se3: 191) of Province 183 (Eastern Ecuador). Language: Jivaran. Economy: C. Organization: I, O. Focus: The Jivaro proper (2° to 4°S, 77° to 79°W) in 1920, near the beginning of Karsten's field work. HRAF: SD9 (a). Authorities: Karsten, Stirling.

170. Amahuaca (Se8: 634) of Province 184 (Montaña). Language: Panoan. Economy: Ch. Organization: I, O. Focus: The Amahuaca on the upper Inuya River (10°10' to 10°30'S, 72° to 72°30'W) in 1960, the date of the beginning of the field work by Carneiro and Dole. HRAF: No file. Authorities: Carneiro, Dole, Huxley & Capa.

171. Inca (Sf1: 93) of Province 185 (Highland Peru). Language: Kechumaran (Quechuan). Economy: A. Organization: L, O. Focus: The Quechua-speaking Indians in the vicinity of Cuzco (13°30'S, 72°W) in 1530, immediately prior to the Spanish conquest. HRAF: SE13 (b). Authorities: Cobo, Cieza de Leon, Rowe (secondary).

172. Aymara (Sf2: 193) of Province 186 (Highland Bolivia). Language: Kechumaran (Aymaran). Economy: Cd. Organization: incorporated in the large Peruvian state, P. Focus: The Aymara of the community of Chucuito in Peru (16°S, 70°W) in 1940, at the beginning of Tschopik's field work. HRAF: SF5 (a). Authority: Tschopik.

173. Siriono (Se1: 91) of Province 187 (Lowland Bolivia). Language: Tupi-Guarani. Economy: Hg. Organization: I, O. Focus: The Siriono in the forests near the Rio Blanco (14° to 15°S, 63° to 64°W) in 1942, during the period of Holmberg's field work. HRAF: SF21 (a). Authority: Holmberg.

174. Nambicuara (Si4: 198) of Province 188 (Western Mato Grosso). Language: Nambicuaran. Economy: Gh. Organization: I, O. Focus: The Cocozu or eastern Nambicuara (12°30' to 13°30'S, 58°30, to 59°W) in 1940, shortly prior to the field work of Lévi-Strauss. HRAF: SP17 (a). Authority: Lévi-Strauss.

175. Trumai (Si2: 98) of Province 189 (Upper Xingu). Language: Trumaian. Economy: Cf. Organization: I, Q. Focus: The single surviving Trumai village (11°50'S, 53°40'W) in 1938, the date of Quain's field work. HRAF: No file. Authorities: Murphy & Quain.

