SIMILARITIES IN SPATIAL CHARACTERISTICS OF SEVERAL BASKETMAKER II SITES ON CEDAR MESA, UTAH

By
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A thesis submitted in partial fulfillment of the requirements for the degree of
MASTER OF ARTS

WASHINGTON STATE UNIVERSITY
Department of Anthropology
1981
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Chairperson

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ACKNOWLEDGEMENTS

I am sure that I have seen graduate students looking like I have felt these past few weeks while I've finished "photo-ready" copies of my thesis—I've seen lots of them. They never made much of an impression on me—perhaps because I'm dense, or perhaps because the feeling of long-term discomfiture and weariness with one's own doings is a difficult feeling to grasp until it is personally experienced. The last few months have been as much an education as the four years it has taken me to crank out the thesis. So, now that I'm much older and wiser, I know that friends who a few weeks ago deserved a heart-felt thanks are now owed a tremendous debt.

Data for this thesis were collected by William Lipe and R. G. Matson; I appreciate both the manner in which they collected the data and the encouragement which they have provided me, and other graduate students, to use those data. I do not believe that such positive encouragement is a regular fact of graduate student life. As might be wished of a committee chairman, Lipe has been of inestimable assistance in completing my thesis, both by his personal knowledge and by putting me in touch with other professionals familiar with the sorts of things my thesis has attempted. (In particular, he won assistance for me from R.G. Matson, who has counseled me on the nature of the sites I chose to study and on statistics, and Ian Hodder, who has saved me from writing a "cautionary note on D.A.V." simply by suggesting that I run multiple iterations before I assessed the results.) That Lipe has maintained a pleasant air, despite my lack of tact and my lack of timeliness, has been an additional blessing.

The thesis simply could not have been completed without the assistance of Tim Kohler, who did the actual programming of the algorithm for dimensional analysis of variance. He has been of further (and to him, perhaps,
interminable) assistance in answering the questions which have gotten my programs off the computer and my similarity matrices off my scratch paper.

I am grateful to Lipe, Kohler, Hassan and Gustafson, my committee members, for reading and commenting on the final draft of my thesis in what must be record time for any graduate committee, and for maintaining a modicum of humor throughout. I have done my best to take all the comments to heart. Of course, I am solely responsible for the content, but I fear I may never be able to duplicate the style. Carl Gustafson has maintained a measure of quality in the discussions derived from philosophy of science, and has demanded somewhat better grammar than I am given to using on an extended basis. Fekri Hassan has added to my grasp of theory, and helped me establish some conviction in it (primarily by not holding it up to ridicule).

Eric Blinman has literally saved the day by doing all of my graphics, more quickly than I deserved, when I was too sick (and sick of it) to face them.

Jeff Walker is more difficult to thank. He has been supportive of my efforts, even to staying in Pullman until my tribulations, as well as his own, were through.

Geneva Burkhart also deserves an extended thanks. She has added counsel that has kept me out of trouble on more than a few occasions.

Margaret Coggins and Steve Woods have aided immeasurably by listening to the endless, unwritten drafts and ravings. Ray Druian provided a much needed first job and office space in Pullman. They, and other friends who have made Pullman bearable, even enjoyable, should be given credit for any sparks of humanity which have survived the thesis. However, unlike friends finishing last June, I feel no debt to St. Helens. Old Man Mountain made my office unbearably hot (with a little help from Physical Plant), my eyes ache and my nose bleed, and removed any incipient enthusiasm I had in trying to finish just then.
SIMILARITIES IN SPATIAL CHARACTERISTICS OF SEVERAL
BASKETMAKER II SITES ON CEDAR MESA, UTAH

ABSTRACT

by Karen Marie Dohm, M.A.
Washington State University, 1981

Chairperson: William D. Lipe

Basketmaker II open sites on Cedar Mesa, Utah are differentiated through
patterning in the spatial distributions of artifacts and features. The sites
are known from surficial evidence only. Source data includes maps and collec-
tions of all surface artifacts. Evidence for site classification is taken
from field notes, results of statistical techniques which provide average pattern
size of groupings of individual artifact classes in each site, and maps of
the spatial distribution of the artifacts in the sites. Similarities between
sites are found not to be dependent on similarities in site size. Further,
sites which may be classed as pithouse habitations all appear to have a regular
distributional structure of features in relation to the total artifact distribu-
tion.

Notes on statistical techniques used in analysis, particularly dimensional
analysis of variance, are included. These notes are limited to comments relevant
to completion of this work or necessary to a reading of the thesis.
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CHAPTER 1

INTRODUCTION

But for the moment I am acting as if I took a certain problem seriously. Without judging beforehand the general value . . . I mean simply to consider whether it answers the conditions I set myself. . . .

Albert Camus

This thesis presents the results of a distributional analysis of surface artifacts and features at several sites of the Basketmaker II period from Cedar Mesa, southeastern Utah. My goal is to determine if there is objectively definable patterning in the distribution of artifacts and features at these sites. Subsidiary questions include whether the presence of any particular artifact/feature cluster occurs with other characteristics of the sites in a predictable manner, and whether clusters occur regularly within any given site.

Description of the sites centers on a habitation/nonhabitation dichotomy. Initially, presence of pithouse remains is used as the denominator. This is augmented, in later stages of the analysis, by size and shape characteristics of the artifact distributions. The addition of these variables expands the site classification beyond a simple dichotomy, although the formal definition of site types is not carried further. Definable patterning is found to be present, at least in sites with evidence of pithouses. Pithouses are present in some of the smallest sites, as well as in larger sites, so it may be seen that this classification is not dependent on site size.

Basketmaker II (BM II) is a division of the Pecos Conference chronology (Kidder 1924, 1927) which identified three Basketmaker and five Pueblo periods
in the Four Corners region. Basketmaker I may be addressed as a heuristic device which connects the Archaic to the Anasazi sequence. Basketmaker II, given general dates of about 100 B.C. to A.D. 400 or A.D. 500, is the first archaeologically known preceramic manifestation of the Anasazi tradition (but, see Martin et al. 1962). Basketmakers were named for the large quantities of baskets and other woven materials discovered in cave sites during the late nineteenth and early twentieth centuries (McNitt 1957). Basketmaker II groups were cultivating some plants, and settlements appear to have been situated near arable land as well as having access to more varied environmental zones, presumably facilitating hunting and gathering (Lipe 1978b).

Manifestations of the Basketmaker II period most often have been described from confined rock shelters or talus slope sites (e.g., the Durango shelters [Morris and Burgh 1954], White Dog Cave [Guernsey and Kidder 1921; Colton, 1939], Cave du Pont [Nusbaum et al. 1922]). Analysis of the more common open mesa top sites contributes to a better understanding of the Basketmaker II site types. Large Basketmaker II surface scatters might be assumed to be habitation sites or base camps, but in fact may be conglomerates of smaller sites, developed as a result of repeated use of the same area. Distributional structure may reveal whether activities were heterogeneous or homogeneous, and whether the site represents a single distributional cluster or a conglomerate of such clusters. Elsewhere, identifications of site types from surface remains, even where the sites have been periodically collected, have been consistent with identifications based on excavation (e.g., Redman and Watson 1970; Plog, Plog, and Wait 1978). Thus objective analysis of surface artifact distributional structure may be expected to contribute to definition of Basketmaker II site types. In any case, the sites in question are largely surficial in nature, so that such information as may be gained from intrasite patterning will have
to be gained from surficial study. Furthermore, the sites are relatively large in areal extent, so that minor disturbances of artifact position should not have affected overall distributional pattern too greatly.

Cedar Mesa is located just north of the San Juan River in southeastern Utah (Figure 1, 2). Structurally, the mesa is the northern part of the Monument upwarp. The north-south divide of Cedar Mesa slopes from about 5,000 feet in the south to 7,000 feet in the north near Elk Ridge (Gregory 1938:11). According to Gregory, local climate is largely dictated by altitude and topography (1938:15). As may be expected, rainfall is greater at higher elevations (approximately 13 inches in the north as compared to 10 inches at the south end of the mesa) and the local climate is relatively colder, limiting the growing season to approximately 129 frost free days in the north of the mesa compared to 144 in the south (Matson and Lipe 1975:125-126). Natural vegetation is sensitive to the local climate. In northern Arizona, Hack (1942:7) identified a vegetation "break" at about 6,000 feet elevation. Communities of desert scrub vegetation were located below this and pinyon-juniper woodland with sagebrush and grasses were located above the break.

Schoenwetter and Dittert (1968:44, 47-48) indicate that climate in the southwestern United States is believed to have been stable over the last 4,000 years but with a wide range of variation in what is considered normal. Cyclical erosion and aggradation related to changes in seasonality of the rainfall represent a continuing pattern. Maize agriculture is believed to have been introduced to the Southwest in Basketmaker II times, during a period of general aggradation.

Entrenchment and aggradation may also be important to natural vegetation by lowering or raising the water table (Hack 1942:12). Accordingly, regularly collectible plant foods such as pinyon (Pinus edulis), wild grasses, especially
Figure 1. Map of Cedar Mesa area showing Cedar Mesa Project survey area and quadrats included in this study.
Figure 2. Aerial view south toward Bullet Canyon.
Indian rice grass (*Oryzopsis hymenoides*), sego lily (*Calochortus nutallii*), and prickly pear (*Opuntia sp.*) (Matson and Lipe 1975:127) previously may have occurred in somewhat different locations than those in which they are found at present.

Although fluvial and aeolian erosion is responsible for major recent geomorphic modifications in the Cedar Mesa area, the patterns of aeolian deposition and erosion outlined by Gregory (1938) and Hack (1942) suggest that artifacts were not displaced by aeolian activity. Relatively fewer small artifacts can be expected in the immediate vicinity of plants or other wind breaks since objects on their lee side are more likely to have been buried than uncovered. Obviously this pattern, in conjunction with an expected displacement of some artifacts by surface runoff may have created linear distortion of artifact clusters.

Since studies of settlement patterning presuppose known site types these studies are implicitly related to studies of the individual sites. Studies of Basketmaker II (BM II) settlement pattern on Cedar Mesa rely on Camilli's division of sites of this period into multiple activity sites or base camps and limited activity sites (Camilli 1975:75). She defined base camps by a relatively high diversity of artifact types, a predominance of core tools and/or ground stone artifacts over flake tools, and sometimes the presence of particular types of structures and site features (Camilli 1975:75-77). Basketmaker II base camp locations show a statistically significant correlation with canyon rim area, and mesa divide sites are generally limited activity sites (Matson and Lipe 1977:4-5).

The analysis of intrasite patterning may be expected to add to the existing information on individual sites in several ways. Traditionally, its contribution has been seen as information on patterned human behavior, with an
emphasis on behavioral variability (see Asch 1975:182; Flannery 1976:16; Hill 1968:103-104; Whallon 1973:266; Yellen 1977:135). Additionally, intra-site patterning has been credited with identifying cultural variability within a single settlement type. Activity area types have also been considered useful in identifying sites of a particular settlement type (Brown 1975:162; Brown and Struver 1968;272; Hietala and Stevens 1977:539).

In this study, the identification of artifact clusters in limited activity sites may be forced to help identify the structural relationship of limited activity sites and base camps. Specifically, the presence or absence of regularly recognizable groups of artifacts (and features) is used to determine whether base camps are aggregates of one type or several types of limited activity sites, or whether base camps are qualitatively different from limited activity sites of all types. Activity areas have been considered in this manner elsewhere, but with variable results (see Flannery and Winter 1976:34; Flannery 1976:16; Yellen 1977:135). My "group of artifacts" is less specific than "activity area" since groups do not have functional implications.

I will call these groups of artifacts "artifact clusters" as a more convenient phrase. Like Lipe and Matson's (1975) sites, these are defined as conveniently mappable concentrations of artifacts or features. The difference between site boundaries and boundaries of artifact clusters is one of scale. Considering a drainage, the primary archaeological interest may be the arrangement of sites in that drainage. If only the area within the boundaries of one site in that drainage is considered, distributions at a smaller scale than whole sites may be recognized. Differences in the densities of artifacts within the site may become apparent and have paramount importance. My use of the term "site" includes the existence of artifact clusters rather than assuming that homogeneous scatters of artifacts comprise the distribution of all artifacts
in the site. There may be many artifact clusters in one site. There may be many in the distribution of one artifact class. These clusters could have the same pattern size and placement as those of other artifact classes. Hence, only one cluster is requisite for my definition of a site. Clusters are defined by relatively high frequencies of one or more artifact classes in any area of the site. One or more of these clusters may define the area in which some activity or related activities took place in the past, and may be found in regular arrangements with other clusters.

I am using a quasi-behavioral model as a starting assumption (see Chapter 3). All site formation processes due to postdepositional events, whether or not they are cultural, are viewed as secondary processes; that is, they are not given the same consideration as cultural formation processes related to Basketmaker II period occupation. As a heuristic device it is assumed that in all cultures there are groups of individuals carrying out given tasks which leave material evidence, and some of these remains are left in recognizable spatial patterns. The tasks may include the ever-present activities of hunting, manufacturing and processing, and discard.

A further assumption is that specific activities result in the abandonment of specific types of artifacts. Reasonably, the types of artifacts recovered from one activity locus could be expected to be analogous to types recovered from another locus where a similar activity was carried out.

Presumably, but less certainly, different "types" of artifacts may be recognized as distinct. This presumption, that morphological characteristics are relevant to functional analysis is the subject of some heated debate. The alternative to morphological identification of function--use-wear analysis--poses its own particular problems. These can be considerable, and even insurmountable. The morphological identification of artifacts is accepted for this study, regardless of its own inherent problems.
For analysis, artifact distributions will be approached systematically as well as subjectively since visual interpretation of large samples tends to become ambiguous (see Hodder and Orton 1976:2). Specifically, my sample of Basketmaker II sites was initially classed as habitation or limited activity on the basis of presence or absence of certain features or artifact complexes, rather than on the basis of size and density of scatter. Spatial patterning of artifact scatters was then described, using a dimensional analysis of variance (D.A.V.) and SYMAP plots of the artifact distributions. Results are compared across the sample and classes of sites are formed based on structure, that is, the regular patterning of artifact clusters in the sites. These site types are compared with those derived from the qualitative analysis of features and key artifacts and the similarities and differences in the classifications are delineated and discussed.

Objections to this methodology may be raised, based on the relegation of postdepositional formation processes to secondary consideration (see Schiffer 1976:29). In addition, the model itself would be considered suspect by Yellen (1977:135) who proposed that overlapping activity areas are a common condition in living sites and difficult to define archaeologically. These objections are recognized, but I felt that by considering several sites for spatial analysis rather than just one, this problem might be reduced.
CHAPTER 2

HISTORY OF RESEARCH

Are they not criminals, books that have wasted our time and sympathy?

Virginia Woolf

This history of research in this paper is organized chronologically by the date of research rather than by the date of publication. This type of chronology serves two purposes. First, organization by date of the research project tends to keep discussion of any particular project together. Second, it recognizes that archaeologists are often familiar with each other's work regardless of timely publication; therefore, problem oriented research in archaeology may draw its questions from current research as well as from publications. For the sake of brevity, Basketmaker II research specific to Cedar Mesa and research contributions to intra-site spatial analysis for this period are not described separately from other types of Basketmaker II research.

Research into the Basketmaker II period of the Anasazi tradition began in the Cedar Mesa area itself, in the 1890s (McLoyd and Graham 1894). This was an early date for archaeological exploration anywhere in the Southwest. The objective of early explorations was obtaining collections, usually for eastern museums. The first reported survey which recovered Basketmaker material was made by Charles McLoyd and C. C. Graham in Grand Gulch apparently in the winter of 1890-1891. It was followed by a second in 1892-1893, this time with John Wetherill as guide (Moseley 1966:142-143). Their Basketmaker collections
consisted largely of mummies and grave goods (McLoyd and Graham 1894). Moseley
claims they recorded artifacts as part of grave lots and thinks that McLoyd and
Graham were cognizant they were dealing with a culture relatively earlier than
the Cliff Dwellers (Moseley 1966:142). That contribution is more usually credited
to Richard Wetherill, who excavated in Grand Gulch, Cottonwood Wash, and Butler
Wash in the winter of 1893-1894. He placed the Basketmakers prior to the Pueblos
on the basis of stratigraphic relationships (Kidder 1924:77; McGregor 1965:41;
McNitt 1957:72). More importantly, he circulated this thesis among the scientific
community through T. Mitchell Prudden (Kidder 1924:77) and George Pepper (1902).

Following the Wetherill explorations, research centered on defining
the Basketmakers. In 1916 and 1917, Guernsey and Kidder excavated caves containing
evidence of Basketmakers. Since much of the evidence was storage cists (and
burials) they surmised Basketmakers lived mostly in the open, in perishable
structures, and resorted to caves only for temporary shelter from severe weather
(Guernsey and Kidder 1921:110; Kidder 1924:241). Based on his excavations
between 1925 and 1927, Morris agreed and added that burials probably were not
limited to caves (Morris 1939:11).

Kidder and Guernsey's research verified the chronological sequence
of Basketmaker to Pueblo, and contributed a series of technological attributes
to the Basketmaker trait list (Guernsey and Kidder 1921:113). Guernsey considered
expansion of the area known to have been occupied by Basketmakers as his major
contribution from the 1916-1917 and the 1920 to 1923 excavations rather than
his contribution to chronology by subdividing the Basketmaker period into two
parts (Guernsey 1931:37-40).

In 1927, a three part subdivision of Basketmaker was incorporated in
the Pecos chronology. Basketmaker I was defined as a hypothetical, pre-
agricultural stage. Basketmaker II was distinguished from Basketmaker III by
the complete absence of pottery in Basketmaker II sites (Kidder 1927:557-558). Hargrave (1935:42-46) tentatively distinguished Basketmaker II pithouses, in the field, from those of later periods, on this basis.

In 1938 and 1940 Morris excavated Basketmaker dwellings near Durango. This was the first definition of Basketmaker II houses in open sites. Each structure had a saucer-shaped floor with a heating pit in the center. Much of the remaining floor space was taken up by stone-lined storage cists topped with mud domes. Metates were found inside the structures and near the storage bins (Morris 1941:23). Burials apparently were located randomly in the site (Morris and Burgh 1954:21) and refuse was downhill (east) from the dwellings (Morris and Burgh 1954:28). Analysis of features and artifact distributions outside the pitstructures was precluded by overlapping occupations; see Morris and Burgh (1954:28) and Sharrock (Sharrock et al. 1963:46) for a similar problem in later research. Nonetheless, Morris' work includes an early attempt at intra-site spatial analysis.

