Recent developments in the study of the social organization of hunter-gatherers may have a bearing on problems of prehistory. The rigid territorial model of hunter social groups, epitomized by Radcliffe-Brown's Australian horde, has been superseded by a more flexible grouping frequently changing in size and composition. These flexible groupings, observed in many contemporary hunter-gatherer societies, are not simply a product of depopulation and breakdown brought on by contact. Many of these groupings in the Americas, Australia and Africa show considerable time depth. Furthermore the flexible group can be shown to possess certain adaptive advantages over the more rigid patrilocal form and these features would have been no less advantageous during the pre-contact period.

This paper presents an explanatory model of hunter-gatherer group structure and land-use, based on the three fundamental variables, space, population and energy. The model builds upon the major contributions to hunter-gatherer research of Steward. As the founder of cultural ecology, Steward was the first to combine social systems and environmental variables in a meaningful analytical framework. In contrast to the simplistic view of hunter local groups found in the writings of Radcliffe-Brown, Steward saw the hunters as living in a variety of kinds of social organization with a diversity of economic situations ranging from loose- to tight-knit social groups, and ranging from primary dependence on meat in parts of the Arctic to a primary dependence on vegetable foods in tropical areas. The form of economic and social organization, Steward argued, was determined by the particular environmental circumstances to which the group was adapted. Steward proposed a three-part typology of hunter-gatherer bands: the composite, the patrilineal, and the family bands, each of which had its geographic representatives, and the occurrence of each could be explained by reference to significant features of the resource base.

Recent field-work has shown the patrilineal band to be empirically rare as a form of hunter social organization. In its place many field-workers have reported a flexible group structure with local groups assuming a variety of
genealogical forms and changing in size and composition with the seasons and even from week to week with a continual reshuffling of sub-groups. The groupings observed by the ethnographers were more or less encompassed by Steward's composite band type. Among the advantages noted for this form over the more rigidly territorial patrilocal form were, for example, the ability to adjust group size to resources, the levelling out of demographic variance in sex ratio and family size, and the ability to resolve conflicts by group splitting. These widespread advantages cast doubt on Service's proposition that "the composite band was obviously a product of near destruction of aboriginal bands after contact with civilization".

Despite these adaptive advantages, the composite band presents a not altogether satisfying picture. If nothing else the patrilineal band model had possessed a certain elegance in its formulation. In the model, the society is structured by the operation of a small number of fundamental jural rules: territorial ownership by males, band exogamy and viripatrilocal post-marital residence. Similarly, the land-use pattern was very neat: a mosaic of territories arranged in a honeycomb pattern each containing its land-owning group. In comparison the flexible living groups of recent hunters seems confused and disorderly. It was a society in which everyone could live wherever, and with whom, he or she pleased.

Another puzzling element in the understanding of hunter-gatherer society concerned their population dynamics. Hunters live in smaller groups and at lower population densities than any other level of society. In fact it is possible to speak of a Pleistocene "carrying capacity" which DeVore and I set at one person per square mile, a level that probably remained in force throughout human history until it was broken for the first time at the origin of agriculture. How this low level of population density was maintained for so long a period is the crucial question of hunter-gatherer demography. Since food supply appears to be abundant in modern hunters, the constant threat of starvation has probably been overestimated as a means of keeping hunting populations in check. But if food supply is not the limiting factor, then what is? This question becomes even more puzzling since it appears that some observed hunter population densities have become stabilized at a mere fraction of the numbers that could be supported by the food supply. How are these low levels achieved and maintained?

The answers to such questions were not to be found by simply collecting more ethnographic data and analysing these data by conventional social anthropological means. What was required was the development of novel approaches for the analysis of group structure, land-use, and population dynamics. And such an approach required the bringing to bear of quantitative ecological, social and demographic data collected over a period of years.

The basis of my approach has been to build a model that places a human hunting and gathering population into an ecosystem and watches what happens. The model starts with three components: a population, a space...
with food resources consumed by the population, and the work that the population performs in order to maintain itself within that space.