176. Timbira (Sj4: 200) of Province 190 (Northern Ge). Language: Ge. Economy: Ch. Organization: I, M. Focus: The Ramcocamecra or Eastern Timbira (6° to 7°S, 45° to 46°W) in 1915, near the beginning of Nimuendajú's field work. HRAF: SO8 (b). Authorities: Nimuendajú, Crocker.
177. Tupinamba (Sj8: 400) of Province 191 (Tupi). Language: Tupi-Guarani. Economy: C. Organization: J, O. Focus: The Tupinamba near Rio de Janeiro (22°30′ to 23°S, 42° to 44°30′W) in 1550, at the time of Staden's captivity. HRAF: SO9 (a). Authorities: Staden, Thevet.
178. Botocudo or Aimore (Sj5: 299) of Province 192 (East Brazilian Highlands). Language: Botocudan. Economy: Hg. Organization: I, O. Focus: The Naknenuk subtribe in the basin of the Rio Doce (18° to 20°S, 41°30′ to 43°30′W) in 1884, the date of Ehrenreich's field work. HRAF: No file. Authority: Ehrenreich.
179. Shavante (Sj11: 1184) of Province 193 (Upper Araguaya and Tocantins). Language: Ge. Economy: Gh. Organization: I, P. Focus: The Akwe-Shavante in the vicinity of São Domingos (13°30′S, 51°30′W) in 1958, the date of the first field work by Maybury-Lewis. HRAF: No file. Authority: Maybury-Lewis.
180. Aweikoma or Shokleng (Sj3: 199) of Province 194 (Caingang). Language: Ge (Caingang). Economy: Hg. Organization: I, O. Focus: The Aweikoma of the Duque de Caxias Reservation (38°S, 50°W) in 1932, at the beginning of Henry's field work. HRAF: No file. Authority: Henry.
181. Cayua or Caingua (Sj10: 1170) of Province 195 (Guarani). Language: Tupi-Guarani. Economy: C. Organization: I, O. Focus: The Cayua of southern Mato Grosso, Brazil (23° to 24°S, 54° to 56°W) in 1890, the approximate period of the earlier good descriptions. HRAF: No file. Authorities: Watson, Müller.
182. Lengua (Sh9: 1168) of Province 196 (Paraguayan Chaco). Language: Mascoian. Economy: H. Organization: I, O. Focus: The Lengua in contact with the Anglican mission (23° to 24°S, 58° to 59°W) in 1889, the date of the founding of the mission. HRAF: No file. Authority: Grubb.
183. Abipon or Mepene (Sh3: 196) of Province 197 (Argentine Chaco). Language: Guaycuran. Economy: Hd. Organization: I, O. Focus: The Apipon in contact with the Jesuit mission (27° to 29°S, 59° to 60°W) in 1750, at the beginning of Dobrizhoffer's missionary field work. HRAF: SI4 (a). Authority: Dobrizhoffer.
184. Mapuche (Sg2: 195) of Province 198 (Araucanians). Language: Araucanian. Economy: A. Organization: I, P. Focus: The Mapuche in the vicinity of Temuco (38°30′S, 72°35′W) in 1950, just prior to Faron's field work. HRAF: SG4 (c). Authorities: Faron, Hilger, Titiev.
185. Tehuelche or Patagon (Sg4: 349) of Province 199 (Patagonians). Language: Tehuelchean. Economy: Hd. Organization: I, O. Focus: The equestrian Tehuelche (40° to 50°S, 64° to 72°W) in 1870, during the period of field work by Musters. HRAF: SH5 (a). Authority: Musters.
186. Yahgan or Yamana (Sg1: 94) of Province 200 (Fuegians). Language: Yahgan. Economy: F. Organization: I, O. Focus: The eastern and central Yaghan (54°30′ to 55°30′S, 67° to 70°W), reconstructed for 1865, early in the period of missionary field work by Bridges. HRAF: SH6 (b). Authorities: Gusinde, Bridges, Lothrop.

For the type of subsistence economy:

A Advanced agriculture (56), employing irrigation, fertilization, crop rotation, or other techniques which largely eliminate fallowing.
B Horticulture (19), i.e., semi-intensive agriculture limited mainly to vegetable gardens and/or groves of fruit trees rather than the cultivation of field crops.
C Simple or shifting cultivation (51), as where new fields are cleared annually, cultivated for a year or two, and then allowed to revert to forest or brush for a long fallow period.
D Domestic animals (15), where their products provide a major source of subsistence, as in a pastoral economy.
E An exchange economy (1), in which food products are largely obtained through trade rather than by subsistence techniques.
F Fishing (17), including shellfishing and/or the pursuit of large aquatic animals, where these activities provide a major source of subsistence.
G Gathering (13), where wild plants and/or small land fauna provide a major source of subsistence.
H Hunting (14), including trapping and fowling, where these activities provide a major source of subsistence.
Capital letters indicate the dominant mode of subsistence; lower-case letters an important subsidiary or auxiliary mode, normally where it provides more than 25 per cent of the food supply. Examples: Ae for advanced agriculture supplemented by the substantial importation of food products; Fb for fishing supplemented by horticulture; Hd for mounted or equestrian hunters. Frequencies treated as intermediate in comparison with the reverse symbols in the Linked Pair test: Fg (3), Fh (8), Gf (1), Gh (12), Hf (4), Hg (4).