In 1949 excavators in the Petrified Forest National Monument, northeastern Arizona, attempted to locate features associated with early pitstructures by excavating a 50 cm strip around each dwelling (Wendorf 1953:Figures 7-21). A tentative Basketmaker II assignment was based on the presence of slab-lined cists. It is tentative because pottery was recovered from the structures. Wendorf suggested the pottery might be a trade item (Wendorf 1953:45) and declared the pithouses similar to dwellings at the Bluff site (Haury and Sayles 1947), which he equated to Basketmaker II and to those near Durango (Morris 1941; Morris and Burgh 1954).

The difficulty in assigning sites to a period on negative evidence was re-established by all archaeological surveys in the Glen Canyon area between 1957 and 1959. Open lithic sites, lacking ceramics, were generally designated
as "campsites," and were sometimes called possible Basketmaker or Basketmaker-like sites (e.g., Adams and Adams 1959:33, 36; Fowler 1959:503; Lipe 1960:3; Lister 1959:110).

The Glen Canyon surveys and excavations, as a whole, opened discussion on the environmental context of the nonceramic sites, and preferred descriptions of Basketmaker II period open sites, including pitstructure architecture. Excavations at Lone Tree Dune in 1961 uncovered a pitstructure which is different from those described by Morris and Burgh (1954) near Durango, Colorado. Most noticeable, perhaps, was the presence of a slab-lined entryway, then the relative dearth of interior storage features, and evidence that the superstructure was not of cribbed log construction (see Sharrock 1963:154-158). More elaborate description was given to Basketmaker II period cave occupations, perhaps because the Glen Canyon surveys and excavations were part of a salvage project, and the cave sites were known to contain distinctive evidence of Basketmaker II material culture. Cave sites contained evidence of domestic activities as well as the remains of storage features and burials. Attempts were made to describe the cave occupations, although patterning was generally obfuscated by later Pueblo occupations (see description of Bernheimer Alcove in Sharrock et al. 1963:44-60).

Lipe's 1959 excavations at the Wright Site during the Glen Canyon project (Lipe 1960:108-109), intimate some distributional patterning of artifacts and features in an open a-ceramic site. The west part of the site was comprised of charcoal and ash-stained sand containing hearths, flint chips, and tools. Lipe suggested the western part of the site was more intensively occupied than the eastern part, but noted that the storage cists were found in the eastern part of the site. No other structures were located.
A 1966 publication on excavations in the Lower Glen Canyon identified some sites recorded there between 1958 and 1962 as definite Basketmaker II sites. This was based on radiocarbon dates consistent with a BM II time range 100 B.C. to A.D. 400 and typological distinctions in the lithic artifacts (Long 1966:62). Despite his chronological refinement, Long did not separate Basketmaker II from later Anasazi manifestations in his discussion of settlement patterns. He suggested that the Lower Glen Canyon probably was exploited on a seasonal basis for its arable land and raw materials, especially lithic resources. Permanent habitations may have been on the highlands south of Glen Canyon (Long 1966:61).

Lipe provided a more specific settlement pattern reconstruction for Basketmaker II in the same general area. Based on work on the Red Rock Plateau between 1958 and 1962, he defined three site types: habitation/burial, food collecting, and storage. In terms of settlement pattern, food collecting and storage sites were considered satellites to the habitation/burial sites (Lipe 1970:98). He suggested the Basketmaker II settlement pattern was determined by a heavy reliance on wild plant foods from the highlands and access to arable land in the canyon bottoms for maize agriculture. This made canyon rims with easy access to bottomlands most favorable for Basketmaker II settlement (Lipe 1966:136, 1970:97).

Between 1959 and 1962, Lindsay's crew in Sand Dune Cave in the Kayenta area made a remarkable venture into intrasite spatial studies. They needed to strip each stratum across the entire cave to prevent slumping of the dry sand deposits (Lindsay et al. 1968:37-38), and perhaps as a result, found one piece of evidence for caves having been used as (temporary?) habitations as well as ossuaries and storage areas. They believed they had found activity areas, especially for sleeping, based on discovery of grass "pallets." This subtle evidence probably would not have been discovered in vertical excavation, even given the distinctive character of remains in Sand Dune Cave.
Eddy's 1959 and 1960 excavations along the Pine River in the Navajo Reservoir District provide data relevant to intra-site spatial studies. His excavations represent one of the first "village" excavations for the Basketmaker period. Structures were found by trenching rather than stripping, so presence and relative location of features outside structures could not be fully described. However, Eddy described some site activities:

Refuse indicates that the living area and work activities were centered around the houses, but some sheettrash also covered most of the intervening bench surface (Eddy 1961:8). Although he defined "hallways" (Eddy 1961:46) thereby recognizing partitioning of space in dwellings, he did not make any explicit statement regarding intramural use-areas.

The village was located directly above the floodplain, and according to Eddy had the appearance of a "nucleus, with outlying, more scattered houses north and south of it" (Eddy 1961:8). Seven of the 10 structures are within 14 meters of some other pitstructure. Three others are more isolated, each being more than 50 meters from the central group and separated from it by an intermittent drainage (see Eddy 1961:Figure 5). Martin (Martin and Plog 1973:197), however, thought this distribution of structures was random.

Conclusions regarding the settlement pattern for Los Pinos phase sites were not published until 1966. Eddy described the placement of Basketmaker II sites in terms of location near arable land (Eddy 1966:473, 1972:19) rather than proximity to wild food resources. Another qualification he suggested for site location was proximity to building materials, especially cobbles. This suggests all Los Pinos Phase sites should be located just above floodplains. This model did not explain why the density of Los Pinos Phase sites was relatively higher along the Pine River section of the reservoir than it was elsewhere (Eddy 1966:473-474).
In 1960, Tumbleweed Canyon, a Basketmaker II period village site was excavated in eastern Arizona. It consisted of only three pitstructures which Martin thought may have been occupied by nuclear families, because the structures were small (Martin et al. 1962:97, 136). His descriptions of site locations are similar to models already discussed (Eddy 1966:473, 1972:19; Lipe 1966:97, 136). Sites were found near water and probably near food sources, and in all cases, the mesa tops were easily accessible (Martin et al. 1962:163-164).

Work recommenced in the Cedar Mesa area in 1969 and 1970. Lipe attempted to relocate BM II cave sites--often successfully--in which Richard Wetherill had excavated in 1896-1897 (Lipe 1978:394). Excavation of sites on the mesa tops was also undertaken. These sites varied in size and component features and artifacts, possibly reflecting differences in activities at those sites (Lipe 1978:394). No villages were recognized; Lipe stated that pitstructures were rare, and did not appear to cluster. The few sites which appeared to have pitstructures had only one. Pithouses were architecturally similar to those at Lone Tree Dune site in the Glen Canyon area (Lipe 1978:396; Sharrock et al. 1963:151-161).

Between 1971 and 1976 systematic survey and some additional test excavations were conducted in the Cedar Mesa area by Lipe and Matson. Their research was directed at explaining changes in settlement pattern from Basketmaker II through Pueblo III times. Lipe was already committed to viewing Basketmaker II sites as functionally heterogeneous (Lipe 1978:394). On the Cedar Mesa Project, sites were defined as mappable composites of activity loci (Lipe and Matson 1971:132). Based on Lipe's 1969-1970 work and a pilot survey conducted in 1971, Lipe and Matson recognized a division in material remains recovered from open, mesa top sites, and rockshelters located in canyons (Lipe and Matson 1971:130-131). Open sites on the mesas were characterized by various combinations
of workshop debris, midden areas, fire-containment areas, and shallow pithouses. Cave (or rockshelter) sites in canyons characteristically had storage cists, burials, habitation debris, and/or Basketmaker II period pictographs (Lipe and Matson 1971: 130-131). Using other Cedar Mesa open sites, Camilli divided site types into multiple-use and limited use by the relative variety of cultural remains and also found some environmental patterning in site location (Camilli 1975:75). Using her divisions, with a larger site sample, Matson and Lipe (1978:4) formalized environmental correlates to site locations. Base camps clustered on canyon rim areas, and sites of all types tended to concentrate away from the deep soil area of the divides and sagebrush flats.

This history of research reflects a long concern with identifying the nature of Basketmaker II culture through comparison with archaeological evidence from earlier and later periods. At each point in this history of research, the theoretical framework appropriate to the corresponding phase of American archaeology has been used. First was a period of exploration in the nineteenth century. Then came identification of Basketmaker occupations on the basis of human skeletal remains, artifacts (or lack thereof, as with ceramics) and architectural features, and a refinement of that identity which included the temporal and spatial placement of Basketmaker II (e.g., Guernsey and Kidder 1921; Kidder 1924; Morris 1939; Morris and Burgh 1954; Pepper 1902). This was followed by the burgeoning concern with culture ecology and settlement patterning (Eddy 1966; Lipe 1970; Long 1966; Martin et al. 1962), and adaptive systems approaches to study of prehistoric change (e.g., Lipe and Matson 1971; Matson and Lipe 1978).

Less attention has been given to the spatial analysis of sites. This may be a reflection of the diachronic orientation of archaeology and of the necessity of fully identifying a period before synchronic studies within that
period can be conducted. Nevertheless, this lack of attention to intra-site spatial analysis has limited understanding of Basketmaker II sites, and thereby has limited understanding of the development of later Anasazi site patternings.
CHAPTER 3

THEORY

"I've been reading Binford," he began. I stiffened a little at that, because these religious fanatics always make me nervous.

Kent Flannery as Mr. Science

My version of intra-site analysis is a comparative description of sites' distributional structures. This goal is distinct from that of most other archaeologists doing spatial analysis. In general, their goals have been limited to description of one site rather than comparison of several sites. Those approaches frequently have been limited to description of tool kits based on co-occurrence of artifact types. The characteristics of the Cedar Mesa data do not encourage the recognition of tool kits. Surface collections provide relatively coarse locational information and only nonperishable cultural materials, and cannot be expected to be useful in identifying traditional "activity areas."

Survey data do provide a large number of sites which can be compared, minimizing the effects of noncharacteristic sites, and minimizing the potential for misinterpretation based on a premature definition of site edges. In the sparsely vegetated Southwest, surface collections provide a unique opportunity to identify the full, spatial extent of the study sites. Therefore, the greatest value of intra-site spatial analysis in the Cedar Mesa data lies in its ability to identify regular site patterning through study of artifact/feature distributions. This may lead to information on the relative frequencies of general types of economic activities. At the least, it can aid in identifying functionally
different site types. Minimally, Basketmaker II groups can be expected to have had habitation sites, resource processing/procurement sites, and storage sites. My approach is largely one of defining such site types on the basis of the artifact clusters within them. And this chapter is largely an attempt to provide a theoretical justification for my approach. My organization is hierarchical: artifact locations are low level units which comprise artifact clusters. Clusters define one or more use areas, which define the site.

On Cedar Mesa, a site was defined as a conveniently mappable concentration of artifacts or features, from other such concentrations (Lipe and Matson 1975:128). Use of this definition has two important implications for my thesis. First, it allows me to limit my field of consideration. Like other archaeological sites, these are defined by material culture. They are not ethnographic sites— that is, they are defined only by behavior of an individual or group of individuals who have left material evidence of their presence. A beautiful view or a potential economic resource will not define a site. For my purposes, if the site is invisible, it does not exist (cf. Yellen 1977; Binford 1980).

Second, the definition predicts my breakdown of the sites for analysis by defining them as conveniently mappable concentrations of material culture. At a gross level, any site contains at least one concentration or cluster of material culture since the site itself is a "cluster" of artifacts or features when considered against the larger region. For distributional patterning within a site to be identifiable, the area which artifact concentrations occupy must be small enough that an artifact concentration occupies less than half the area of the total site distribution. Unless there is more than one such concentration of artifacts, the "cluster" is apt to appear as part of a clinal distribution of artifacts in the site. Clusters must have diminished frequency of artifacts at their edges; they are not defined by arbitrarily subdividing
continuous distributions. Hence, identification of patterning within the total site distribution may require relatively large membership of the artifact classes which describe these clusters or concentrations. One or more of these clusters may define an area in which some activity or several compatible activities, took place in the past. "Activity areas," the places which record an instance of a person sleeping, cutting wood, or making tools individually may be expected to occupy less than a 2 m by 2 m area. Hence, evidence of a single activity event may be expected to demand less space than a single collecting location for the Cedar Mesa Project survey. The clusters which I would attempt to define have more in common with agglomerated activity areas and agglomerated disposal areas---the results of repeated individual activities (Speth and Johnson 1976). There may be many such artifact clusters in a site, but only one is requisite for my definition of a site.

If only one type of artifact/feature cluster is discernible, the site may be considered a limited activity site. This should be true whether there is one artifact cluster or several clusters of a single kind. If many clusters are identifiable, the site function is defined by the sum of activities which took place at the site.

Some regular, distributional structure may be expected in sites with multiple artifact clusters. Forty years ago, Colton and Hargrave coined the oft-quoted phrase, "small, miscellaneous sherds are not habitually seen knocking about floors of occupied pueblos" (Colton and Hargrave 1937:24). The implication is that trash disposal is structured in Pueblo sites and recovery of artifacts from an occupation surface does not necessarily imply that the artifacts were used where they were found by archaeologists.

On the other hand, briefly occupied sites and irregularly used parts of habitation sites are rarely reported to have structured trash disposal areas.
Yet, Yellen (1977) mapped multiple discard areas in every Bushman camp he studied. Similarly, Binford (1980) mapped multiple discard areas in an Eskimo hunting stand. In an earlier report, those discard areas were more clearly identified as the direct results of activities undertaken in the same areas (Binford 1978). Although both Yellen's and Binford's reports showed that the most functionally sensitive tools which were used in the activity areas would not be recovered by an archaeologist, they also demonstrated a direct spatial relationship between the materials which were discarded and the activities which were undertaken in the same, spatially-defined area.

Longacre and Ayres made quite specific statements regarding the probable use of particular areas in an abandoned Apache camp. Their inferences were validated, in general, by an Apache informant, despite their mapping having been completed more than 2 years after abandonment of the site (Longacre and Ayres 1968). Some of this success must be attributed to the ethnographic analogy they were able to make. Very few archaeological attempts at specific functional identifications of spatial areas have been so successful. Most may have been hampered by the loss of sensitive materials from the archaeological record, a problem which has been repetitiously defined by experimental archaeology (Ammerman and Feldman 1974:616; Binford 1978:356; Bonnichson 1973; Lange and Rydberg 1972:430-431; Robbins 1973:356). However, this does not mean that few artifacts were left at abandoned sites. In all of the studies cited above, many artifacts were left at the sites, and many of those were left in the area where a specific task in which they were used was carried out. Few of the recovered artifacts were functionally specific. Nonetheless, as explained in the Introduction, I am assuming that in all cultures there are groups of individuals carrying out given tasks which leave material evidence. Judging from the archaeological literature, evidence often is found in a spatially
discrete area, although the discarded artifacts may not be diagnostic of a particular task. I suggest that when artifacts are left close to the area of activity, they may be considered primary refuse (cf. Schiffer 1976).

Based on the apparently dispersed pattern of Basketmaker II "villages" (Eddy 1961), secondary refuse in open Basketmaker II sites also is not likely to have been deposited at a very great distance from the area of the activity that generated it. I think that structured trash deposition may be a function of perceived congestion. Speth and Johnson note that distinctions between agglomerated activity areas and agglomerated disposal areas may be trivial in Bushman camps where activity areas are, in a sense, also disposal areas. They suggest that agglomerated activity areas versus agglomerated disposal areas are less likely to be a trivial distinction for groups occupying caves (Speth and Johnson 1976:52). Implicitly, they seem to be dealing with what I consider to be an expected distinction between site structure in bounded and unbounded space.

Mesa top sites would be expected to make use of unbounded space, as the locations of pithouse villages which Eddy (1961) and Wendorf (1953) described suggests. Eddy (1961) and Wendorf (1953) have indicated multiple deposits of trash in these pithouse "villages." Each reported trash surrounding the pitstructures. Eddy also recorded trash in the open areas between the pitstructures (Eddy 1961:8). In both cases, the discrete trash deposits surrounding each pitstructure suggest that discard was related to the occupation of individual structures. Or, put more generally, secondary refuse was deposited near the area of activity.

Since both discarded and abandoned materials are presumed to have been left near the area of aboriginal activity in Basketmaker II period open sites, both content and distributional structure of artifact clusters should bear some
relationship to the activities that produced them. A probable correspondence of artifact locations with the area in which the artifacts were used has already been noted. That distributional structure of artifact clusters also is defined by cultural behavior is taken up next. Distributional structure is equivalent with a concept of self-defined spatial boundaries.

Walls are not the only cultural elements which define space. Spatial bounds also have been correlated with changes in floor surfaces, level changes, fixed features, and a variety of movable and temporary objects (Saile 1977:159). That these additional variables can act as spatial boundaries was empirically shown in an earlier study in an Illinois housing project (Saile 1972). There is some agreement among ethnoarchaeologists that architectural structures, artifact/feature distributions, and artifact distributions have a modicum of reliability in identifying site patterning regardless of the absence of sensitive artifacts. For example, ethnoarchaeologists Lange and Rydberg (1972:426) defined the edges of a site by presence or absence of artifacts. Binford (1978:356) determined that artifact density was inversely proportional to the amount of activity in the Eskimo hunting stand which he mapped. David L. Clarke maintained that patterning is a result of both social and economic factors at work within a site. Social factors could account for the groupings of materials (that is, correlations of artifact classes within a cluster) while economic factors could account for the locations of these groupings within the site (Clarke 1977:11). His explanation is relatively appealing since it agrees with previous archaeological findings and legitimizes the comparison of patterning between sites.