I have adopted an explicitly cultural materialist research strategy; in this perspective social organization and ideology are seen as outcomes of the interaction of techno-environmental and demographic variables\textsuperscript{12}. The advantages of the cultural materialist research strategy over conventional methodology in social anthropology are: first, it uses units of measurement that can be precisely defined such as spatial units and units of time, and most important, units of energy, such as calories; second it deals with societies as integrated systems, and allows the analyst to examine the relationship between the variables in the system, and to observe how a change in one variable affects the other components of the system. Also I have found it analytically necessary clearly to distinguish between the activities performed by individuals and groups, that can be measured and confirmed by a community of observers, and the individual culture bearer’s perceptions of these activities. One of the shortcomings of earlier work on the hunters was that etic and emic categories were interwoven in the analysis. This is not to say that one approach is more valuable than another—both have a role to play—but only that they must be distinguished analytically. Finally, the materialist research strategy places the study of human society firmly within the context of the natural sciences. By our choice of units of measurement we are enabled to treat natural systems and human systems within a single analytical framework. This latter feature is particularly valuable and necessary if one of our purposes is to illuminate the evolution of human behaviour.

The model of hunter-gatherer adaptation starts with the three variables: numbers, resources, and work; later additional variables such as group size, seasonal variation, conflict and even cognitive variables will be incorporated.

Let us consider each of the primary variables and how each may vary:

The population of people occupies the space and its size is subject to increase through birth and immigration and to decrease by deaths and emigration. Also by weighing the people as we have, one can add the concept of biomass.

The space contains a patterned distribution of resources of a given density including vegetable and animal foods perceived by the people to be edible; the amount and types of food may vary seasonally and on a longer term basis; for example, with a cycle of drought years and high rainfall. The inter-section of population and space gives one, of course, population density.

Work is the energy—expressed in calories—that the population performs in order to maintain itself within its space.

These are the variables. The constant or the given in this simple model is the techno-economic system: the tools, knowledge and organization necessary to making a living in that environment.

When a research worker enters into a field situation he finds an ongoing
system, and his task is to unravel all the relationships between the components of that system.

Every population has to behave in a sufficiently business-like manner to ensure its own survival. Since the group we are studying is surviving it must be that the work level at which it is performing is sufficient for maintaining the population at its current numbers. We can confirm this point empirically by several simple measures such as taking the weights and skinfold measurements and certain biochemical tests on the individuals in the population. If they are maintaining weight, fitness, and fat and muscle mass, we are reasonably sure that intake is adequate. At this stage we may calculate energy figures for the total society in \( x \) millions of calories consumed per annum against \( y \) millions of calories expended in subsistence work effort. And we calculate from the total work effort the work effort per capita for the society in hours or calories.

But totals tells us little about what would happen if there were a change in the parameters. In order to get a handle on that problem we have to observe what happens when a change occurs in variables one and two. If numbers of people increase, due to a rise in births, and food resources remain the same, then work effort will have to increase to feed the greater population, not only total work, but work per capita as well. Or if food resources decrease, as in a drought year, but the numbers to be fed remain the same, then work effort per capita will have to increase in order to maintain adequate caloric levels. The reason for this per capita increase is that work effort is partly a function of distance travelled between the home base and the food supply. As I have discussed elsewhere, the longer a group stays in one place the farther the workers have to walk each week in order to reach the food supply. These relationships between numbers, work, and resources can be precisely plotted and reduced to mathematical terms.

The key point I want to make is the central position that work plays in the model. Work effort is the intervening variable between population and food supply. And work is the major way that individuals and groups of men respond to changes in the parameters. If food supply decreases, humans do not respond by dying off like fruit flies, they respond by working harder.

Nothing has been said so far about the organization of this population into groups. A great deal of scholarly effort has been directed to the study of ideal group size for hunters, and a figure of twenty-five has been called the magic number of hunter group size. However, given the tremendous variations in the size and composition of individual groups from season to season, I feel this approach is not as fruitful as the approach that starts from work.

Let us assign a strictly arbitrary mean group size of say thirty, just to be different. With a given age-sex composition we note that there will be a level of work effort appropriate to that particular group size—work effort measured in kilometres walked in order to find food. This distance will increase through time as are foods eaten out over an increasing radius. In this illustration, let us
say that the mean work effort is two hours per adult per day. Now double the group size to sixty, while holding resources at a constant, and we see that the mean work effort will have to rise accordingly, let us say to three hours. For an even larger group double the group size again, to 120 and the mean work effort will again rise, this time to four and a half hours per adult per day. The point is that each one of these group sizes is quite feasible given the food resources, it is simply a matter that the larger the group, the more work the individuals in it will have to do.