For the level of political integration:

I Independent local communities (79), i.e., a stateless society.
J A single level of political integration transcending the local community (50), e.g., a petty paramount chiefdom.
K Two levels of supra-community integration (23), e.g., a small state organized into districts.
L Three or more levels of supra-community integration (34), e.g., a large state subdivided into provinces and districts.

For the prevailing rule of descent:

M Matrilineal (24), with any rule of residence other than avunculocal. Treated for the Linked Pair test as partially similar to N, Np, and Pm.
N Matrilineal (6, plus one case of Np), with a predominantly avunculocal rule of residence.
O Nonlineal or bilateral (66), i.e., without lineages though often with personal kindreds.
P Patrilineal (70, plus 6 cases of Pm).
Q Quasi-patrilineal (3), i.e., with incipient or decadent patrilineages. Treated for the Linked Pair test as partially similar to both O and P.
R Ambilineal (10), e.g., with nonunilineal ramages.
For intermediate cases a double symbol is used, i.e., Pm for double descent where the patrilineal rule is dominant and the matrilineal rule subordinate and Np where the reverse obtains.

For the adequacy of the corresponding HRAF file:

a Satisfactory (74), i.e., containing a good selection of the source materials, including all the major sources.
b Useful (25), i.e., including the major sources but an incomplete selection of other important ones and thus adjudged adequate for most cross-cultural research but requiring supplementation by library research on particular subjects.
c Inadequate (19), i.e., lacking at least one of the major sources or several important ones and thus to be used in cross-cultural research only with caution and preferably with supplementation by library research.

Locations of Cultures
in the Standard Cross-Cultural Sample

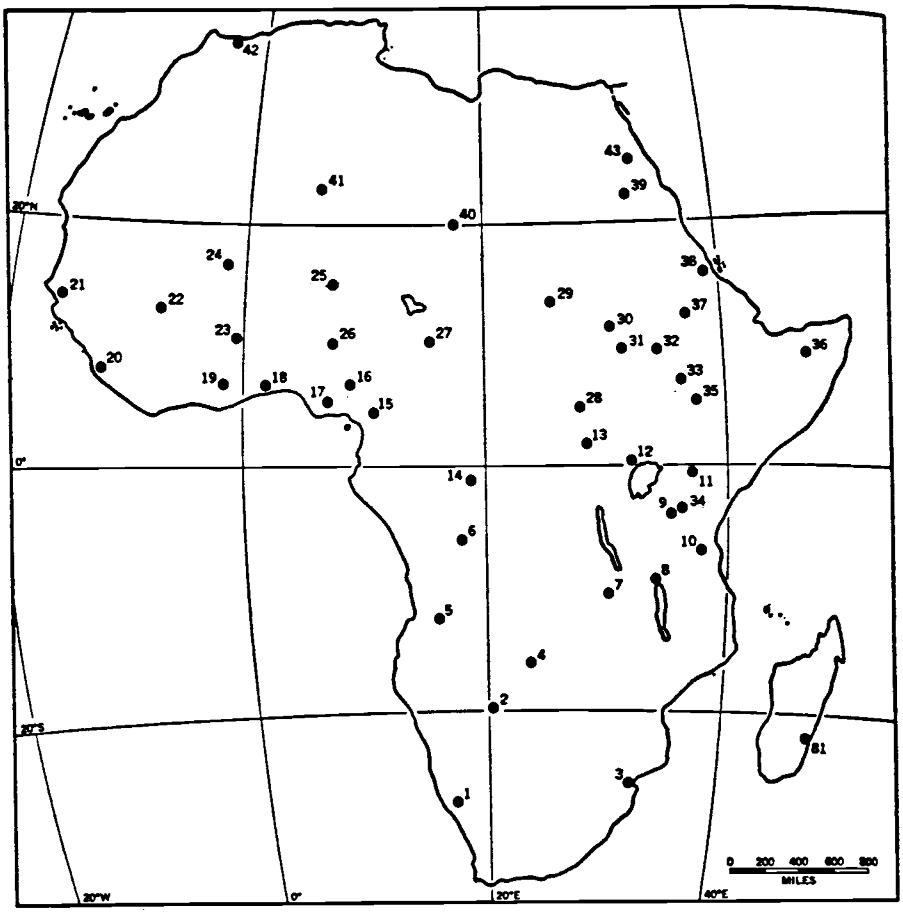
from

George P. Murdock and Douglas R. White
Ethnology 8: 329-369. 1969.