My cautious approach to spatial analysis reflects my intuition that a graduate student cannot be too careful (or perhaps skeptical), and also a conviction that even Cedar Mesa sites are not pristine. They have certainly
been modified by a variety of postdepositional processes, both additive and subtractive. Schiffer's models (1972, 1976, 1978) are probably the most familiar for postdepositional site formation. Although not specifically addressed, I do not think my treatment of postdepositional site formation processes is inconsistent with his models. The Cedar Mesa sites are deflated, and in some cases eroded, but none are covered with alluvium or aeolian sand. In many, items probably have been scavenged by aboriginal and modern collectors. Some artifacts may have been displaced by the collectors. I can deal only superficially with those problems. I would suggest that natural processes could, perhaps, account for the displacement or loss of very small flakes, but erosion and deflation have probably served more to excavate the sites than to remove or displace any but the smallest artifacts. That is hypothetical. The fact is that the point location data are not sufficient to adjudge the effects of natural processes except where these have been so severe that artifacts are obviously distributed along intra-site drainages. The probable loss of certain types of artifacts can be recognized, but not compensated for. Confusion added by later occupations may be separated by use of the dimensional analysis of variance across a number of sites, but even this is uncertain in a pilot study.

In general, cultural and natural postdepositional processes probably selected against certain classes of items remaining in the archaeological record--very small artifacts which could be removed by natural processes, and those artifacts which are more frequently reused than discarded which likely were removed by cultural processes. Aboriginal curation and modern collecting may alter the overall artifact inventory or the content of individual clusters within the site, making site description based on these measures unreliable. However, the context from which these artifacts were removed probably has not been altered significantly. Artifacts were used in spatially discrete areas of
the sites, probably in conjunction with other objects, then carried away, or dropped and possibly scavenged later, or collected much later by one of our contemporaries.

Some aboriginal curation seems certain, however. If cultural materials were aboriginally removed from one of the present study sites and, hence, were not collected from that site during the Cedar Mesa Project, they probably had functional or aesthetic value. Their prior removal probably has not affected the pattern of the surrounding artifact/feature distribution. Those items probably did not constitute a large percentage of the total artifact population. By far, most of the artifacts found at these sites are stone artifacts having (apparently) very low time investments in manufacture or core-debitage or lightly modified or used tools of commonly available raw materials. The artifacts which remain in that distribution probably were used or produced during the same or similar activities as were the materials removed, although the remaining materials might not be functionally specific to that activity alone. Consequently, the structure or form of the distribution may retain spatial information about the activity sets which produced it. Distributional structure can be expected to provide a level of comparability for sites on the basis of "use-areas," through number, size, and relative locations of artifact clusters within the sites.

Also, site formation is likely to have been multi-stage, with differing activity sets occurring at different times; therefore, site "function" may have varied through time. As stated previously, subdivision of sites into smaller, meaningful spatial components has advantages for identifying multivariate groupings of artifact types as discrete assemblages. Carrying this inductive reasoning further, dividing the site into sub-units should have advantages as well for analysis of sites as diachronic units. Spatial analysis of the site components
is more likely to reflect complexity in site formation processes than is analysis of the site artifact/feature inventory taken as a whole.

Assuming that postdepositional alterations have not been too great, distributional structure may reveal whether activities were heterogeneous or homogeneous, and whether the site represents a single distributional cluster or a conglomerate of such clusters. Spatial analysis of site components is a potentially significant method for discriminating site types. A site composed of a single cluster, or multiple clusters of one type, may be considered a single function, or limited activity site. A site composed of heterogeneous clusters might be called a multiple activity site, and may be considered a base camp if there is also evidence of investment in permanent (reusable) features.

In summary, site function is defined by the sum of activities that have taken place at the site. Some activities or activity sets leave spatial clusters of artifacts; if these are close to the area of activity, they may be considered primary refuse. In open Basketmaker II sites secondary refuse is not likely to have been deposited at a very great distance from the area of the activity that generated it. Hence, on a gross spatial scale, both content and distributional structure of artifact clusters should bear some relationship to the activities that produced them. There are both cultural and postdepositional processes, however, that operated to subtract or alter the distribution of certain classes of items. Distributional structure of refuse is less likely to have been altered by these processes than is artifact content or inventory. Consequently, the structure or form of the distribution may retain information about the activity sets which produced it. Also, site formation is likely to have been multi-stage with differing activity sets occurring at different times; therefore, site "function" may have varied through time of occupation. Assuming that postdepositional alterations have not been too great, distributional
structure may reveal whether activities were heterogeneous or homogeneous, and whether the site represents a single distributional cluster or a conglomerate of such clusters.
CHAPTER 4

METHOD

Even mathematical solutions (though here I speak with trembling) can have aesthetic beauty.

F. L. Lucas

The sites used in this study were systematically surveyed between 1972 and 1974. All artifacts were collected. Virtually all are of flaked chert. Materials were given a provenience using large-scale "point-locations" so that the site maps could be overlaid with a post facto grid to facilitate mapping artifact densities within the sites and within quadrats. These "point-locations" are collection units which may have a radius as great as one and one-half meters. Point locations were mapped with reasonable accuracy from base lines and large-scale grids (e.g., 20 to 50 m intervals). Field maps show these point locations, as well as cultural features and natural features.

I chose to work only with sites that have been previously identified as definite, single component, Basketmaker II by Lipe and Matson (Lipe, personal communication). These sites appear less likely to have been disturbed by use of the same area during later culture-periods so problems with reoccupation accompanied by culture change are not so overwhelming.

Lithic artifacts from these sites have already been classified by Cedar Mesa Project personnel (especially Paul Sneed) using both morphological and technological characteristics which I will refer to as a morpho-technological classification. I have used this classification exclusively. It contains
several major categories--unifacial tools, bifacial tools, large percussion or ground stone artifacts, identifiable debitage, and unidentifiable debitage--each with subdivisions so that there were 43 categories in all. I lumped "drills" into one category, all remaining bifaces into another, and all "hammerstones" into a third. Otherwise, the categories have been kept separate. These categories (Appendix A) seem sufficient to distinguish the scale of patterning which I am trying to detect.

I do not feel that functional categories relying on use-wear analysis would be legitimate for surface sites, particularly in a sandy area in circumstances under which I surmise flake edges could be readily damaged. Also, since utilized/nonutilized distinctions are the most critical to my analysis, I suspect that morpho-technological classification has much more to offer than a purely technological system. But, it is a moot discussion. I am not a lithic technologist. In this case (and others) I have presumed that some degree of reliance must be placed in previous research.

Separation of habitation from nonhabitation sites was accomplished using site structure and, in a separate analysis, presence/absence of traits. As previously suggested, size is taken as the most easily identified aspect of site structure. Dimensional analysis of variance (D.A.V.) has been used to discover the pattern size of artifact class distributions in each of the sites. Regularities in the occurrence of cluster/structure sizes were used to divide the sites into categories. Sites have been independently classed as habitation sites where some "sensitive" features or artifacts, such as pit-structures, hearths, or metates are present. Site divisions based on cluster size were compared with this judgmental breakdown. Site structure was further assessed using SYMAP, to plot density distributions of summed artifact classes in the sites. Clusters inferred from high density areas, as displayed by SYMAP,
can then be compared with the average cluster size implied by D.A.V. Description of the regular site structure occurring across the site sample is a composite of cluster size, identified using SYMAP and D.A.V., and an assessment of artifact types found in each cluster size.

**Use of Dimensional Analysis of Variance**

Dimensional analysis of variance measures clustering within a square or rectangular grid. While nearest-neighbor analysis categorizes spatial data as clustered, random, or regular, D.A.V. provides an assessment of cluster size—the initial step from which an analysis of covariance among artifact classes may be begun. This is the most common reason, among archaeologists, for performing a dimensional analysis of variance. The technique has achieved limited popularity among archaeologists because it does not require two-point provenience, but can make use of data collected by grid units. The mean-square ratio of artifact density is calculated for a given block size, then for block sizes which are successively double the size of the previous block, until the final block size, equal to the whole grid area is reached. A quote from Whallon provides a more complete description of the technique. It requires

> a grid whose sides contain a number of grid units equal to some power of 2 and which is either square or rectangular with the greater dimension just twice the lesser dimension. The grid units are then grouped in the course of analysis into successively larger 'blocks,' each twice the area of the next smaller block, until the last and largest block comprises the entire area of the grid. . . . A dimensional analysis of variance is based on the sums of squares . . . for each block size (Whallon 1973:270-271).

This is not a traditional "sum of squares" known from statistical literature. Whallon's is derived by addition of the squares of item counts in each block of the grid. The sum of that addition is divided by the number of grid units comprising a single block of that size; the quotient is the "sum of squares." This sum of squares is used to calculate the variance between blocks of successive sizes, as described above.
The tendency toward spatial concentration and the scale at which such a tendency occurs are then determined through the calculation of the variance in count per block at each block size. This variance, or mean square, is calculated for each block size (Whallon 1973:271).

It may be seen that the variance, or mean-square (m-s) is an average of the difference in density between one block and the block immediately adjacent for all blocks in the grid. Clustering within the grid is recognized by peaks in the graph of mean-square ratios against block size (see Pielou 1969; Whallon 1973). A large variance (or "mean-square") indicates that a high proportion of cells have zero, or few, artifacts while other cells have a large number of items. Several such peaks can appear in the graph of mean-square ratios to block size (m-s ratios), and regularly indicate the presence of clusters of more than one size.

Dimensional analysis of variance or "analysis of spatial dispersion" using contiguous quadrats, was developed by P. Greig-Smith in 1948 as an alternative to randomly spaced quadrats for studying plant communities (Greig-Smith 1952:295). In archaeology, D.A.V. is most frequently used as an alternative to nearest neighbor analysis when point-location provenience is not available, or when analysis of co-occurrence of artifact classes may be expected as a following stage of analysis (Dacey 1973; Whallon 1973). Dimensional analysis of variance, which lacks the statistical elegance of nearest neighbor analysis, is a pragmatic technique for measuring size of clusters. Greig-Smith developed the technique after he was confronted with trying to collect random quadrats in a tropical rainforest, a task which he thought impractical. Hence, the method of dimensional analysis of variance has been experimentally, rather than mathematically, verified. The method gained considerable popularity among plant ecologists between Greig-Smith's first publication on the method in 1952 and archaeologists' first publications on D.A.V. in 1973 (Dacey 1973; Whallon 1973).
Whallon has made the greatest contribution to familiarizing the archaeological community with D.A.V. as an appropriate technique for recognizing patterning. Although Whallon (1973:267), and others (Burley 1976:100-102, Jermann 1978:79-80) have recommended comparing the results of D.A.V. with density maps of the site, only Burley has done this systematically. In general, D.A.V. previously has been used as a method for preparing data for correlation of tool types (see Dacey 1973:320).

A D.A.V. has several advantages over nearest neighbor analysis. Using D.A.V., multiple scales of patterning can be recognized, while nearest neighbor analysis generally identifies only the smallest scale of significant concentration (Whallon 1973:268; Kershaw 1957). A D.A.V. is able to separate overlapping distributions (Whallon 1973:274). It allows re-organization of the original data in a form appropriate for the study of similarity between units or correlation between artifact classes, because it separates individual cluster sizes (see Speth and Johnson 1976:56), and because data are already organized into grid squares required for correlation matrices. Also, it is possible to treat separate areas of excavation independently, and connect them for the last step of the analysis (Whallon 1973:268). Extrapolating from this technique, it also is possible to compare among sites using D.A.V. Finally, a charming advantage for archaeologists is an infrequently specified requirement of D.A.V.: satisfactory results can only be ensured where there is a reasonably high proportion of blank units (Greig-Smith 1952:315). These last are the most important to me.

A D.A.V. also has disadvantages, of course. The site must be fit into a square or rectangular grid. Therefore, if the site is smaller than the grid or irregularly shaped (as all Cedar Mesa sites are) some predictable peaks in the graph of mean-square ratios to block size will be misleading. Generally these problems can be overcome if several D.A.V. s are run with each grid shifted
slightly from its original placement on the site map. The second major disadvantage has, perhaps, already been anticipated. A D.A.V. does not actually divide the site into specific clusters, but rather into average cluster sizes. Also, D.A.V. cannot effectively define spatial concentrations at less than twice the size of the minimal grid unit utilized (Whallon 1973:268; Kershaw 1957), and it is not sensitive to clusters of items with a very low total count (Greig-Smith 1952:306).

Since D.A.V. is my primary technique for identification of structure size within each of the sites, recognition of all the disadvantages are important to this study. Obviously, I have tried to maximize the advantages of D.A.V. for my thesis. I have excluded outlying areas of the sites that contain only a few artifacts, or alternatively, I have added dummy units to the edges of the site to increase the grid size and shape to an appropriate area for D.A.V. Initially, I thought the addition of dummy units would be more appropriate, but after some review of patterns in my results, I modified my views as described in the conclusions.

At least two D.A.V.s were performed for each site (Table 1) one with the grid oriented north-south, the other east-west. When additional D.A.V.s were conducted, the grids were shifted slightly from their original placement on the site maps. These successive iterations were done to determine reliability of peaks in the mean-variance ratios, since consistency of results from several samples has been taken to indicate significance in large variances with more accuracy than Greig-Smith's (1964) published confidence intervals (Whallon, 1973).

Interpretation of high variances in artifact density also considers information on location of drainages in a site relative to collecting locations, the size and pattern of the total site distribution relative to the D.A.V. grid, and the number of artifacts in each class under consideration. Classes
with few members generally have a rapid drop in mean-square ratios as block
size increases, and therefore cannot be considered in summaries of site structure.
Otherwise, structure size of individual artifact classes was compared within
each of the sites, then across sites. Large peaks in the m-s ratios were
recorded for all artifact classes in each site. Groupings of artifact types
with peaks at the same block size were made, in an informal manner. These
within-site comparisons represent an attempt to identify site structure.

Table 1. Number of Dimensional Analyses of Variance Run for Each Study
Site and the Number of Artifact Classes Included in Each Site’s
Dimensional Analysis of Variance

<table>
<thead>
<tr>
<th>Site</th>
<th>Number of artifact classes</th>
<th>Number of D.A.V.s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Grid oriented N-S (^a)</td>
</tr>
<tr>
<td>B 9-6</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>B 14-1</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>HS 11-1</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>HS 11-2</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>UGG 5-3</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>UGG 7-4</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>WJ 15-3</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>WJ 17-3</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>WJ 19-1</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>WJ 19-2</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>WJ 19-3</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>WJ 19-4</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>WJ 19-5/6</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>WJ 19-7</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

\(^a\)The D.A.V. grid oriented north-south corresponds to having the long-
axis of rectangular blocks, in analysis, oriented east-west.
Results from groupings among sites also were compared, and regularities in optimum block sizes and group constituents recorded. These cross-site comparisons represent a search for patterned regularities which could reflect differences in site types or site function. "Optimum block size," on which these inter-site comparisons are based, is not entirely clear-cut.

Method and conclusions become somewhat confused in final stages of analysis since as one set of results is reached, it is natural that a review of the material and the technique should take place. Some alteration in the techniques for following stages of analysis is then almost inevitable. This dynamic approach to analysis characterizes my assessment of site similarities from D.A.V.

Identification of "optimum block size" acquired some judgmental aspects after my first review of all results from D.A.V. Last peaks in the m-s ratio tend to occur at block sizes approaching total site size. Since last peaks in the m-s ratio for artifact classes in large sites may represent areas larger than the whole area of small sites, last peaks in the mean-square ratio cannot be expected to measure similarities between large and small sites.

First peaks in the m-s ratio, on the other hand, generally are within the size range of all sites, but the peaks are smaller. Further, in any site the block size at which the first peaks occur tends to vary with the placement of the D.A.V. grid and the grid's polar orientation more than do last peaks in the m-s ratio. So, neither first peaks nor last peaks are ideal for identifying site structure.

Tim Kohler (a Washington State University faculty member) suggested using both first and last peaks in assessing site similarities. This is innovative, and in some measure, illuminating. The suggestion has provided the bridge between artifact clusters identified by first peaks in the m-s ratio and those
identified by last peaks. However, that also presents a problem: by using first and last peaks together some level of association between sites is guaranteed. Although that may be a realistic assessment of site similarities, when more than half of my study sites may freely move between groups, I believe that some site dissimilarities probably are being masked.

Nonetheless, I applied Kohler's suggestion, with some qualifications, and assumed first and last peaks in the m-s ratio were equally meaningful. I characterized average pattern size of each artifact class in a site by the smallest peak which was recognized in all iterations with the grid oriented either north-south or east-west. This single pattern size, for each grid orientation, was used in forming groups of similar sites from the artifact distributions. Again, I have not used any other indicator of significance in average pattern size except the internal consistency of my results. This tended to reduce the number of peaks in the m-s ratio of an artifact class to one—the optimum block size.

Formulating a method for assessing site similarities on the basis of optimum block size was postponed for as long as possible. In fact, it was put off for too long. By the time I squarely faced the problem, I had amassed an unequal number of D.A.V. plots for each site (some artifact classes were too small to be assessed by D.A.V.) and was forced to use a nonstandard similarity coefficient (Appendix B). At the same time, I felt pressed for time and computer funds. As a result of my choice of similarity coefficients and my frantic desire to get through the rest of the analysis, choosing from a full range of clustering techniques was not possible.

Of course, I wanted an unattainable number of advantages from a cluster analysis. I wanted tight clusters, where all sites in a group were very like each other so that I would have a better chance of not being surprised by groups
based on similarities in D.A.V. pattern sizes when these were compared to the visual appearance of the artifact distributions. On the other hand, the potential for having a large number of unique sites was already apparent and less desirable than being able to compare each site to others, even if that site could not be placed in a group. Moreover, I was unable to do the clustering on a computer. Locally available "canned" computer programs could not handle an input similarity matrix--they form their own matrices prior to developing clusters. Therefore, clustering was done by hand.

Hand calculation limited the choice of clustering technique to single-linkage or complete linkage. Average linkage was not considered since it has two disadvantages. First, it is time consuming and prone to error when done by hand, since it requires repeating individual calculations almost endlessly. Second, it is arbitrary: a join may be prevented by very slight differences in the original data or in the data entry order. Unlike complete-linkage clustering techniques, the distortion in average linkage is hidden and unpredictable (see Hodson 1970:307-308). Single linkage clustering techniques seemed inappropriate since they could not form tight clusters and are prone to chaining. Therefore, complete linkage proved the most satisfactory for this study. It forms tight clusters, so its groups should be very like each other in terms of D.A.V. pattern sizes. By lowering the level of similarity needed to join a group, all sites can be made to join some group. Therefore, on a gross scale, all sites may be compared to others. Its advantages over average linkage are the fewer repetitive calculations which are required, and that complete linkage bypasses the sticky problem of weighting clusters against potential new group members which has plagued the average linkage freaks.