There is a corollary to this relation between work and group size. Resources may be denser in one season than in another so that it may be possible to move from a scarce season group of thirty to an abundant season group of 120 with no increase in the mean daily work effort—at least in the short run. These relationships—work effort against group size and work effort against density of resources—can also be expressed mathematically.

Now we can ask: what determines whether populations of hunters will arrange themselves into groups of thirty, sixty, or 120, or twenty-five, fifty, or 100, and for how long will such groups remain together? The “principle of least effort” would specify that people always arrange themselves into the smallest groups since doing so would always keep work effort at a minimum. Field observations, however, indicate radical departures from this picture. Among the Bushmen large aggregations of 100 persons and over are observed in which individuals put out a considerably larger work effort than would be required if they split up and dispersed into smaller groups of say, twenty to thirty. At other times the Bushmen were observed to divide up into smaller living groups and here the work effort was observed to be modest.

These data indicate that the principle of least effort alone is not sufficient to explain the observed living groups of the Bushmen and other hunters. The clue to a possible answer comes from a classic paper by Mauss and Beuchat on the seasonal life of the Eskimo\(^1\). They distinguished two phases in the annual cycle of the Central Eskimo—the winter phase, when large groups of 100–150 gathered for sealing through the breathing holes and for ceremonials, and a summer phase when the large groups split up into small domestic groups of fifteen to thirty, for fishing and hunting caribou. They called the large group phase, “the public life” and the small group phase, “the private life.”

Such a division of the year seems to be characteristic of most hunter-gatherer groups including the Bushmen. In the winter dry season, when water points are limited, the !Kung would aggregate in large groups for a period of more intense social life. This was an exciting time of the year, the time when the men’s initiation ceremonies were performed, a time of frequent trance-dancing and curing, and a time for catching up on the news from distant camps, trading, and marriage brokering\(^2\).

This was a period when individuals had a much higher social velocity than at other times of the year. But this intense social life had its disadvantages:
first, because the group was so large, people had to work a lot harder to bring in food and, second, fights were much more likely to break out in larger camps than in smaller camps. I heard about initiation camps disbanding because of disagreement on procedural matters and the groups fanning out back to their home localities. And in eighteen case histories of homicides—for which I have data on the size of the camp in which the killing took place—fifteen killings occurred in larger camps of forty to 150 people and only three in camps of less than forty people.

In short, living in large groups was a mixed blessing. It offered the people a more intense social life but it also meant harder work and a higher frequency of conflict. But, like many other hunter-gatherers, the Bushmen sought both kinds of social existence, the intensity and excitement of a larger grouping and its attendant risks, and the domestic tranquillity and leisure time of smaller groupings. The small group was easier to support, but the larger group was possible to maintain if people were strongly motivated to stay together. Work effort was the sliding scale between group size and resources.

There is another aspect to work. It may be useful as a tie-in between the objective material conditions of life, or etic situation, and the individual culture bearer's perception of his role in society and the forces placed upon him, or emic situation. How are group size and work effort perceived and reacted to by the individual members of the group? In a large gathering of the kind we have been discussing, an increasingly wider and wider radius of food resources are eaten out with each succeeding week that the group stays together. Accordingly, the work effort required of individuals rises with each week. As work increases, the individual perceives his “costs” of staying together as increasing. He has to work harder than he did last week, or accept a substandard diet or, if he slack off, come in for the criticism of his fellows.

People get on each other’s nerves and as the situation tightens, this leads to heightened irritability and a lowered threshold of conflict. With food getting harder to provide it becomes more important that everyone does his fair share of the work. In this atmosphere even small disagreements may erupt into conflict and this conflict usually results in one or both parties splitting off to seek greener pastures. Hunters say “to hell with it”. This is not to say that Bushmen only argue when food is scarce or when the group is large. They argue all the time about lots of things. What I am suggesting is that arguments in large, harder working groups are more likely to lead to a split than in smaller groups.

In contrast to agricultural and urban peoples, hunters have a great deal of latitude to vote with their feet, to walk out of an unpleasant situation. And they do so, not when the food supply is exhausted, but well before that point when only their patience is exhausted.