SAMPLING PROVINCE CODES

A - Sub-Saharan Africa
C - Circum-Mediterranean
E - East Eurasia
I - Insular Pacific
N - North America
S - South and Central America

MAP I: AFRICA

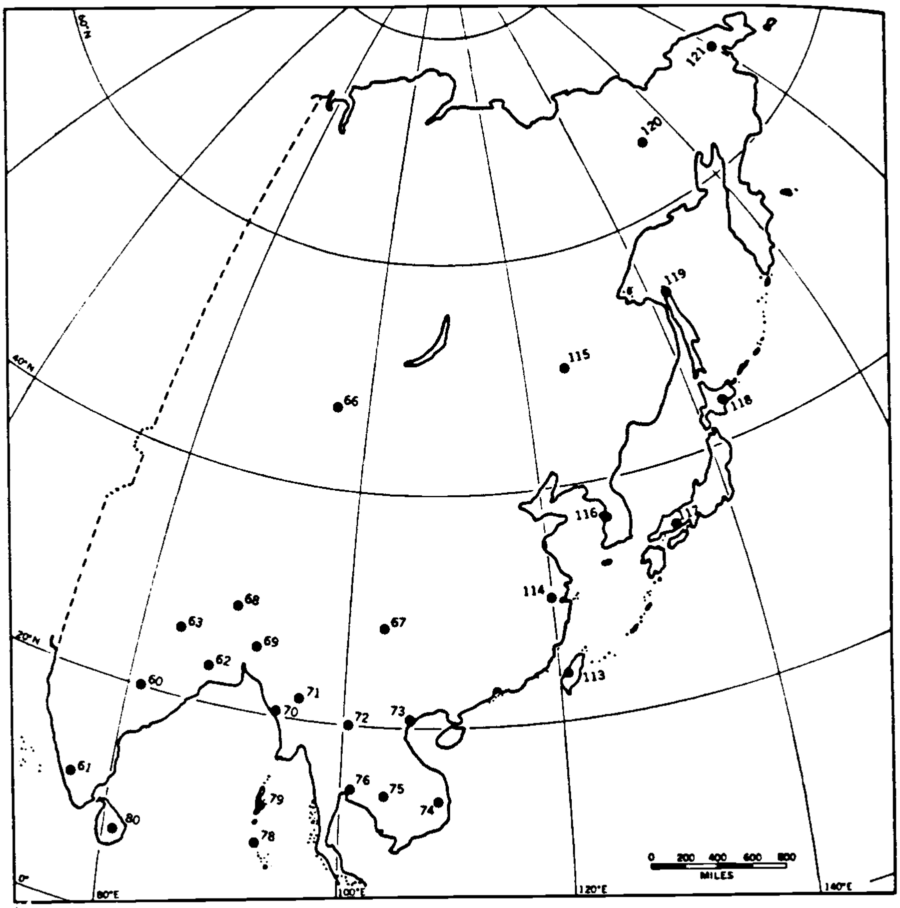


This map locates all 28 of the sample societies in Sub-Saharan Africa (A), fifteen of those in the Circum-Mediterranean region (C), and one in Madagascar, which is included in East Eurasia (E).