These clusters were not the end-product of the analysis. Site structure was further assessed using SYMAP, a computer mapping program which uses a standard line printer as its output device.
Use of Synagraphic Mapping System

"SYMAP" is short for synagraphic mapping system (Dougenik and Sheehan 1975). The system originally was developed by H. T. Fisher in 1963. Data values are entered with coordinates and the program interpolates values between these to create density gradients.

Although SYMAP is extensively used in archaeology, its use has not been cited frequently in the literature. Jermann (Jermann and Dunnel 1976; Jermann 1978) seems to be its chief proponent. In his 1978 article, Jermann used both SYMAP and D.A.V. to determine the presence of clustering of cultural materials, and their general distribution in an archaeological site.

SYMAP permits visual comparison of densities across a site, and can provide the archaeologist with a subjective "feel" for her data. The program is flexible enough so that impression of density plots can be kept quite close to the original, numerical data by appropriate choice of package subroutines.

Its disadvantage is that of any automated mapping program: it does not deal well with clustered data. Degree of clustering, or degree of reliability, generally is based on a nearest neighbor statistic. Maps cannot be considered reliable unless the statistic is 0.9 or greater, that is, unless the data have a random to uniform distribution (Morrison 1970:501).

I mapped density distributions of the summed artifact classes, then of the individual artifact classes, using SYMAP, as a check on the results of the dimensional analysis of variance. Clusters inferred from high density areas on the SYMAP output were compared back to the average cluster size implied by D.A.V. Relative locations of the clusters were identified on SYMAP plots, and these are the primary data for statements assessing the regular distributional character of the sites.

The choice of SYMAP electives may determine the final appearance of the maps nearly as much as does the actual, numerical data.
Jermann and Dunnell (1976) suggested several procedures for choosing class intervals for the density levels. Those were ignored, because I wanted densities to be comparable within classes across all of the study sites. So, I subdivided classes judgmentally, on a quasi-logarithmic basis. I think I have had moderate success. It is only moderate because SYMAP (except in the hands of an accomplished Fortran programmer) is unable to add values from contiguous locations. In some instances, densities derived from the four meter grids previously used in the D.A.V. would have been more appropriate than the density plots drawn from point locations.

All sites were mapped at the same scale (1 inch equals 5 m). Therefore, SYMAP plots are comparable and a grid can be overlaid for a more direct comparison with cluster sizes inferred from D.A.V.

**Site Attribute Analysis**

An independent, judgmental analysis of site types also was undertaken. This analysis separated habitation from nonhabitation sites by presence of some "sensitive" structures/features and artifacts. Sites were identified as "habitation" sites by the presence of five or more of eight "sensitive" attributes: pithouses, hearths, or ashy areas, slabs, burned limestone fragments, manos, metates, choppers, drills, and other ground stone. I also tried to describe similarities in the same manner that had been used with pattern sizes from D.A.V. A similarity matrix was formed using the same similarity coefficient as with the D.A.V. comparisons but from mutual presence or absence of the "sensitive" traits. Mutual presence and absence were counted equally because all artifacts on the sites were collected and because some sites are small (see Driver and Kroeber 1932:25).

For the final description of the study sites emphasis has been placed on judgmental techniques. An attempt has been made to re-unite features and
artifact classes having few members with the density plots of larger artifact
classes and, where possible, with artifact-pattern size as inferred from
dimensional analysis of variance. Regularities in these structure sizes and
their presence in sites of particular sizes, was searched for. Site size is
measured here by the total area and the total number of artifacts. Regularities
in locations of artifact distributions, as inferred from SYMAP, were recorded.
Groupings of sites with the same artifact-pattern sizes, those with similar
arrangements of distributions of artifact classes and the site groupings from
the judgmental sample were compared. From this comparison, my final inferences
regarding site types, and my conclusions on the advantages of the several methods,
were made.
CHAPTER 5

THE SITES

Up to the present there is, as far as I know, not even a tentative record of Basketmaker II remains of any sort outside of caves. . . . They would be inconspicuous at best, and so barren that anyone who might poke experimentally into one would soon desist unless bent on a specific quest.

Earl Morris

All of the study sites are open, mesa top sites. And, they do not offer much reward in terms of material culture. The study sites vary in size from the smallest of the sites, with only 48 artifacts in a 900 sq. m area, to huge sites of over 2000 artifacts scattered across a 9000 sq. m area (Table 2). Guernsey and Kidder predicted, in 1921, that Basketmakers probably lived mostly in the open and resorted to caves only for shelter and temporary storage (Guernsey and Kidder 1921:110). Five of the study sites have obvious pithouse remains (evidence for these consists of parallel, upright sandstone slabs marking the entryway). Other sandstone slabs could be either structures or smaller features. Only WJ 19-3 shows indications of more than one pithouse. Presence of pithouses may be taken to indicate presence of some other features, as well. Only one site with a pithouse does not also have a hearth, although the reverse certainly is not true. In terms of portable material culture, all sites but one have burned limestone. All of the sites have manufacturing debris, utilized flakes, and bifaces. Most of the sites also have some area of ashy, gray soil which frequently is associated with concentrations of lithic debris. These, I presume, are deflated middens. Despite the similarities described, the appearances of the sites are quite distinct.
Table 2. Size of the Basketmaker II Study Sites, Measured by Area and Number of Artifacts

<table>
<thead>
<tr>
<th>Site</th>
<th>Area (sq. m)</th>
<th>Artifact Totals</th>
<th>Standardized Area</th>
<th>Values\textsuperscript{a} for Artifacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>B 9-6</td>
<td>900</td>
<td>83</td>
<td>- 0.51</td>
<td>- 0.38</td>
</tr>
<tr>
<td>B 14-1</td>
<td>9100</td>
<td>2364</td>
<td>1.15</td>
<td>5.62</td>
</tr>
<tr>
<td>HS 11-1</td>
<td>1560</td>
<td>1270</td>
<td>- 0.37</td>
<td>2.74</td>
</tr>
<tr>
<td>HS 11-2</td>
<td>4000</td>
<td>1724</td>
<td>0.12</td>
<td>3.94</td>
</tr>
<tr>
<td>UGG 5-3</td>
<td>8500</td>
<td>420</td>
<td>1.03</td>
<td>0.51</td>
</tr>
<tr>
<td>UGG 7-4</td>
<td>2000</td>
<td>351</td>
<td>- 0.28</td>
<td>0.33</td>
</tr>
<tr>
<td>WJ 15-3</td>
<td>2500</td>
<td>1018</td>
<td>- 0.18</td>
<td>2.08</td>
</tr>
<tr>
<td>WJ 17-3</td>
<td>3400</td>
<td>120</td>
<td>0</td>
<td>- 0.28</td>
</tr>
<tr>
<td>WJ 19-1</td>
<td>4100</td>
<td>110</td>
<td>0.14</td>
<td>- 0.31</td>
</tr>
<tr>
<td>WJ 19-2</td>
<td>1200</td>
<td>223</td>
<td>- 0.45</td>
<td>- 0.01</td>
</tr>
<tr>
<td>WJ 19-3</td>
<td>6300</td>
<td>406</td>
<td>0.59</td>
<td>0.47</td>
</tr>
<tr>
<td>WJ 19-4</td>
<td>900</td>
<td>53</td>
<td>- 0.51</td>
<td>- 0.46</td>
</tr>
<tr>
<td>WJ 19-5/6</td>
<td>1886</td>
<td>141</td>
<td>- 0.31</td>
<td>- 0.22</td>
</tr>
<tr>
<td>WJ 19-7</td>
<td>1350</td>
<td>48</td>
<td>- 0.41</td>
<td>- 0.47</td>
</tr>
</tbody>
</table>

All BM II $\bar{x} = 3398.4^a$  $\bar{x} = 226.5^a$  0  0

\textsuperscript{a}Values are based on all Cedar Mesa sites identified as definite, single component BM II. (Formula for standardizing site values is $[x_i - \bar{x}]/s$). Average areal size of the study sites (595 sq. m) is almost the same as average from all Cedar Mesa BM II sites. The average artifact count from the study sites (3406 artifacts) is relatively larger. This is expected because values from all Cedar Mesa sites are from catalog entries (some catalog entries represent more than one artifact), while artifact totals shown for the study sites are from actual counts.

The study sites used in this thesis are a subsample of Basketmaker II sites known from the Cedar Mesa Project (CMP) survey (Figure 1). The CMP conducted intensive survey within 400-m square quadrats randomly selected within drainage basins. The drainages were selected by stratified (north versus south portion of the region) sampling (Matson and Lipe 1975:128). Site names, e.g., WJ 19-3, indicate drainage (West Johns), quadrat (19), and the field
description number of the site (3). WJ 19-3 is the third site described from quadrat 19 in the West Johns drainage. Within quadrats all sites were surveyed and within sites all features and collecting locations were mapped and all artifacts were collected.

From those quadrats, a random sample of six BM II sites, stratified by standardized values for site area and artifact counts were selected. Standardized values divided the sites into groups of small sites with few artifacts, small sites with many artifacts, and large sites. Two of the initial study sites were dropped because of clerical difficulties with notes and artifact tallies. Rather than completing site selection randomly, two large Basketmaker II sites were added. Later the sample was expanded to include tested sites (WJ 19-3 and WJ 19-7) and the rest of the sites in the WJ 19 quadrat. These judgmental additions to the sample were attempts to describe adequately at least those sites which seem likely to possess, or certainly to possess, pithouses.

**Bullet 9-6 (45SA4125)**

B 9-6 includes a possible burial, judging from a few fragments of human bone eroding out of the side of a wash. A lithic scatter is associated.

The artifact distribution covers approximately 30 m by 30 m. A total of 83 artifacts was collected from the site; a large proportion of these were utilized or bifacial flakes (Table 3). Areas of ashy soil and scattered fragments of burned limestone were mapped on the north part of the site. Both ashy soil and burned limestone are almost ubiquitous in sites of the Basketmaker II period (on Cedar Mesa, based on Lipe and Matson's descriptions of the sites). No other structures or features are located in B 9-6.

Three other possible Basketmaker II sites are described from this quadrat. One of these has two slab-lined cists or hearths. It is located about 200 m west of B 9-6. The other two are scatters of flaked lithic artifacts and limestone, less than 50 m from B 9-6. All three are considerably smaller, even than B 9-6.
| Site   | Unifacial-Steep | Unifacial-Narrow | Utilized-Steep | Utilized-Narrow | Denticulates | Other F.L. | Bifaces | Drills | Hammerstones | Cores | Manos | Metates | Gizzard Stones | Miscellaneous | Primary Flakes | Secondary | Tertiary | Detritus | Totals |
|--------|-----------------|-----------------|----------------|----------------|--------------|------------|---------|--------|-------------|-------|-------|---------|---------------|---------------|--------------|-----------|---------|---------|--------|-------|
| B 9-6  | 9               | 0               | 9              | 8              | 0            | 0          | 10      | 0      | 4           | 0     | 0     | 0       | 0              | 3             | 0            | 11        | 7       | 22      | 83     |
| B 14-1 | 48              | 3               | 30             | 60             | 14           | 0          | 16      | 2      | 0           | 0     | 0     | 0       | 0              | 2             | 6            | 2         | 0       | 180     | 742    | 1246  |
| HS 11-1| 26              | 4               | 69             | 184            | 21           | 4          | 21      | 0      | 3           | 8     | 0     | 0       | 29             | 3             | 5            | 256       | 466     | 171     | 1270   |
| HS 11-2| 67              | 3               | 63             | 170            | 40           | 5          | 76      | 10     | 1           | 13    | 0     | 0       | 32             | 1             | 3            | 427       | 585     | 228     | 1724   |
| UGG 5-3| 9               | 0               | 10             | 17             | 19           | 0          | 5       | 0      | 1           | 0     | 0     | 0       | 0              | 13            | 0            | 28        | 38      | 282     | 422    |
| UGG 7-4| 11              | 3               | 19             | 22             | 4            | 1          | 5       | 0      | 2           | 0     | 0     | 0       | 2              | 11            | 14           | 38        | 24      | 186     | 351    |
| WJ 15-3| 11              | 1               | 55             | 95             | 13           | 2          | 9       | 0      | 1           | 15    | 0     | 0       | 0              | 1             | 12           | 154       | 205     | 444     | 1018   |
| WJ 17-3| 0               | 0               | 6              | 20             | 23           | 1          | 3       | 0      | 0           | 0     | 0     | 0       | 0              | 0             | 0            | 19        | 20      | 28      | 120    |
| WJ 19-1| 5               | 0               | 5              | 12             | 4            | 1          | 3       | 0      | 2           | 0     | 1     | 0       | 0              | 0             | 0            | 18        | 43      | 17      | 111    |
| WJ 19-2| 5               | 1               | 14             | 24             | 10           | 0          | 4       | 0      | 6           | 6     | 0     | 0       | 0              | 2             | 4            | 27        | 28      | 92      | 223    |
| WJ 19-3| 9               | 3               | 17             | 35             | 4            | 1          | 7       | 2      | 7           | 50    | 2     | 0       | 0              | 8             | 6            | 126       | 46      | 83      | 406    |
| WJ 19-4| 3               | 1               | 3              | 8              | 6            | 0          | 3       | 0      | 0           | 1     | 0     | 0       | 0              | 0             | 3            | 6         | 18      | 52      |       |
| WJ 19-5/6| 3              | 2               | 5              | 19             | 8            | 0          | 9       | 0      | 3           | 3     | 1     | 0       | 0              | 0             | 0            | 21        | 29      | 38      | 141    |
| WJ 19-7| 3               | 2               | 0              | 8              | 1            | 0          | 4       | 0      | 0           | 3     | 0     | 0       | 2              | 0             | 15           | 4         | 6       | 48      |       |
Bullet 9-6 is located 1/2 m above the bottom of a small, ephemeral wash flowing into Bullet Canyon. Elevation is approximately 5,800 feet. Site notes indicate a possible spring seep in the area of the site. Vegetation is of a type characteristic of cliffsides and canyon bottoms. Soil cover on the site is continuous, and the site is only moderately dissected. These gullies drain to the south. Artifact locations show no correspondence to the drainages.

**Bullet 14-1 (42SA4155)**

B 14-1 covers an area of approximately 75 m north-south by 125 m east-west. Although 2364 artifacts were collected from the site, the only evidence of structural remains was an ashy hearth. The hearth is recorded from a "blow-out" (deflated sand area). Surveyors described the hearth area as an apparent chipping station with a wide variety of raw material represented by the flakes. Field maps show the artifact distribution is subdivided into several "areas." These "areas" are separated by shallow drainages running north-south off the long, low ridge on which B 14-1 is located.

The site is not highly dissected, but has quite a few blowouts like the one from which the hearth is recorded and has exposures of caliche in a number of areas, as well. The tremendous number of artifacts recovered by surface collection may be a function of deflation. Some ashy areas were noted, but apparently not many. Only small amounts of sandstone rubble were observed. No evidence of a more formal structure was discovered although a metate fragment was found near the ash area, perhaps in association with the hearth construction. Aside from the single metate fragment, few of the "sensitive" artifacts (choppers, drills, bifaces) commonly associated with other large sites were found.

One other Basketmaker II site is located in the Bullet 14 quadrat, about 160 m south of B 14-1. Less than 60 artifacts were recovered from that site, and again, no features were recognized.
Elevation of B 14-1 is about 6,160 feet. The nearest water source appears to be in Bullet Canyon about 800 m south. The site is in a transitional vegetation zone between open, pinyon-juniper woodland and sagebrush flats.

**Hardscrabble 11-1 (42SA3978)**

HS 11-1 is a dense lithic scatter. Twelve hundred and seventy (1270) artifacts were recovered from an area 40 m north-south by 60 m east-west. Except for a few hammerstones, all artifacts are flaked lithics (Table 3). Scattered sandstone rubble, chunks of burned limestone and three ashy soil areas were found, but no erect, sandstone slabs.

The site is physically constrained on the north, east, and south by low cliffs which also provide some protection from the wind. Site exposure is northwest. Despite the exposure and lack of a pithouse depression, surveyors thought HS 11-1 might be a winter camp.

Two other BM II sites are located in the Hardscrabble 11 quadrat. One of these, HS 11-2, is included in this study. The other is a very small site, located above the rim of a side canyon leading into Grand Gulch.

HS 11-1 is at an elevation of about 5600 feet. The quadrat crosses several vegetation communities, including both cliffside and canyon bottoms. Hardscrabble 11-1 is located away from the canyon rim in a blackbrush flat just north of a large flat of Indian rice grass.

**Hardscrabble 11-2 (42SA3979)**

HS 11-2, also, is a dense lithic scatter. This one has upright slabs indicating either features or structures. Seventeen hundred and twenty-four (1724) artifacts were collected from the 50 m north-south by 75 m east-west site. Most of the artifacts are lithic flakes, but there are also a considerable number of projectile points. Virtually all other classes of artifacts recovered
from BM II sites on Cedar Mesa are represented here (Table 3). Other cultural material includes burned and unburned sandstone rubble, several upright sandstone slabs which are probably parts of hearths, one metate, and a fairly widespread area of ashy soil which varies between 5 and 40 cm in depth at the center of the site.

Surveyors thought HS 11-2, like HS 11-1, might be a winter camp. Proximity to HS 11-1 may indicate some relation between the sites. HS 11-2 is a more likely pithouse site than is HS 11-1. In HS 11-2, the central area of deep soil with very few artifacts might be a pithouse.

Hardscrabble 11-2 is located entirely within the blackbrush and pinyon-juniper vegetation zones, at about the same elevation as HS 11-1. Water would have been available in the canyon bottom north of the site. The site is protected on south by a low (15 m) cliff, and has a northwest exposure. The center of the site and the area of the greatest concentration of cultural material consists of stabilized sand dunes.