This mobility has a profound ecological adaptive significance. Fear and avoidance of conflict has the effect of keeping people apart. This perception
of the threat of conflict functions to maintain group size and population density at a much lower level than could be supported by the food resources, if the population could be organized to use those resources more efficiently. By stabilizing numbers at a lower level through a behavioural spacing mechanism, the population is buffered against a wide range of variation in the abundance of food resources. Thus conflict, far from being a causal factor that is opposed to an ecological explanation, may best be seen as an ecological variable, a usage that is consistent with contemporary thinking in animal behaviour and animal ecology.

The model of Bushmen land-use and social organization presented here may be of use in illuminating Steward’s typology of hunter-gatherer bands—particularly the composite band and family band types. About forty-five years ago Bantu-speaking Herero pastoralists began to move into the Dobe Area. They set up their cattle posts at large waterholes and the Bushmen came in and built camps near them in order to drink some of the surplus milk. At /ai/ai for example, where I spent fourteen months in 1968–69 there were at various times 147 Bushmen resident, along with seventy Herero and their 500 head of cattle. Bushmen subsistence was eclectic: they drank some milk and made frequent short hunting and gathering trips to the hinterland. For a long time I was not able to figure out what was going on at /ai/ai, but it is now clear that the Bushmen have achieved there what amounts to a permanent “public life” situation. Where formerly they spent eight to ten months of the year dispersed in their home localities and a few months together in the large groups for dancing and trading, today they have reversed this ratio and can spend most of the year together dancing and trading and just spend a few months split up into smaller groups.

The question becomes, how are they able to enjoy the public life without experiencing its disadvantages? Two reasons are suggested. First they get a substantial food input from the Herero—milk, meat and, at times, agricultural products—and this reduces the level of work effort by comparison with what would be required if the same size group were dependent strictly on wild foods. But the second and also important reason is that the Herero provide a legal umbrella under which this large number of feisty Bushmen can live together. Arguments and fights are always breaking out at /ai/ai, but when they do, someone yells “stop everything” and runs to get a Herero, who immediately comes over to break up the fight and adjudicate the dispute. The outside mediator thus becomes a crucial element in stretching the duration of the Bushmen public life beyond the few weeks or months of former years. Even though the food supplies sufficient for such a large group are present, the added element of someone to maintain order is also necessary.

In this perspective Steward’s family bands and composite bands may actually be different seasonal manifestations of the same social system. The composite band of several hundred persons observed among the northern Athapaskans may be an expression of the public life phase made permanent...
as the population stabilizes around mission stations or Hudson's Bay posts. And the family bands of the Great Basin Shoshone may have been a stabilization in the private or domestic life phase. The ethnographies note that the Athapaskans split up for part of each year into smaller groups and the Shoshone came together for part of each year into much larger groups than the extended family-sized units that gave them their name²².

The model presented here offers partial answers to the questions of how hunter-gatherers are organized with reference to food resources and how their organization is affected by culture contact. I have also explored the relation between population aggregation and political development. What happens when more Bushmen get together in one place may have bearing on problems of political evolution.

The model also has something to say about the factors that keep population densities of hunter-gatherers at adaptively low levels. Threat of conflict, it is argued, contributes to keeping people apart, so that the Bushmen's perception of the appropriate number of people that can safely live together in one place falls far short of the number that could be supported by the food supply.

The possible utility of this model for prehistory may be briefly discussed. It has been customary to regard hunter-gatherer land-use in terms of a mosaic of territories with a group of a given size encapsulated in each one. The present model visualizes group size as a continuum along the dimension of concentration-dispersion. Any specific group size postulated in this framework is likely to be an ephemeral event in the continual reshaping of groups into larger and smaller aggregates.

On the other hand if the view presented here has validity then it may be useful for prehistorians to consider their settlement pattern data in terms of concentration and dispersion. Sites indicating large population size and sites indicating small population size may represent seasonal manifestations of the same society.

Instead of postulating mean group size of twenty-five, or fifty, or 100 for prehistoric populations it may be analytically more useful to think in temporal terms of the amount of time members spend in groups of various sizes.

Notes

1 Data for this paper were collected during three years of field work among the !Kung Bushmen of the Republic of Botswana (1963-1969). I wish to thank the National Science Foundation (U.S.), the National Institute of Mental Health (U.S.), and the Wenner-Gren Foundation for Anthropological Research for financial support of the research.


21 See also Netting, R. McC. (In press). Sacred power and centralization; some notes on political adaptation in Africa, in Spooner, B. J. (ed.). op. cit.