Map 2: West Eurasia

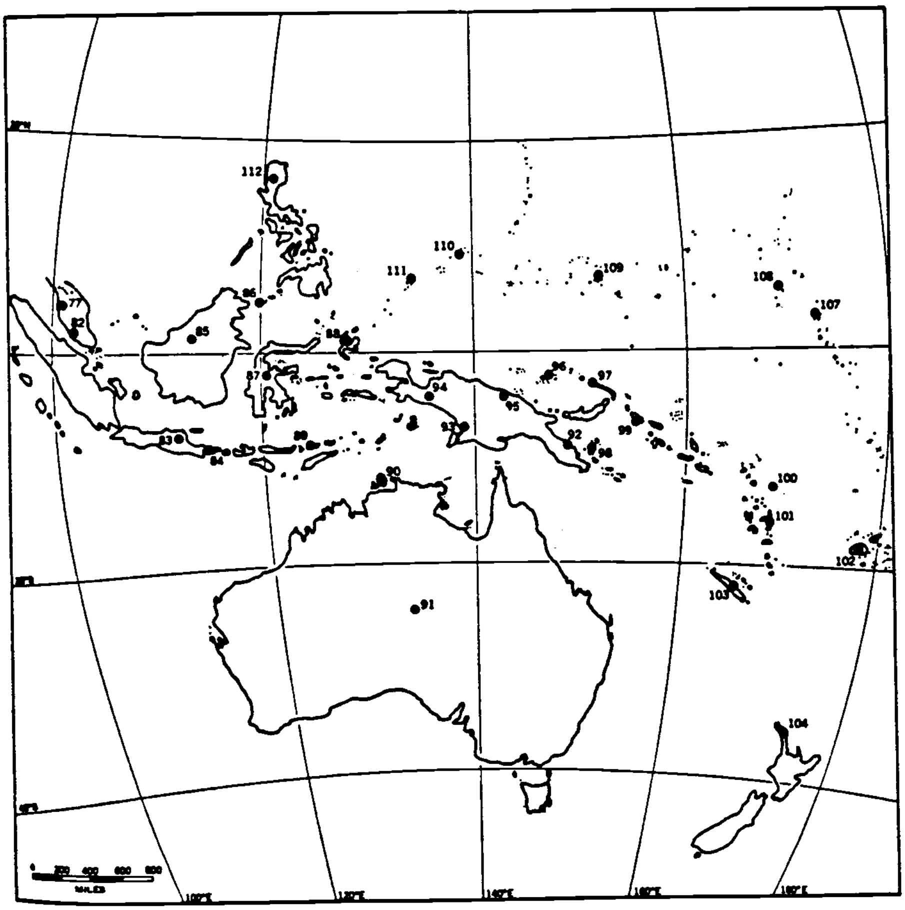
This map locates thirteen of the sample societies of the Circum-Mediterranean region (C) and five of those in East Eurasia (E).

MAP 3: EAST EURASIA



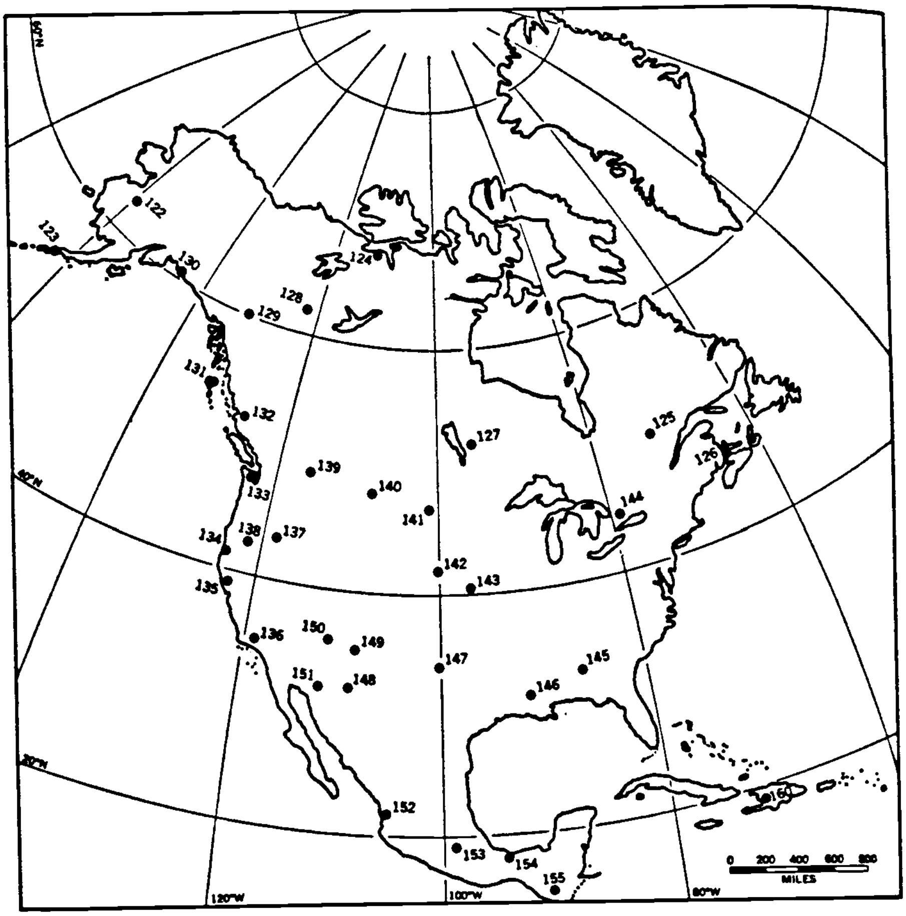
This map locates 25 of the sample societies from the world region of East Eurasia (E) and one from the Insular Pacific (I).