**Upper Grand Gulch 5-3 (42SA4055)**

UGG 5-3 is a lithic scatter. Four hundred and twenty-two (422) artifacts were recovered from an area 170 m north-south by 50 m east-west (an area nearly as large as that occupied by B 14-1, but with only a quarter the number of artifacts). Virtually all artifacts recovered are lithic flakes. The only feature is an ashy area which surveyors believed was a hearth.

The site is located on the extreme east side of the quadrat. Artifact collections were made only to the quadrat boundary. The site certainly extends beyond that boundary so UGG 4-3, as described here, may be only the edge of a larger site.

Other sites are located in the quadrat, but these do not appear to be BM II.
UGG 5-3 is located at approximately 6700 feet elevation, in pinyon-juniper woodland. The site is situated on Grand Flat between two canyons of Grand Gulch which appears to be the closest source of water. A few shallow drainages run off the site to the north and northwest. Drainage does not appear to have affected the artifact distribution.

**Upper Grand Gulch 7-4 (42SA4063)**

Three hundred and fifty-one (351) artifacts were collected from an area 50 m north-south by 40 m east-west. The site is comprised of several discrete distributions. By far the largest of these abuts the south edge of the quadrat and appears to extend outside the quad. A sandstone structure is located in this distribution, at its northwest edge. It is probably a cist. The only other cist described from any of the study sites is in WJ 19-3. That cist is located north of a pithouse. However, in UGG 7-4, no artifacts were collected or mapped in the area south of the quadrat boundary, although the greatest recorded artifact distributions are at the quadrat boundary. As it seems unlikely that an artifact distribution would end so abruptly, I think the site extends south, outside the quadrat boundary.

Most of the artifacts which were collected are lithic flakes (Table 3). Several bifacially retouched artifacts, denticulates, and choppers were recovered also. Other cultural material includes upright sandstone slabs. In at least one instance, these represent a hearth, but in another, the slabs may be part of a more substantial structure (although tests indicate the soil is very shallow and bedrock and caliche are exposed in places, on the site). Areas where the slabs are located are eroded, so positive statements of presence or absence of structures could not be made from the surface evidence.

UGG 7-4 is one of seven possible Basketmaker II sites in this quad. Two of these are less than 20 m from UGG 7-4, but neither these two nor any of the other BM II sites in the quad have any evidence for structures.
Upper Grand Gulch quad 7 is just north of Kane Gulch in pinyon-juniper woodland, at about 6500 feet elevation. Kane Gulch appears to be the closest source of water. Drainages run toward the southeast (Kane Gulch). The drainages in UGG 7-4 are numerous, but shallow.

**West Johns 15-3 (42SA4256)**

Surveyors felt that WJ 15-3 could be a chipping station associated with other sites, possible hunting stands, in the same quad. One thousand and eighteen (1018) artifacts were distributed over an area approximately 50 m north-south by 50 m east-west. Most of the artifacts collected were lithic flakes. A considerable number of cores were found also, consistent with a workshop identification.

The only feature is an ashy soil area in the extreme northwest corner of the site. Artifacts were concentrated in this area of ashy soil, under a small shelter. All but one of the cores recovered from the site was taken from this area. Most of the artifacts in this part of the site are manufacturing debris.

WJ 15-3 is located in a shallow canyon bottom above West Johns at about 5220 feet elevation. The nearest permanent water is in the canyon proper, about one-half mile away. Vegetation is characteristic of canyon bottoms, growing into continuous, sandy alluvium. Site exposure is to the south, and drainage is in the same direction, on a gentle slope (the site is not dissected).

**West Johns 17-3 (42SA4266)**

WJ 17-3 is distinguished by the lack of formal structures. No features were discovered, not even a single area of ashy soil. One hundred and twenty-four (124) artifacts were collected. Many of these are edge-damaged lithic flakes and snapped denticulates.
The artifact distribution is discontinuous. Artifacts were located away from the gullies draining the site. The gullies are deep, and drainage is to the south (toward a tributary canyon of West Johns).

Another BM II site is recorded in this quadrat, less than 100 m from WJ 17-3. It also is devoid of features.

WJ 17-3 is at about 6000 feet elevation, in pinyon-juniper woodland. Presumably, West Johns is the closest permanent water source.

West Johns 19-1 (42SA4269)

WJ 19-1 is one of seven Basketmaker II sites in this quadrat. Six of these are included in this study. WJ 19-1 is one of the smallest of these sites. One hundred and eleven (111) artifacts were recovered from the 60 m by 75 m area of the site. These are mostly flaked lithics, but also include a mano and two hammerstones. Two areas of ashy soil are mapped on the site as well as some sandstone rubble. Both are in the central part of the site, but are not associated with the most dense concentrations of artifacts. There is no obvious evidence of more formal structures on the field maps, but notes indicate the probable presence of a pithouse.

Drainage is in a north-south direction, and there may be some correlation of artifact locations with the drainages.

The West Johns quad is located at about 6500 feet elevation in the pinyon-juniper woodland above West Johns Canyon. Presumably, the canyon was the closest source of permanent water. The quad slopes toward the canyon and drainage is in that direction. Neither WJ 19-1 nor any of the other West Johns 19 sites are strongly dissected.

West Johns 19-2 (42SA4270)

WJ 19-2 is located just south of WJ 19-1. Two hundred and twenty-three (223) artifacts were recovered from its 70 m north-south by 60 m east-west area.
Most of these are flaked lithic manufacturing debris. Some hammerstones, bifaces, denticulates, and a fragment of ground stone are also in the inventory. A large, circular depression and several upright slabs are presumed to represent a pithouse. It is located just northwest of the main artifact distribution.

Drainage off the site is in all directions. The only level area is in the center of the site, near the pithouse depression.

The environmental setting is, of course, the same as for WJ 19-1.

**West Johns 19-3 (42SA4271)**

WJ 19-3 is located about 30 m east of WJ 19-1 and WJ 19-2. The site is known by 406 artifacts recovered during surface collection from a 90 m north-south by 70 m east-west area, and by test excavations during 1973.

The surface collection produced all classes of "sensitive" artifacts: manos, metates, choppers, and drills. (Oddly, no denticulates were recovered from the site.) Surficial evidence indicated two possible pithouses and a row of storage structures. Midden areas are associated with these (possible) structures. Excavations confirmed the presence of both a pithouse and storage units in one artifact concentration in the south half of the site. (The north fraction of the site was not tested.)

The site is dissected by gullies draining to the south. These partly exposed the tested pithouse, but do not appear to have altered the (remaining?) artifact distribution.

**West Johns 19-4 (42SA4272)**

Fifty-three (53) artifacts were recovered from this 30 m by 30 m site. The artifact assemblage includes one mano but otherwise consists of flaked lithic tools and debris. Surveyors noted that the artifacts show a considerable variety of stone. No formal structures were identified. Two semi-erect sandstone
slabs are located in the northwest quadrant of the site. The area around these was tested, but provided no indication of a pithouse or other structure. Likewise, the area containing the majority of artifacts, and corresponding with a north-south drainage, was tested but provided no indications of a formal structure.

The site is located on a complex slope. Its exposure is northeast and southeast, as are the shallow site drainages. Local environment is similar to that described for WJ 19-1.

**West Johns 19-5/6 (42SA4273)**

WJ 19-5/6 is the northernmost site in the West Johns 19 quadrat. One hundred and forty-one (141) artifacts were collected from an area 80 m north-south by 30 m east-west. The inventory includes nearly the whole range of potential artifacts from BM II sites, although no choppers, drills, or metates were found. Structural remains are limited to some sandstone rubble in the north part of the site, associated with an area of ashy soil.

Shallow drainages dissect the site, and there is some correspondence of the artifact collecting locations to the drainages.

There is a slight vegetational shift in West Johns 19 from the north to the south end of the quadrat. WJ 19-5/6 is in this transitional area between open, pinyon-juniper woodland and sagebrush.

**West Johns 19-7 (42SA4274)**

A total of 48 artifacts were recovered from WJ 19-7. They were dispersed over an area 30 m north-south by 50 m east-west. The site did show evidence of a pitstructure (parallel rows of slabs and a depression) with an associated area of ashy soil directly east and a hearth (Figure 3). The site was tested in 1973, verifying the presence of the pithouse.
Figure 3. MJ 19-7 showing excavation trench through pithouse and depth of deposits.
The site is nearly level but a few shallow drainages run to the north. Otherwise, local environment is the same as that described for WJ 19-1.

**Summary**

Eight Basketmaker II sites were discovered in the West Johns 19 quadrat; seven of these are described in this thesis (Figure 4). Upper Grand Gulch Quadrat 7 revealed a similar number of BM II sites although only UGG 7-4 is described here. Unlike the West Johns 19 sites, not all sites in the Upper Grand Gulch 7 quadrat have permanent, or reusable, features. The distances between sites in the West Johns 19 or the Upper Grand Gulch 7 quadrats range between 50 and 100 m. In terms of appearance, divined from the field notes, the West Johns 19 sites are more similar to each other than to any of the other study sites. Based on the presence of multiple sites in a small area, particularly those having evidence of pithouses, and the similarity of those sites to others in the same quadrat, I think that some consideration could be given to these sites as independent parts of a larger site, or "village." In a loose sense some quadrats, particularly the West Johns 19 quadrat, possibly also the Hardscrabble 11 quadrat and the Upper Grand Gulch 7 quadrat, may each be described as all or part of a very large, loosely aggregated "site," which I would prefer to call a "village."
Figure 4. Site locations in West Johns 19 quadrat.
CHAPTER 6

RESULTS

"Where would you like them--at the head of the bed or at the foot?"
Marietta started up, sleep gone, and wide-eyed. There was Richard
beside their bedroll, crouching, both arms circled about in supporting
embrace two of the withered Ancients he had carried in out of the
snow. . . . The mummies stared back at her sightlessly and gape-jawed,
the long wild hair of one streaming down across a wizened, tobacco
colored face. Out of a dry throat Marietta finally answered:
"At the foot, Mr. Wetherill. At the foot of the bed."

Frank McNitt: Exchange between Marietta
and Richard Wetherill

The intent of this thesis was to distinguish differences among Basketmaker
II sites on the basis of their artifact distributions. My technique was to
quantify artifact types recovered from collection points on each site and,
from these, assess average pattern size in the spatial distribution of each
artifact class in a site. The total array of average pattern sizes from the
artifact classes was used to compare the study sites. For obvious reasons,
this study was limited to artifact classes with relatively large membership.
Judgmental identification of sites as habitation or nonhabitation sites was
done separately, and incorporated presence and absence of classes of material
items which regularly have a small membership. Results from the judgmental
identification of sites act as a check on the results of dimensional analysis
of variance. SYMAP was used as a connecting link between the two analytical
techniques by mapping the distributions of artifact classes with large member-
ships, and the distributions of all artifacts in the site. This section addresses
both the techniques and the identification of the study sites.
Results of Judgmental Analysis

Based on the presence or absence of particular traits, study sites were identified as habitation or nonhabitation sites. Eight "sensitive" traits were defined as relevant for the Basketmaker sites: pithouses, hearths or ashy areas, upright slabs, burnt limestone, manos, metates, choppers, and drills. Sites were pigeonholed as "habitations" if they possessed five or more of the sensitive structure/features or artifact classes. "Habitation" sites include HS 11-2, UGG 7-4, WJ 19-1, WJ 19-2, and WJ 19-3. WJ 19-7 is classed as a "habitation" despite showing only four "sensitive" traits, since one of these is a (excavated) pithouse. B 9-6, B 14-1, HS 11-1, UGG 5-3, WJ 15-3, WJ 17-3, WJ 19-4, and WJ 19-5/6 are left as "nonhabitations" as they have fewer than five of the sensitive traits (Table 4).

WJ 19-3 is the only study site possessing all eight traits. No site lacks all the traits, but the only "sensitive" trait in WJ 17-3 is burned limestone. Limestone is a baseline trait: all the study sites, except WJ 19-4, possess this material. None of the "sensitive" traits, by itself, appears to divide the sites between "habitation" and "nonhabitation." Presence of upright slabs comes close to serving as this divisor. Except for appearance in WJ 19-4, slabs were limited to sites with at least four other "sensitive" traits. WJ 19-4 is identified as "nonhabitation" in the judgmental analysis since its only other sensitive traits are a mano and a possible hearth.

Based on the mutual presence or absence of each of these nine sensitive traits, groups of sites were then formed using the same similarity coefficient used to group sites on the basis of similarities in average pattern size of artifact distributions. This was done because I wanted to recognize groups based on similar patterns of sensitive traits as well as on purely quantitative differences which had led to the "habitation/nonhabitation" distinction.
<table>
<thead>
<tr>
<th>Site</th>
<th>Structures</th>
<th>Hearths</th>
<th>Slabs</th>
<th>Limestone</th>
<th>Manos</th>
<th>Metates</th>
<th>Choppers</th>
<th>Drills</th>
<th>Functional Assignment</th>
<th>Group Assignment (Figure 5)</th>
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</table>
Similarities between sites based on the mutual presence or absence of traits (Figure 5; Table 4) identified four site groups. Groups were formalized when 13 of the 14 sites could be grouped with at least one other site. Group I contains B 9-6, HS 11-1, UGG 5-3, WJ 15-3, B 14-1, and WJ 17-3. Group II consists of WJ 19-2, UGG 7-4, WJ 19-7, and WJ 19-1. Group III contains HS 11-2 and WJ 19-3. Group IV is described by WJ 19-4 and WJ 19-5/6. Groups I and II comprise all previously identified "habitations," while Groups I and IV represent the "nonhabitation" sites.

These site groups go beyond a recreation of the dichotomy formed by dividing sites with five "sensitive" traits from those sites with fewer. WJ 19-7, the very small, pithouse site, was lumped with three "habitation" sites when groupings were formed by similarities in mutual presence and absence of the traits. Further, using this similarity matrix, WJ 19-4 and WJ 19-5/6 were grouped together, a discrete cluster among the other sites. (Based on D.A.V. results and the SYMAP graphics, these sites will again appear similar to each other, and unlike the other sites.) I thought the formation of multiple site groups would increase the chances of showing similarities between the results from dimensional analysis of variance and results from the judgmental analysis. This was not always true. However, the results do show that my manner of developing site similarities with a nonstandard coefficient (Appendix B) has reasonable success.

**Dimensional Analysis of Variance Results**

Dimensional analysis of variance produces a summary of average cluster sizes for individual artifact classes within each site. These have been used to assess similarity in site distributional structure among the study sites. My conclusions on the technique rest on some 39 suites of analysis, where a suite is runs of all the artifact classes within a site. The D.A.V. forms the core of this thesis.
Figure 5. Dendrogram of Basketmaker II study sites based on similarities in presence or absence of "sensitive" traits.
Dimensional Analysis of Variance: The Technique

The results of dimensional analysis of variance were useful when characteristics of the site met certain criteria and when the D.A.V. grid was overlaid on the site in such a way as to adjust for cultural or natural anomalies away from the ideal, square distribution of artifacts with a single cluster size in each site. I found that each artifact class must have a certain minimum number of members for D.A.V. to be useful for inferring cluster sizes within the distribution. Further, real variation in cluster size cannot be too great if a meaningful, average pattern size is to be produced for that artifact class. Likewise, sites which are heavily dissected by erosion may not produce meaningful pattern sizes for any class. However, a distribution may be elongated in some direction, whether from cultural processes or erosion, without necessarily reducing the effectiveness of D.A.V. The placement of the D.A.V. grid over the site can elucidate this type of patterning (repeated, linear groups of items) if the long axis of the clusters is parallel to the direction in which square grid units are joined to form rectangular grid units as block size is increased in D.A.V. (alternatively, patterning can be obscured if the grid dissects real clusters). When the minimum number of items is present for each artifact class, when real variation in cluster sizes is not too great (as shown by one or a few sharp peaks in the graphs of mean variance ratios for each artifact class), and when placement of the grid seems appropriate to the site (as shown by consistency in repeated trials with the grid axis oriented in one direction but offset slightly in different trials), then I think it may be assumed that D.A.V. is effectively characterizing site distributional structure.

With the study sites, I found that a minimum of eight members was necessary for dimensional analysis of variance to identify an optimum block size for an artifact class in any site. Smaller memberships produce smaller mean-square
ratios (m-s ratios). When class membership fell below the critical number, the initial m-s ratio was very small and approached zero within a few increases of block size. The minimum, requiring at least eight items per artifact class, appears to be area dependent. In WJ 19-3 and B 14-1, the largest study sites, artifact classes with fewer than 11 members did not produce meaningful m-s ratios. This is only a fractional increase considered against area increases from the smallest sites (D.A.V. grid of 256 m²) to the largest sites (grid of 4096 m²).

Establishing optimum block size also requires that the distributions can be described by a few cluster sizes. I suspect that a multiplicity of cluster sizes obscures peaks in the m-s ratio at smaller block sizes. Effectively, this would make the location of clusters within a site (for instance, in the same quadrant of the site) more important in forming peaks in the graph of m-s ratios than is the number of members in any of the individual clusters. Regardless of whether I am correct on this last point, it is apparent that fewer pattern sizes in a site correlates with having larger peaks in the m-s ratio at block sizes most closely corresponding to visually apparent (SYMAP) cluster sizes.

Finally, the placement of the D.A.V. grid over the site can significantly alter the results. Both the location of the grid, with respect to areas of high artifact density, and the polar orientation of the grid (when analyzing elongated distributions) are important.

Varying the placement of the site within the D.A.V. grid can wholly alter the results of analysis. If the study site is small relative to the whole D.A.V. grid (as it may be if the shape of the total artifact distribution is not square) centering the grid over the site will effectively compare the four quadrants of the site to dummy grid units. In this instance peaks in the
m-s ratio can be expected at a block size approaching one-fourth the area of the total artifact distribution. (Of course, small shifts in the location of the D.A.V. grid can similarly alter results depending on whether grid units dissect areas of high artifact density.) In general, locating as much of the site as possible in grid units which are joined in larger blocks early in the iterative process is preferable. It should be recalled that dimensional analysis of variance joins contiguous grid units in a regular pattern, in which blocks alternate between squares (iteration 1, 3, etc.) and rectangles (iteration 2, 4, etc.). Grid units that are contiguous are not necessarily lumped into one block until late in the analysis (see Appendix B for diagram). When the site is centered under the D.A.V. grid, artifacts near the center of the total distribution (the place where we might expect the highest density of artifacts) will not be considered together until the final iterations, when the number of artifacts in one-half of the site is compared to the number in the opposite half of the site. Unfortunately, this point has not been explicitly stated in published discussions of D.A.V. Simply put, it is necessary to look at the site before attempting to characterize it with dimensional analysis of variance.

Where gullies dissect the site it is apparent that having the grid approximate the orientation of these drainages (or the slope of the site) produces the best results. When the D.A.V. grid is oriented with the characteristics of the site in mind, I think peaks in the m-s ratio may occur at rectangular block sizes as well as, or instead of, square block sizes.

Whallon found that distributions of artifact classes in his analysis always had a larger m-s ratio for square blocks than for rectangular blocks. He indicated his finding as a warning that small dips in the m-s ratio, which may regularly occur between square and rectangular block sizes, are a product of
the mathematical technique rather than behavioral differences (Whallon 1973). He implied that all distributional pattern sizes in artifact distributions within the rockshelter that he was describing were products of human behavior. To an extent, I believe that all artifact concentrations in the Cedar Mesa sites are products of human behavior, but because these sites are surface scatters in a deflated area, and are exposed to natural alteration, the effects of these natural alterations must be recognized. This is not a problem that Whallon had to overcome.

Six of my study sites have peaks in the m-s ratio at rectangular block sizes in all or most of their artifact classes, and slope wash may be implicated as a causal factor. B 14-1, HS 11-2, UGG 7-4, WJ 15-3, WJ 19-2, and WJ 19-4 drain in the same, approximate, direction as the long axis of the rectangles from which the m-s ratio was derived. I think the two phenomena may be related. None of these sites were deeply dissected and one site is not dissected at all, but drainage in this site, WJ 15-3, is on a gentle slope, north to south as are the long axes of the rectangular blocks. Results are not conclusive since most sites have drainages, but relatively few sites have linear artifact distributions. However, it may be seen again that placement of the D.A.V. grid has considerable importance to the results of analysis.

Even a small shift in the placement of the D.A.V. grid over the artifact distribution can alter the location or size of peaks in mean-square ratios, as shown by successive D.A.V.s using the same data. This effect has been noted before and is not taken up here. As described in the section on Method, I have been able to use repeatability of my results, that is, the regular appearance of the same pattern size from repeated runs of D.A.V., as a measure of significance of peaks in the m-s ratio.

High values of the mean-square ratio indicate optimum block size at which clustering within the artifact distribution should be considered. This
optimum block size approaches actual cluster size within the distribution
(based on my comparisons with D.A.V. results and SYMAP graphics) when the three
conditions just discussed are met. That is, each artifact class must have
a minimum membership, real variation in pattern size must be low (either as
recorded or by dividing the site into several areas to be separately analyzed),
and some care must be taken in the placement of the D.A.V. grid over the site.

**Dimensional Analysis of Variance:**

**Site Descriptions**

Dimensional analysis of variance was valuable for three aspects of
the site description. The D.A.V. assessed the effect of drainage (erosion)
on artifact distribution. With SYMAP, D.A.V. addressed density gradients in
artifact distributions on recognized pithouse sites. Finally, D.A.V. allowed
me to assess similarities among the study sites, independent of their visible,
structural remains. In this last, D.A.V. made a positive addition to the other
techniques used to describe Basketmaker II sites.

Since Basketmaker II sites on Cedar Mesa are primarily recognizable
as surface scatters, erosion could be expected to have altered artifact distribu-
tions in at least some of the sites. Dimensional analysis of variance shows
that drainage may have affected the artifact distributions in six of the study
sites. Generally, these drainages have a north-south orientation. This direc-
tionality was discovered during my attempt to characterize distributional shape
of the total artifact collection for each site, one of the aspects of site
distributional structure. Originally, I had thought vagaries in site configuration
should reflect cultural, depositional process. Although culturally defined
variation does occur within the Cedar Mesa sites, most elongation of artifact
scatters is more economically dealt with as a function of noncultural processes.

Cultural explanations were not abandoned entirely. Results from D.A.V.
and the SYMAP graphics were used to determine whether there is a regular gradient
in artifact density from north-to-south, on sites with visible, structural remains (i.e., UGG 7-4, WJ 19-1, WJ 19-2, WJ 19-3, and WJ 19-7). The D.A.V. was used to verify presence of an average pattern size approaching one-half total site size while SYMAP graphics were used to identify which half of the site the higher density of artifacts came from when average pattern size approached one-half of site size. No consistent relationship was found between high artifact densities in any half of the site (north, south, east, west) and evidence of pit-houses. However, sites with upright slabs regularly have some gradient in artifact density at block sizes approaching one-half of site size (Table 5). Since not all sites are square, this does not presuppose variation at rectangular block sizes. Although not implied by D.A.V., artifact clusters do seem to have regular locations relative to pithouses and slab-lined features (see results from SYMAP).

Another variation in average pattern size was discovered when D.A.V. grids were rotated 90 degrees. Variation in average pattern size among artifact classes may be greater with a particular grid orientation, generally the same orientation that provided smaller, average pattern sizes for most artifact classes in a given site. This is true in HS 11-1, HS 11-2, WJ 15-3, WJ 19-2, WJ 19-3, WJ 19-4, WJ 19-5/6, and WJ 19-7. (All artifact classes keep the same optimum block size in three sites: B 9-6, where D.A.V.s were run only with the grid oriented north-south, in UGG 5-3 and in WJ 19-1.) For my similarity matrices of sites, I came to prefer the grid orientation which produced the smallest average pattern size because I found that this grid orientation better anticipates size-dependent characteristics of SYMAP graphics, such as which artifact classes may occur entirely within the distribution of another class.
<table>
<thead>
<tr>
<th>Site</th>
<th>Structural Remains</th>
<th></th>
<th>Artifact Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pithouse (+/0)</td>
<td>Slabs/Hearth N. Edge of Artif. Distr (+/0)</td>
<td>N-S or E-W Variation (+/0)</td>
</tr>
<tr>
<td>B 9-6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B 14-1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>HS 11-1</td>
<td>0</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>HS 11-2</td>
<td>+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>UGG 5-3</td>
<td>0</td>
<td>0</td>
<td>N/A (^a)</td>
</tr>
<tr>
<td>UGG 7-4</td>
<td>+</td>
<td>+</td>
<td>N/A (^a)</td>
</tr>
<tr>
<td>WJ 15-3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>WJ 17-3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>WJ 19-1</td>
<td>+</td>
<td>N/A (^b)</td>
<td>+</td>
</tr>
<tr>
<td>WJ 19-2</td>
<td>+</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>WJ 19-3</td>
<td>+</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>WJ 19-4</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>WJ 19-5/6</td>
<td>0</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>WJ 19-7</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

\(^a\)Not all artifacts collected, so distributional differences cannot be determined.

\(^b\)Structures identified in field notes but not shown on field maps.

Basing site similarities on results from analyses in which grid orientation produced the smallest average pattern sizes is preferred for two other reasons, as well. First, larger patterns may represent the sum of several artifact scatters. Of course, this also may be true of the smaller pattern sizes (which have a minimum size defined by the mechanics of D.A.V. of 4 m x 8 m on the study sites) but the effect must multiply for the largest average pattern sizes of artifact classes. The second reason for preferring the smallest pattern size in developing similarities among sites is that smaller patterns are within
the metric boundaries of all the study sites, while larger pattern sizes from sites such as B 14-1 are greater than the total area of smaller sites, such as B 9-6 or WJ 17-3. Therefore, grid orientation which produced the smallest optimum block sizes was used in conjunction with north-south grid orientation (since the north-south grid was run twice for all sites and so provides better verified pattern size estimates) to derive values for the similarity matrices.

Discussion of the possible, underlying relationships determining the site groupings is provided after identification of all site groups based on similarities in artifact distributions is described. The following paragraphs detail the matrices of site similarities based on average pattern size of artifact distributions. Primarily, discussions provide the characteristics measured by each similarity matrix. I have not found a direct correspondence between site groups from any one matrix and particular traits described in Chapter 5. However, the matrices considered together allow sites to be addressed as core members, or marginal members, of a group. In this way, salient characteristics of group membership can be addressed.

In the first site grouping, similarities among sites were formed on the basis of shared, absolute values of optimum block size from each artifact class (Table 6, Table 7). Four groups of sites were formed using complete linkage, with the similarity level which a site needed to join the group being dropped .1 at each pass (Figure 6). Since I was determined to show some similarity for every site (so that it could be described in comparison with the other study sites) these groups are quite loosely formed. It is important to recognize that a site may have only a small similarity to a group (e.g., WJ 19-5/6 to Group I in Figure 6) while it has strong similarities to some members of that group (e.g., WJ 19-3).
<table>
<thead>
<tr>
<th>Site</th>
<th>Unifacial--Steep</th>
<th>Utilized--Steep</th>
<th>Utilized--Narrow</th>
<th>Denticulates</th>
<th>Bifaces</th>
<th>Cores</th>
<th>Hammerstones</th>
<th>Primary Flakes</th>
<th>Secondary Flakes</th>
<th>Tertiary Flakes</th>
<th>Debris</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>B 9-6</td>
<td>8 x 8</td>
<td>0</td>
<td>8 x 8</td>
<td>4 x 4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8 x 16</td>
<td>16 x 16</td>
<td>32 x 64</td>
<td>N</td>
<td>8 x 8</td>
</tr>
<tr>
<td>B 14-1</td>
<td>8 x 8</td>
<td>4 x 8</td>
<td>4 x 8</td>
<td>8 x 8</td>
<td>4 x 8</td>
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<td>0</td>
<td>0</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>N</td>
<td>8 x 8</td>
</tr>
<tr>
<td>HS 11-1</td>
<td>16 x 16</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>16 x 16</td>
<td>16 x 16</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16 x 16</td>
<td>8 x 8</td>
<td>16 x 16</td>
<td>N</td>
</tr>
<tr>
<td>HS 11-2</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>16 x 16</td>
<td>16 x 16</td>
<td>8 x 8</td>
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<td>0</td>
<td>0</td>
<td>16 x 16</td>
<td>16 x 16</td>
<td>16 x 16</td>
<td>8 x 8</td>
</tr>
<tr>
<td>UGG 5-3</td>
<td>16 x 16</td>
<td>4 x 8</td>
<td>8 x 8</td>
<td>8 x 8</td>
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<td>0</td>
<td>0</td>
<td>8 x 8</td>
<td>16 x 16</td>
<td>8 x 8</td>
<td>4 x 8</td>
<td></td>
</tr>
<tr>
<td>UGG 7-4</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>8 x 8</td>
<td>16 x 16</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td></td>
</tr>
<tr>
<td>WJ 15-3</td>
<td>8 x 8</td>
<td>4 x 8</td>
<td>4 x 8</td>
<td>8 x 16</td>
<td>8 x 16</td>
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<td>0</td>
<td>4 x 8</td>
<td>8 x 16</td>
<td>8 x 16</td>
<td>16 x 16</td>
<td>N</td>
</tr>
<tr>
<td>WJ 17-3</td>
<td>0</td>
<td>0</td>
<td>4 x 8</td>
<td>16 x 16</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>N</td>
</tr>
<tr>
<td>WJ 19-1</td>
<td>0</td>
<td>0</td>
<td>8 x 8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8 x 16</td>
<td>8 x 8</td>
<td>16 x 32</td>
<td>8 x 16</td>
<td></td>
</tr>
<tr>
<td>WJ 19-2</td>
<td>0</td>
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<td>4 x 8</td>
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<td>4 x 8</td>
<td>4 x 8</td>
<td>4 x 8</td>
<td>N</td>
</tr>
<tr>
<td>WJ 19-3</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>0</td>
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<td>8 x 8</td>
<td>32 x 32</td>
<td>16 x 16</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td></td>
</tr>
<tr>
<td>WJ 19-4</td>
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<td>0</td>
<td>16 x 32</td>
<td>8 x 16</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8 x 8</td>
<td>16 x 32</td>
<td>4 x 8</td>
<td></td>
</tr>
<tr>
<td>WJ 19-5/6</td>
<td>0</td>
<td>0</td>
<td>4 x 8</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16 x 16</td>
<td>16 x 16</td>
<td>4 x 8</td>
<td>16 x 32</td>
</tr>
<tr>
<td>WJ 19-7</td>
<td>0</td>
<td>0</td>
<td>8 x 16</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>8 x 8</td>
<td>0</td>
<td>0</td>
<td>32 x 32</td>
</tr>
</tbody>
</table>

Note. Results are for D.A.V. grid which produced smallest average pattern size for most artifact classes.

aPattern size given as m x m.

b"0" indicates too few artifacts were present to produce meaningful results in D.A.V.

"N" indicates D.A.V. not run for these classes.
Table 7. Optimum Block Size for Clustering Artifact Classes, by Site--North-South Grid

<table>
<thead>
<tr>
<th>Site</th>
<th>Unifacial-Steep</th>
<th>Utilized-Steep</th>
<th>Utilized-Narrow</th>
<th>Denticulates</th>
<th>Bifaces</th>
<th>Cores</th>
<th>Hammerstones</th>
<th>Primary Flakes</th>
<th>Secondary Flakes</th>
<th>Tertiary Flakes</th>
<th>Debris</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>B 9-6</td>
<td>8 x 8</td>
<td>0</td>
<td>8 x 8</td>
<td>0</td>
<td>4 x 8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8 x 16</td>
<td>16 x 16</td>
</tr>
<tr>
<td>B 14-1</td>
<td>8 x 8</td>
<td>4 x 8</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>4 x 8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>8 x 8</td>
</tr>
<tr>
<td>HS 11-1</td>
<td>16 x 16</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>16 x 16</td>
<td>16 x 16</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16 x 8</td>
<td>8 x 16</td>
</tr>
<tr>
<td>HS 11-2</td>
<td>16 x 32</td>
<td>16 x 32</td>
<td>16 x 32</td>
<td>16 x 32</td>
<td>16 x 32</td>
<td>16 x 32</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16 x 8</td>
<td>16 x 16</td>
</tr>
<tr>
<td>UGG 5-3</td>
<td>16 x 16</td>
<td>0</td>
<td>8 x 16</td>
<td>16 x 16</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>32 x 8</td>
<td>32 x 32</td>
</tr>
<tr>
<td>UGG 7-4</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>8 x 8</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>8 x 8</td>
<td>8 x 16</td>
<td>8 x 16</td>
</tr>
<tr>
<td>WJ 15-3</td>
<td>16 x 16</td>
<td>16 x 16</td>
<td>16 x 16</td>
<td>16 x 16</td>
<td>8 x 8</td>
<td>16 x 16</td>
<td>0</td>
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<td>16 x 16</td>
<td>16 x 16</td>
<td>16 x 16</td>
<td>16 x 16</td>
</tr>
<tr>
<td>WJ 17-3</td>
<td>0</td>
<td>0</td>
<td>4 x 8</td>
<td>16 x 16</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>8 x 8</td>
</tr>
<tr>
<td>WJ 19-1</td>
<td>0</td>
<td>0</td>
<td>8 x 8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>8 x 16</td>
<td>4 x 8</td>
</tr>
<tr>
<td>WJ 19-2</td>
<td>0</td>
<td>16 x 32</td>
<td>16 x 32</td>
<td>16 x 16</td>
<td>16 x 16</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>16 x 16</td>
</tr>
<tr>
<td>WJ 19-3</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>16 x 16</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>32 x 32</td>
<td>16 x 16</td>
<td>8 x 8</td>
<td>8 x 8</td>
<td>8 x 8</td>
</tr>
<tr>
<td>WJ 19-4</td>
<td>0</td>
<td>0</td>
<td>16 x 16</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8 x 16</td>
<td>16 x 16</td>
</tr>
<tr>
<td>WJ 19-5/6</td>
<td>0</td>
<td>0</td>
<td>8 x 8</td>
<td>16 x 32</td>
<td>16 x 16</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4 x 8</td>
<td>8 x 8</td>
</tr>
<tr>
<td>WJ 19-7</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8 x 16</td>
<td>0</td>
</tr>
</tbody>
</table>

Note. Results for D.A.V. with grid oriented north-south. Pattern size as m x m. "0" indicates too few artifacts present to produce meaningful pattern sizes. D.A.V.s not run for a class, or any other indicated by "N."
Figure 6. Dendrogram of Basketmaker study sites based on similarities in absolute pattern size of individual artifact classes.
In the second instance, similarities among sites are identified on the basis of relative pattern sizes between the lumped artifact classes within each site (Table 8). The manner of forming these combined classes was described in the chapter on Method. Three lumped classes are considered in comparing site structures: utilized lithic flakes, retouched lithic flakes, and manufacturing debris. Again, site groups were formed using complete linkage. Five groups of sites were formed in this manner (Figure 7).