MAP 4: INSULAR PACIFIC



This map locates two of the sample societies from the East Eurasian region (E) and 28 of those from the Insular Pacific region (I).

MAP 5: NORTH AMERICA



This map locates all 33 of the sample societies of the North American region (N) and two of those from the South American region (S).

MAP 6: SOUTH AMERICA

This map locates 30 of the 32 societies from the South American region (S).

Appendix B

SPSS Instructions for Recoding of Variables

```
RUN NAME        DIVERSITY VALUES
VARIABLE LIST   ID,NAME1,NAME2,RELY,COMPACT,DENSITY,MATS,BASKETS,
                CLOTHING,WOOD,BONE,METAL,HOUSE,GATH,
                HUNT,FISH,ANIM,AGRIC,BIOMEONE,BIOMETWO
N OF CASES      186
INPUT FORMAT    FIXED(F4.0,2A8,F2.0,14F1.0,2F2.0)
COMPUTE         NMATS=MATS
COMPUTE         NBASK=BASKETS
COMPUTE         NCLOTH=CLOTHING
COMPUTE         NWOOD=WOOD
COMPUTE         NMETAL=METAL
COMPUTE         NHOUSE=HOUSE
RECODE          NMATS(1=9999)(2 THRU 7=1)/NBASK(1=9999)(2 THRU 7=1)/
                NCLOTH(1=9999)(2 THRU 7=1)/NWOOD(1=9999)(2 THRU 7=1)/
                NMETAL(1=9999)(2 THRU 7=1)/
                NHOUSE(1=9999)(2 THRU 7=1)/
MISSING VALUES  NMATS TO NHOUSE(9999)
COMPUTE         NCOMPLEX=NMATS+NBASK+NCLOTH+NWOOD+
                NMETAL+NHOUSE
ASSIGN MISSING  NCOMPLEX(9999)
RECODE          MATS(5=1)(4,6=2)(3,7=3)(1=9999)(2=2.11)/
                BASKETS(5=1)(4,6=2)(3,7=3)(1=9999)(2=2.182)/
                CLOTHING(5=1)(4,6=2)(3,7=3)(1=9999)(2=2.067)/
                WOOD(5=1)(4,6=2)(3,7=3)(1=9999)(2=2.857)/
                METAL(5=1)(4,6=2)(3,7=3)(1=9999)(2=1.436)/
                HOUSE(5=1)(4,6=2)(3,7=3)(1=9999)(2=2.589)/
MISSING VALUES  MATS TO HOUSE(9999)
COMPUTE         COMPLEX=MATS+BASKETS+CLOTHING+WOOD+METAL+HOUSE
ASSIGN MISSING  COMPLEX(9999)
COMPUTE         EVENCOMP=COMPLEX/NCOMPLEX
ASSIGN MISSING  EVENCOMP(9999)
COMPUTE         VARMATS=(EVENCOMP-MATS)*(EVENCOMP-MATS)
COMPUTE         VARBASK=(EVENCOMP-BASKETS)*(EVENCOMP-BASKETS)
COMPUTE         VARCLOTH=(EVENCOMP-CLOTHING)*(EVENCOMP-CLOTHING)