<table>
<thead>
<tr>
<th>Site</th>
<th>Grid Oriented North-South Average Pattern Size (m x m)</th>
<th>Grid Oriented so that classes have a smaller average pattern size (m x m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Edge-Damaged Retouched Debitage</td>
<td>Edge-Damaged Retouched Debitage</td>
</tr>
<tr>
<td>B 9-6</td>
<td>8 x 8 8 x 8 16 x 16</td>
<td>8 x 8 8 x 8 16 x 16</td>
</tr>
<tr>
<td>B 14-1</td>
<td>8 x 8 8 x 8 8 x 8</td>
<td>4 x 8 8 x 8 8 x 8</td>
</tr>
<tr>
<td>HS 11-1</td>
<td>8 x 8 16 x 16 16 x 16</td>
<td>8 x 8 16 x 16 16 x 16</td>
</tr>
<tr>
<td>HS 11-2</td>
<td>16 x 32 16 x 32 16 x 32</td>
<td>16 x 16 16 x 16 16 x 16</td>
</tr>
<tr>
<td>UGG 5-3</td>
<td>8 x 16 16 x 16 32 x 32</td>
<td>- - -</td>
</tr>
<tr>
<td>UGG 7-4</td>
<td>8 x 8 8 x 8 16 x 16</td>
<td>8 x 8 8 x 8 16 x 16</td>
</tr>
<tr>
<td>WJ 15-3</td>
<td>32 x 32 0 16 x 32</td>
<td>4 x 8 8 x 16 8 x 16</td>
</tr>
<tr>
<td>WJ 17-3</td>
<td>4 x 8 8 x 8 16 x 16</td>
<td>4 x 8 8 x 8 16 x 16</td>
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<td>WJ 19-1</td>
<td>8 x 8 0 32 x 32</td>
<td>8 x 8 0 8 x 16</td>
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<td>WJ 19-2</td>
<td>16 x 32 16 x 16 16 x 16</td>
<td>4 x 8 16 x 32 4 x 8</td>
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<td>8 x 8 16 x 16 32 x 32</td>
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<td>WJ 19-4</td>
<td>16 x 16 0 8 x 16 16 x 32</td>
<td>8 x 16 8 x 16 8 x 8</td>
</tr>
<tr>
<td>WJ 19-5/6</td>
<td>8 x 8 - 8 x 8</td>
<td>4 x 8 8 x 8 16 x 16</td>
</tr>
<tr>
<td>WJ 19-7</td>
<td>8 x 8 0 8 x 16</td>
<td>8 x 16 0 8 x 8</td>
</tr>
</tbody>
</table>

Note. "-" indicates there was no match in average pattern size for artifact classes which comprise the "lumped" class, while "0" indicates the total was too small to produce pattern size using D.A.V.
Figure 7. Dendrogram of Basketmaker II study sites based on similarities in relative pattern sizes of lumped artifact classes.
An advantage to using combined artifact classes in forming site similarities, in addition to the claims made in the Method section, is that the source of variation among sites may be more easily identified with only three variables than with more variables. Use of combined artifact classes showed that for one group of sites, pattern sizes of "utilized flakes" is relatively smaller than either "retouched flakes" or "manufacturing debris." Another set of similarities among sites seems to be based on the opposite condition. That is, the pattern size of "utilized flakes" is as large, or larger than, either of the other combined artifact classes. Relative size of the manufacturing debris distribution also seems to separate sites. A pattern of manufacturing debris scattered over a much larger area than utilized or retouched flakes applies to most of the sites in Groups I and III (B 14-1, UGG 5-3, HS 11-1, UGG 7-4, WJ 15-3, WJ 17-3, WJ 19-1, WJ 19-3, and WJ 19-5/6). The pattern in which debris is the least scattered of any combined artifact class provides a reasonable separation for Group IV (WJ 19-4 and WJ 19-7). In a preceding section of the thesis I theorized that relatively long use of an unbounded area should allow dispersed refuse ("sheet trash") to accumulate across the site. Curated artifacts, since they would have been used repeatedly, and perhaps moved about the site, should be less abundant but more clustered in those areas where they do occur. This might apply to retouched or even utilized flakes. Obviously, the data are inadequate for testing hypotheses on duration of site use versus intensity of site use.

Using both types of information, optimum block size of each artifact class and relative pattern size of combined artifact classes in one similarity matrix, does not substantially alter the groups of sites (Figure 8). Again, groups are divided on average pattern size of artifact class distributions, although the nature of the differences is not identified. The results of this
Figure 8. Dendrogram of Basketmaker II study sites based on similarities in pattern size of individual artifact classes with dimensional analysis of variance grid oriented north-south then oriented to produce smallest average pattern size for most classes. (Note: this is a derivation of similarities shown in Figure 6 and Figure 7.)
similarity matrix are included because they suggest that only certain sites were changing groups, and these could be predicted.

Sites which were grouped as "habitation sites" based on judgmental analysis always are grouped with some other judgmentally defined "habitation site" in groupings based on average pattern size of artifact classes. However, this association of habitation sites in similarity matrices based on D.A.V. results is not an exclusive association; sites identified as "nonhabitation," by absence of a sufficient number of sensitive traits may be members of these same groups. Membership in Group I, based on relative pattern sizes or on absolute average pattern sizes of artifact class distributions includes sites from both sides of the habitation/nonhabitation dichotomy. The obvious question is whether similarities based on pattern sizes are more, or less, basic than that of presence or absence of sensitive traits.

**Synagraphic Mapping System Results**

Each map produced by SYMAP plots the distribution of one artifact class, or all artifact classes combined, on a site. Number of items is shown at each collecting location, surrounded by symbols representing the relative density of artifacts at that point in comparison to density of artifacts at other collecting locations. These density symbols ("gray levels") have been used to provide visual assessment of the meaning of "optimum block size" from D.A.V., and to create site maps which could be overlaid to provide a graphic counterpart to similarities among sites based on their distributional structures. It is worth stressing that SYMAP displays the existing data--it does not produce new data unless the program is allowed to extrapolate beyond existing points.
Synagraphic Mapping System: Conclusions on the Technique

SYMAP provided me with a sense of security, a feeling that I understood the nature of the data. And, SYMAP plots were instrumental in allowing me to consider the nature of site structure. However, SYMAP has several shortcomings all stemming from difficulty in using, or manipulating the program. Nonetheless, it is preferrable to other locally available, commercial mapping programs and all of these are much quicker than mapping by hand, and probably much more accurate insofar as they reduce boredom which tends to promote error.

For this paper, "site structure" is the internal arrangement of artifacts, structures, and features. Although ostensibly it is possible to derive this sort of information directly from field maps, it would be extremely difficult to do so in practice. Field maps show collecting locations rather than presence of individual artifacts. Obviously, not all artifact classes need to be present at a given location and densities of a given artifact class may vary greatly from one collecting location to the next. SYMAP was used to plot the distribution of individual artifact classes and relative densities of artifacts within each class. The ease with which the distributions could be mapped on the computer, compared to mapping by hand, made it possible to inspect distributions of several sites at one time. Plurality is the strongest point in favor of SYMAP.

As noted, SYMAP does have shortcomings, relating to user sensitivity. The standard SYMAP program (without the FLEXIN subroutine which allows an accomplished FORTRAN programmer to manipulate all parts of the SYMAP package) cannot add artifact counts from two collection locations immediately adjacent to one another. This tends to reduce the number of high density areas on the maps. Further, where the values from adjacent collecting locations are dissimilar, the area normally included with the higher density point is contracted
so that it does not overlap with the area of the lower density surrounding
the other collecting location. Adding the artifact counts of the two locations
would be preferable here since I think it is as likely that artifacts were
divided into two locations by bias in the collection method as it is that the
division recognizes real, spatial segregation in situations where collection
locations are very close together. Collection locations may have as much as
a 1.5 m radius, but the radii also may be much smaller. As previously noted,
Lipe and Matson had collected the data in a manner which would allow a super-
imposed grid for within-site spatial analyses. In some sites I suspect that
presence of a scarce artifact was sufficient to warrant splitting artifacts
among several locations. The inflexibility in the SYMAP program, in not allowing
entry of "IF" statements and thereby not allowing artifact counts to be added
mechanically within the program, is a failing that can lead to visually discon-
ccerting and perhaps, misleading maps.

Despite its apparent shortcomings, SYMAP is preferable to other canned
mapping programs since it displays densities as well as counts. To recapitulate,
the strong points of SYMAP are its speed and accuracy relative to mapping by
hand, and its flexibility relative to other mechanically produced graphics.
Its weaknesses are functions of a mechanical plotting program: it requires
a fairly regular spacing of collection locations since accuracy is based on
the nearest neighbor statistic, and all point locations have equal weight,
regardless of qualitative differences among them.

**Synagraphic Mapping System: Results**

Based on SYMAP maps of total artifact distributions, three basic shapes
of site distributions were identified: block, u-shaped distributions, and
scattered distributions (Figure 9). These distributions were identified on
a comparative basis--composite tracings of the SYMAP graphics were placed on a
Figure 9. "Typical" distribution shapes from Synagraphic Mapping System plots. West Johns 17-3 represents the "scattered distribution;" West Johns 19-5/6 represents the "u-shaped distribution;" Hardscrabble 11-2 represents the "block distribution."
table and arranged so that distributions which seemed most similar were set closest together. Highly-aggregated, or block-shaped distributions are best defined. In these, all artifact classes are clustered in one area. Although distributions of individual artifact classes were discontinuous, the total artifact distribution formed an unbroken whole. U-shaped distributions have one large cluster, often with most artifact classes concentrated in the "arms" of the U. Frequently, the long axis of these distributions was oriented north-south. The definitive characteristic is a large cluster having a definite kidney-bean or u-shape, rather than inclusion of all artifacts in one cluster. Scattered-distributions, as implied by the term, are multiple artifact groupings of which no single cluster can serve as a focal point.

Sites described as having block-shape distributions did not group together in the site similarities based on D.A.V., nor necessarily, did sites described by u-shape distributions. Block-shaped distributions do correspond partly to homogeneity of average pattern size of artifact classes within a site (not one of the characteristics used in the similarity matrices). Sites with the same average pattern size for all artifact classes tended to be composed of one artifact distribution, as is true for the distribution of HS 11-2. Average pattern size does not correspond either to total site size, or to a regular fraction of the total site size. Probably more important to the appearance of SYMAP, these sites (HS 11-2 and WJ 15-3) have a tremendous artifact density in a small area. This pattern is also true of HS 11-1 which I have characterized as having a u-shaped distribution although a block-shape distribution could be equally well argued.

U-shaped distributional structures, like block-shaped distributional structures, seem to have some relation to site size. In general, sites with u-shaped distributions have a small number of artifacts in a small area. Of the
small sites (B 9-6, WJ 19-2, WJ 19-4, WJ 19-5/6, WJ 19-7), only B 9-6 does not have a u-shaped distribution. There is no simple relation between u-shaped distributions and surficial evidence of pithouses or storage cists, nor is there a direct relationship between u-shaped distributions and similarities from D.A.V.

Plots of sites that I characterize as having scatter distributions (UGG 7-4, WJ 19-3, WJ 19-1, B 14-1, WJ 17-3, and UGG 5-3) share possible problems in definition of site boundaries, problems which only have become apparent in relatively large sites. In some instances, large sites seem to be aggregates of small sites and could have been studied more effectively by their component parts.

One example of the problem of aggregate large sites is seen where a u-shaped artifact distribution is only one part of the total distribution. For example, WJ 19-3 has several large artifact "clusters." One of these approaches the size and shape of the total distribution for WJ 19-5/6 (a site which WJ 19-3 grouped with, using similarities in average pattern size of artifact distributions). This u-shaped distribution in the south half of WJ 19-3 probably should have been separated from the north half of the site in all parts of my analysis. Had that been done, describing similarities or dissimilarities between the north fraction of WJ 19-3 and other (small?) sites may have been possible. Presently, I cannot determine what relations, if any, the north half of the WJ 19-3 distribution has to nonpithouse sites.

B 14-1 may have suffered a similar failure on determination of site boundaries. B 14-1 is a huge site with multiple artifact "clusters," all lacking site furnishings such as upright slabs or possible pithouse evidence and having no indication of multiple pattern sizes for any of the artifact classes. It seems most likely that this is a composite site, but SYMAP plots did not reveal unequivocal boundaries for subunits of B 14-1.
UGG 5-3 and UGG 7-4 cross quadrat boundaries and unlike HS 11-1, these sites were collected only to the edge of the quadrats. Oddly, this was not apparent to me until I reviewed SYMAP plots showing the highest densities of artifacts at the edges of the sites. This is, in part, a cautionary note. The number of collecting locations in an area is not always a good indicator of artifact density. There were relatively few collecting locations at the quadrat boundaries of either of these sites. The collecting locations at the boundaries had many artifacts, albeit no rare artifacts, such as bifaces. I do not have an immediate solution for the problem, nor am I certain that the results from UGG 5-3 and UGG 7-4 are less useful than results from B 14-1 and WJ 19-3.

SYMAP provided one other unexpected result concerning the scattered distribution of artifacts on a medium-sized site. Graphics of the strongly dissected WJ 17-3 show a negative correlation between site drainages and artifact concentrations. This raises the question of whether the artifact concentrations were bounded by the drainages during aboriginal use of the site. The question, of course, is not answerable here.

SYMAP proved more helpful in providing secondary description of distributional structures in sites previously grouped together by judgmental analysis and in verifying the optimum block sizes from D.A.V. as reflecting average pattern size in artifact distributions. In sites with pithouses or other slab features (except for HS 11-2 and WJ 19-1 for which structures are listed but not mapped), SYMAP showed that the pithouse, or a group of slab features, was located near the center of the major artifact distribution. Where other slab features in addition to a pithouse were described for the site (UGG 7-4, WJ 19-3, WJ 19-4, WJ 19-7), these were located north of the pithouse depression on the edge of the major artifact distribution. This is probably the most easily recognized success in my thesis.
As implied earlier, I believe that differences in pattern size within the artifact distributions of the study sites reflect underlying differences among the sites. I do not want to compare results from D.A.V. directly to the more traditional, judgmental identification of sites. That approach tends to question only the merits of the techniques and to adjudge only one to be accurate. I am more comfortable with plurality. Although neither differences in average pattern size of artifact distributions as described earlier, nor differences in the regular structuring of the distributions within sites, were fully addressed in this study, I suspect that they measure differences among sites as fundamental as the presence or absence of pithouses.
CHAPTER 7

CONCLUSIONS

Here I must confess that I know nothing whatever about true underlying reality, having never met any. There are many people who say they have, I know, but they've been luckier than I.

E. Abbey

Although it is no surprise that there are several types of Basketmaker II sites on Cedar Mesa, several bits of new information have been brought out during the construction of this thesis. There are Basketmaker II "villages" on Cedar Mesa. These have several types of sites, all of the sites containing some permanent structural features, evidenced by upright slabs. Only one of the sites within the "village" analyzed for this thesis is large, the others are quite small. The large site (WJ 19-3) like other large, Basketmaker II sites, appears to be an agglomerate of small sites. Small sites may be very different from each other, by presence or absence of slab features and scarce artifacts and by differences in sites' distributional structures. Sites with pithouses have a regular internal arrangement of the houses and other features in relation to the major concentrations of artifacts. Sites without such features do not have a regular arrangement that is as easily described. However, site descriptions do show the presence of specialization in the Basketmaker II sites.

West Johns 19 is one of the Basketmaker II "villages." Hardscrabble II may be another, although it is very small. Neither these nor any of the other quadrats that may be part of Cedar Mesa, Basketmaker II villages have sites even as clustered as the scattered pithouses in Eddy's Valantine Village
(Eddy 1961). Some sites in the Cedar Mesa "villages" are as much as 80 m apart, although the average distance between sites is probably much less than 50 m. In a review of the summary sheets of surveyed quadrats on Cedar Mesa, I found six quadrats, in addition to West Johns 19 and Hardscrabble 11, which also might be parts of Basketmaker II pithouse "villages." These are Bullet 10, Bullet 20, Bullet 21, North Road 6, North Road 2, and West Johns 9. None of these quadrats have more sites than West Johns 19, but Bullet 10 has as many and Bullet 21 includes six sites, only one fewer than West Johns 19.

Some synchronic relation among Basketmaker II sites in a single quadrat seems likely. In visual appearance, field maps and SYMAP plots of West Johns 19 sites tended to be more like each other than like sites in other quadrats. This was true also of Upper Grand Gulch 7-4 and Upper Grand Gulch 7-5 (a site which had to be dropped from consideration in the thesis because of my failure to acquire all the pertinent data on it, prior to analysis). If this similarity among sites in a quadrat is regular, it may indicate that further refinement of the variables used in comparing sites should be made prior to inter-quadrat comparisons, and that whole quadrat comparisons should be considered, as well as the comparisons of single sites. One of the sources of similarity within the West Johns 19 sites is presence of slab features in all sites (except WJ 19-5/6). On this evidence, it does not seem likely that all types of sites could be expected within "villages." "Village" sites seem to be pithouse or other "habitation" sites.

Nonhabitation sites should probably be searched for in quadrats where only one or two Basketmaker II sites are present. Not unexpectedly, the distributional structure of B 14-1 and WJ 17-3 is unlike the distributional structure of any site in West Johns 19. B 14-1, WJ 17-3, and B 9-6 are located at lower elevations than the pithouse sites, in blackbrush or canyon bottom vegetation
communities rather than pinyon-juniper. Locational differences between habitation and nonhabitation sites, which this implies, would not be in disagreement with Matson and Lipe's (1978) settlement pattern model.

The site type differences and concomitant locational differences have no correspondence to site size. Some sites in "villages" are large. Like other large Basketmaker II sites on Cedar Mesa, these appear to be conglomerates of small sites. Large sites seem to be conglomerates regardless of whether they represent habitations. As discussed in results of D.A.V. and SYMAP, both B 14-1 and WJ 19-3 appear to be composites of small sites which could have been more effectively analyzed in their component parts. In WJ 19-3, one of the tested sites, this would have meant separating a large cluster at the south end of the site which contains a pithouse and a set of storage rooms (with distributional affinities to WJ 19-5/6) from the northern section of the site with its single slab feature and possible pithouse. Analysis by component parts would have meant separating B 14-1 into as many as three sites, located east to west along the ridge on which the whole of B 14-1 is situated. Inclusion of B 14-1 in the study sample was fortuitous. It shows that large sites do not always have pithouse habitations, or even an appearance of permanence, while structurally they do have the appearance of agglomeration. HS 11-1 and HS 11-2 may represent different aspects of this agglomeration. Both have a considerable density of artifacts in a small area, and each may represent either a single, intense occupation or a sequence of occupations. In terms used in my Introduction, large sites are aggregates of small sites, but are qualitatively different from at least some of the small sites. Likewise, there are several structurally different kinds of small sites.

Small sites are distinctive. In fact, they proved to be less problematic than I had anticipated. Where all the artifacts from a site were collected, it
is apparent that these small sites may be habitations with pithouses (visible or inferred) or they may be special use sites. Small pithouse sites include WJ 19-1, WJ 19-7, and WJ 19-4. WJ 19-1 is identified as a pithouse site in the field notes. WJ 19-4 is inferred to be a pithouse site on the basis of its similarities to WJ 19-7 in average pattern size of individual artifact classes and especially of relative pattern sizes of combined artifact class distributions. Further, the plot of WJ 19-4 distributional structure is very similar to that of WJ 19-7 and also of WJ 19-5/6. Characterization of these sites is no more problematic than characterization of the large sites using pattern size of artifact distributions.