COMPUTE         VARWOOD=(EVENCOMP-WOOD)*(EVENCOMP-WOOD)
COMPUTE         VARMET=(EVENCOMP-METAL)*(EVENCOMP-METAL)
COMPUTE         VARHOUSE=(EVENCOMP-HOUSE)*(EVENCOMP-HOUSE)
COMPUTE         SSCOMP=VARMATS+VARBASK+VARCLOTH+VARWOOD+VARMET+VARHOUSE
COMPUTE         SDCOMP=SQRT(SSCOMP/NCOMPLEX)
RECODE          RELY(0=9999)/
COMPUTE         STRESS=RELY
COMPUTE         STORE=RELY
RECODE          STRESS(1,2,3=5)(4,5,6=4)(7,8,9=3)
                (10,11,12=2)(13,14=1)
MISSING VALUES  STRESS(9999)
RECODE          STORE(1,4=0)(2,5=1)(3,6=2)(7,10,13=3)
                (8,11=4)(9,12,14=5)
MISSING VALUES  STORE(9999)
RECODE          DENSITY(0=9999)(7=3)(6=3)(5=2)
                (4=2)(3=1)(2=1)
MISSING VALUES  DENSITY(9999)
RECODE          COMPACT(0=9999)(2=4)(3=7)(4=10)
MISSING VALUES  COMPACT(9999)
COMPUTE         DENSPACT=COMPACT+DENSITY
ASSIGN MISSING  DENSPACT(9999)
COMPUTE         NGATH=GATH
COMPUTE         NHUNT=HUNT
COMPUTE         NFISH=FISH
COMPUTE         NANIM=ANIM
COMPUTE         NAGRIC=AGRIC
RECODE          NGATH(BLANK=9999)(1 THRU 9=1)/NHUNT(BLANK=9999)(1 THRU 9=1)/
                NFISH(BLANK=9999)(1 THRU 9=1)/
                NANIM(BLANK=9999)(1 THRU 9=1)/NAGRIC(BLANK=9999)(1 THRU 9=1)/
MISSING VALUES  NGATH(9999)/NHUNT(9999)/NFISH(9999)/NANIM(9999)/NAGRIC(9999)/
COMPUTE         SUBS=NGATH+NHUNT+NFISH+NANIM+NAGRIC
ASSIGN MISSING  SUBS(9999)

COMPUTE         XSUBS=(GATH+HUNT+FISH+ANIM+AGRIC)/SUBS
ASSIGN MISSING  XSUBS(9999)
COMPUTE         VARGATH=(XSUBS-GATH)*(XSUBS-GATH)
COMPUTE         VARHUNT=(XSUBS-HUNT)*(XSUBS-HUNT)
COMPUTE         VARFISH=(XSUBS-FISH)*(XSUBS-FISH)
COMPUTE         VARANIM=(XSUBS-ANIM)*(XSUBS-ANIM)
COMPUTE         VARAGRIC=(XSUBS-AGRIC)*(XSUBS-AGRIC)
COMPUTE         SSSUBS=VARGATH+VARHUNT+VARFISH+VARANIM+VARAGRIC
COMPUTE         SDSUBS=SQRT(SSSUBS/SUBS)
COMPUTE         WTSTORE=(STORE/2.44)*100
COMPUTE         WTCOMPLX=(COMPLEX/13.038)*100
COMPUTE         WTDENSP=(DENSPACT/5.8)*100
COMPUTE         WTSUBS=(SUBS/3.24)*100
COMPUTE         TOTALD=WTSTORE+WTCOMPLX+WTDENSP+WTSUBS
ASSIGN MISSING  WTSTORE TO WTSUBS(9999)/TOTALD(9999)
```