Pithouse sites and sites that I think may have been regularly occupied camps because of possessing upright slabs or because of similarities in their distributional character to other, already identified, habitation sites have a regular distributional structure that transcends differences in the immediate, natural surroundings of the site. That is, a regular internal arrangement of artifacts and features that occurs without relation to site exposure, elevational differences within the site, or naturally defined site boundaries, is found in well-defined pithouse sites. These sites are described by one major artifact concentration. The evidence for a pithouse, when present, is near the center of this artifact concentration. The location of the major trash deposits in the site varies, although these are always near the pithouse remains when pithouse location is known. Trash deposits are claimed for deposits of ashy soil, or dense concentrations of manufacturing debris. Storage features and single, slab-lined hearths are located north of the pithouse, removed from it by at least 10 m, and characteristically are north of the major artifact concentrations, also. I would characterize this arrangement of structures and features as linear. That is, remains of storage features are located near
the northwest edge of the site (as defined by the extent of the artifact
distribution), and evidence for the pithouse near the center of the major
accumulation of artifacts (trash?). This arrangement foreshadows some of the
internal structural characteristics, namely the northwest-southeast alignment,
generally associated with later Anasazi sites.

Small sites without structures do not have this regular internal arrange-
ment, at least not one that is so easily defined. B 9-6 probably is one example
of a site that may have been for special use. It appears to include a burial
(although the presence of "midden" begs the question). B 9-6 shows little
or no similarity to other sites in absolute or relative pattern sizes of artifact
class distributions derived from D.A.V., WJ 17-3 is another of the small non-
habitation sites. This site has no features. Its entire artifact inventory
consists of utilized flake tools and manufacturing debris (from tool manufacture?).
WJ 17-3 is comparable to only one other site, B 14-1, in terms of average pattern
size of individual artifact class distributions. I think WJ 17-3 is most
economically characterized (on comparison with a "nonhabitation" site and its
artifact classes) as a specialized site, perhaps a processing site.

From the discussion of pithouse sites and nonhabitation sites it may
be seen that size of the artifact population did not make sites either problematic
or easily identified. Some small sites were easy to classify and some large
ones were difficult. For example, WJ 19-4, WJ 15-3, and UGG 5-3 are difficult
to characterize based on traditional "sensitive" traits and artifact counts.
WJ 19-4 is a very small site, WJ 15-3 is large, while UGG 5-3 is a medium-
sized site. UGG 5-3 is a dispersed site--its 422 artifacts are scattered over
an 8500 sq. m area--covering an area nearly as large as B 14-1. Undoubtedly,
it should have been subdivided prior to analysis, but this process was compli-
cated by an artifact collection aborted at the quadrat boundaries. Its group
assignment, using D.A.V. average pattern sizes, is not firm (cf. Figures 6-8). Although UGG 5-3 could not be classified successfully by D.A.V., based on the successes of D.A.V. in keeping all the habitation sites together, I feel reasonably confident in making assignments of WJ 19-4 and (possibly) WJ 15-3 to habitation type sites, although neither has sufficient "sensitive" traits to place them with those groups by a judgmental analysis. In physiographic terms WJ 19-4, is at the same elevation as other "habitation sites" in the same quadrat. WJ 15-3 is more problematic. It is located at a much lower elevation than other habitations. In fact, it is located in a canyon bottom. Nonetheless, plots of the total artifact distributions tend to confirm the similarity of these sites to groups which contain habitation sites. In terms of SYMAP plots, WJ 15-3 is very like HS 11-2, and WJ 19-4 is very like WJ 19-7. Evidence from D.A.V. and SYMAP do not present a circular argument; D.A.V. shows pattern size, while SYMAP shows pattern placement.

Sites which appear as "habitations," based on traditional traits always are distinct and are classed with other "habitations" on the basis of dimensional analysis of variance. Frequently, these sites show some cohesiveness in location of artifact groups as well as in pattern size. I would like to suggest that u-shape distributions are generally indicative of pithouse sites. It is possible, but far less than certain. Using D.A.V., sites with u-shaped distributions were grouped with sites earlier classified as habitations, but sites with u-shaped distributions (e.g., WJ 19-5/6) have not been test excavated to establish the presence of pithouses. Regardless, it is only a one-way correlation; pithouse sites do not necessarily have u-shaped artifact distributions. More certain is that scatter distributions indicate a poor selection of site boundaries, those situations in which I should have subdivided the sites prior to analysis. Highly aggregated (block-shape) distributions are problematic. They may indicate long-term occupation or repeated occupation of the same site.
The sample should be enlarged to find the limit on the number of site
distributional structures in the Cedar Mesa Basketmaker II sites, an asymptote
where more sites could be added to analysis without adding more descriptive
site types. At present, lacking the full range of distributional structures
for Cedar Mesa BM II sites, my conclusions are short of any functional inferences.

However, the major problems of my thesis have been addressed with
moderate success. There are several site types among the Basketmaker II on
Cedar Mesa. "Habitations" include small pithouse sites, small sites with permanent
slab-lined features which do not seem to include pithouses, and large pithouse
sites which may have been formed as an aggregation of small sites. All three
of these site types seem to have a regular internal arrangement in which pit-
houses, when present, were a central aspect, and in which the major artifact
centers occur south of hearth or cist features. The sites which I have
classed as nonhabitations all seem to lack a central, or focal, point. Because
so few of the study sites are clearly nonhabitations, dividing these sites
into subtypes is impractical. It is possible to say that not all are burial
sites, and like habitation sites, the larger sites may be aggregates of smaller
sites.
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APPENDIX A

DEFINITIONS OF ARTIFACT CLASSES
Table 9. Definitions of Cedar Mesa Artifact Categories  
(from Sneed and Matson 1972)

<table>
<thead>
<tr>
<th>Class Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unifacial Tool</td>
<td></td>
</tr>
<tr>
<td><strong>Unifacial Flake--steep angle edge</strong></td>
<td>A flake tool with steep retouch (ca. 45°-90°) on the ventral and/or dorsal face of the flake, but not bifacial.</td>
</tr>
<tr>
<td><strong>Unifacial Flake--narrow angle edge</strong></td>
<td>A flake tool with narrow (acute) retouch (ca. 5°-45°) on the ventral and/or dorsal face of the flake, but not bifacial.</td>
</tr>
<tr>
<td><strong>Utilized Flake--steep angle</strong></td>
<td>A flake which exhibits use marks (i.e., random, minute flake scars, use polish, etc.) on a steep (ca. 45°-90°) edge on the ventral and/or dorsal face of the flake.</td>
</tr>
<tr>
<td><strong>Utilized Flake--narrow angle</strong></td>
<td>A flake which exhibits use marks (i.e., use polish; random, minute flake scars etc.) on a narrow (acute) (ca. 5°-45°) edge on the ventral and/or dorsal face of the flake.</td>
</tr>
<tr>
<td>Resharpening or Thinning Flakes</td>
<td>Small, thin, expanded flakes which result from thinning biface preforms or resharpening finished bifaces. These flakes exhibit flake scars from the original biface on the dorsal face of the flake and the platform lip on the ventral side is often very pronounced. The dorsal edge of the platform is often ground and/or polished either from platform preparation or use.</td>
</tr>
<tr>
<td>Bifacially Retouched or Cutting Flakes</td>
<td>Flakes with steep (45°-90°) and/or narrow (5°-45°) edge angles which exhibit bifacial retouch along a lateral edge(s).</td>
</tr>
<tr>
<td>Graver</td>
<td>A flake implement made by pressure retouch to have one or more functional points used for engraving soft material. The retouched projection is usually short (i.e., less than 0.5 cm.) in relation to the length and width of the flake. The tip of the graver projection is often polished by wear.</td>
</tr>
<tr>
<td>Snapped Denticulates (Don's Saws)</td>
<td>Fairly thin flakes which exhibit a radial series of notches separated by prominences resembling teeth on a saw. The notches are produced by snapping them from the flake edge. The prominences are sometimes worn.</td>
</tr>
<tr>
<td>Retouched Denticulates</td>
<td>Flakes which display a radial series of notches separated by prominences resembling saw teeth. The notches are produced by pressure retouch forming a concave edge(s) separated by teeth. A flake with two notches separated by a projection will be classified as a graver. The teeth are sometimes worn by use.</td>
</tr>
<tr>
<td>Class Name</td>
<td>Definition</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Unifacial Tools—Continued</strong></td>
<td></td>
</tr>
<tr>
<td>Core Scrapers</td>
<td>These are large scrapers produced when a core is exhausted and is modified by a series of steep retouch flakes to produce a scraping edge. One must be careful to distinguish between retouch to produce a scraper and flake scars produced by core preparation.</td>
</tr>
<tr>
<td><strong>Bifacial Tools</strong></td>
<td></td>
</tr>
<tr>
<td>Biface Fragments</td>
<td>Fragments, generally midsections, of bifaces (i.e., artifacts bearing flake scars on both faces) which cannot be put into a more specific class.</td>
</tr>
<tr>
<td>Large Point Fragments</td>
<td>Projectile point fragments with the base truncated (i.e., point tips) from large points (i.e., greater than 3.5 cm long and 2.0 cm wide).</td>
</tr>
<tr>
<td>Small Point Fragments</td>
<td>Projectile point fragments with the base truncated (i.e., point tips) from small points (i.e., less than 3.5 cm long and 2.0 cm wide).</td>
</tr>
<tr>
<td>Jumbo Side and Corner Notched Points</td>
<td>Projectile points greater than 6.0 cm long and 3.0 cm wide. Can be side or corner notched with any style of base.</td>
</tr>
<tr>
<td>Large Corner Notched—Straight Base</td>
<td>Corner notched with an expanding stem and a base that describes a straight line perpendicular to the long axis of the point which is greater than 3.5 cm long and 2.0 cm wide.</td>
</tr>
<tr>
<td>Large Corner Notched—Round Base</td>
<td>Corner notched with an expanding stem and a base that describes an excursive line perpendicular to the long axis of the point which is greater than 3.5 cm long and 2.0 cm wide.</td>
</tr>
<tr>
<td>Large Side Notched</td>
<td>Side notched point with an expanding stem and generally a straight base (but can be slightly excursive) greater than 3.5 cm long and 2.0 cm wide.</td>
</tr>
<tr>
<td>Small Corner Notched—Barbed</td>
<td>Small point, less than 3.5 cm long and 2.0 cm wide, with deep corner notches which produce long pronounced barbs, a contracting or straight stem, and generally narrow, straight or excursive bases.</td>
</tr>
<tr>
<td>Small Corner Notched—Broad Based</td>
<td>Small point, less than 3.5 cm long and 2.0 cm wide, with moderately deep corner notches, slight barbs, an expanding stem, and broad straight, excursive, or incurvate bases.</td>
</tr>
<tr>
<td>Small Triangular Points</td>
<td>Small points, less than 3.5 cm long and 2.0 cm wide, with triangulate outline, no notches, usually straight edges, and generally straight or incurvate bases.</td>
</tr>
</tbody>
</table>
### Table 9.--(Continued)

<table>
<thead>
<tr>
<th>Class Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desert Side Notched Points</td>
<td>Small point, less than 3.5 cm long and 2.0 cm wide, with narrow, deep side notches placed relatively high-up the point from the base, producing a wide stem and usually a straight or excursive base.</td>
</tr>
<tr>
<td>Small Shallow Side Notched or Stemmed</td>
<td>Small point, less than 3.5 cm long and 2.0 cm wide, with wide shallow side notches, expanding stem, and generally broad excursive or straight base.</td>
</tr>
<tr>
<td>Large &quot;Knives&quot; and Fragments</td>
<td>Complete or fragmentary bifacial artifacts which do not exhibit the attributes of projectile points (e.g., tertiary retouch, notching, base preparation, etc.) and greater than 5.0 cm long and 3.0 cm wide. Some of these artifacts have been modified for hafting (i.e., they have a shaped and edge-ground basal stem). Note that some of these bifaces are probably preforms for large projectile points.</td>
</tr>
<tr>
<td>Small &quot;Knives&quot; and Fragments</td>
<td>Complete or fragmentary bifacial artifacts lacking projectile point attributes and less than 5.0 cm long and 3.0 cm wide. Some may be modified for hafting and some may be preforms.</td>
</tr>
<tr>
<td>T or Flanged Drills</td>
<td>These have drill shafts (formed by bifacial or unifacial pressure flaking) attached perpendicular to a basal flange forming a more-or-less T shaped outline. May include drills with long shafts attached to a large flange base or a shorter shaft attached to a smaller base. Flanges may be unmodified flakes or modified tear-drop shaped bases.</td>
</tr>
<tr>
<td>Other or Plan Shaft Drills</td>
<td>Any other kinds of drills with no flange base, usually parallel-sided, and bifacially flaked shafts.</td>
</tr>
<tr>
<td>Drill Fragments</td>
<td>Fragments of drill shafts, probably midsections or tips, which cannot be placed in any of the other drill classes.</td>
</tr>
</tbody>
</table>

#### Large Percussion or Ground Stone Artifacts

<table>
<thead>
<tr>
<th>Class Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irregular (Spherical) Hammerstone</td>
<td>NODULES OF RAW LITHIC MATERIAL OR UTILIZED CORES WHICH HAVE EXTENSIVE EDGE BATTERING DUE TO USE BY POUNDING OR PECKING.</td>
</tr>
<tr>
<td>Pebble Hammerstone</td>
<td>A ROUND TO FLAT, GENERALLY OVAL STEAM-WORN COBBLE WHICH HAS BATTERED WEAR ON ONE OR BOTH ENDS, AND OFTEN AROUND THE SIDES.</td>
</tr>
</tbody>
</table>
Table 9.--(Continued)

<table>
<thead>
<tr>
<th>Class Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Percussion or Ground Stone Artifacts--Continued</td>
<td></td>
</tr>
<tr>
<td>Hammerstone Fragments</td>
<td>Large, irregular-shaped flakes which have broken off a hammerstone during use. Extensive evidence of battered use should be preserved and care must be taken to not confuse these with fragments of edge ground cores.</td>
</tr>
<tr>
<td>Choppers</td>
<td>Large, heavy tools made with large, primary flakes or cobbles or cores with unifacial or bifacial percussion on one of more edges. Wear is indicated by &quot;wing&quot; flakes which are short, linear fractures paralleling the plane of the chopping edge.</td>
</tr>
<tr>
<td>Cores</td>
<td>The end product of the removal of flakes from a nodule of raw material or stream cobbles or large primary flakes. Often spherical or ovoid shaped because flakes have been removed from most of the surface. Others can be discoidal, bifacial cores, bi-directional cores, or bi-conical cores.</td>
</tr>
<tr>
<td>2 Hand Manos</td>
<td>A large, rectangular or oval shaped ground stone usually with straight leading edge and rounded corners. Cross-section varies from a rectangular block in the mano blank to an airfoil-like shape in the worn-out mano. The grinding face is convex. Probably held with 2 hands and used to grind seeds.</td>
</tr>
<tr>
<td>1 Hand Manos</td>
<td>Flattened, oval to rectangular either made by moderately modifying a stream-worn cobble or by extensive shaping by pecking and grinding. Oval cross-section with convex grinding surfaces. Probably held with 1 hand and used to grind seeds.</td>
</tr>
<tr>
<td>Milling Stones or Metates</td>
<td>Usually ovoid or rectangular sandstone slabs. Sometimes the slab has been intentionally shaped by flaking the slab edges. Milling surface is trough or basin shaped varying from slightly convex pecked area to a deep concave worn surface. Both 2 hand and 1 hand manos could have been used on the milling surface, depending on its size and shape. Used for seed grinding.</td>
</tr>
<tr>
<td>Ground Stone Fragments</td>
<td>Those fragments of ground stone which will not fit into one of the above classes.</td>
</tr>
<tr>
<td></td>
<td>Miscellaneous Artifacts</td>
</tr>
<tr>
<td>Gizzard Stones</td>
<td>Highly ground and polished, lusterous pebbles or chips, under 5 cm diameter, which were presumably from turkey gizzard.</td>
</tr>
</tbody>
</table>
Table 9.--(Continued)

<table>
<thead>
<tr>
<th>Class Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Miscellaneous Artifacts--Continued</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>Those rare artifacts which do not fit into any of the above 37 classes. For example, pendants or beads. Items should be listed with a descriptive name in the provided blank spaces on the tabulation sheets and counted.</td>
</tr>
</tbody>
</table>

**Identifiable Debitage**

<table>
<thead>
<tr>
<th>Primary Flakes</th>
<th>Primary flakes are the first flakes struck off of the raw material to prepare a core nucleus. The flakes are often termed decortication flakes and two kinds of such flakes can be distinguished:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Primary decortication flakes have cortex material covering the entire outer face of the flake.</td>
</tr>
<tr>
<td></td>
<td>2. Secondary decortication flakes have an outer face covered only partially with cortex.</td>
</tr>
<tr>
<td></td>
<td>Both subclasses were probably produced by percussion flaking and for our purposes we will lump both together.</td>
</tr>
<tr>
<td>Secondary Flakes</td>
<td>These are large (generally greater than 1.0 cm wide and 1.5 cm long) expanding, contracting, or blade-like flakes which were removed from cores by percussion. These are sometimes called blank flakes because they were often used as or modified into tools. The rejects which we are classifying here were apparently not suitable for tool use or probably supply of flake flanks exceeded demand.</td>
</tr>
<tr>
<td>Tertiary Flakes</td>
<td>These are small (generally less than 1.0 cm wide and 1.5 cm long) expanding, contracting, or blade-like flakes which were probably removed by pressure or finely-controlled percussion from flake blanks or bifaces. These flakes generally have diminutive platforms and bulbs of applied force. Tertiary flakes were seldom used or modified into tools.</td>
</tr>
</tbody>
</table>

**Unidentifiable Debitage**

<p>| Lithic Debris | These are fragments of lithic debitage which exhibit no identifiable critical technological attributes and no indication of use or modification as tools, e.g., core fragments, flake fragments. |</p>
<table>
<thead>
<tr>
<th>Class Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unidentifiable Debitage--Continued</td>
<td></td>
</tr>
<tr>
<td>Unmodified Raw Material</td>
<td>These are nodules or cobbles or chunks of lithic raw material which</td>
</tr>
<tr>
<td></td>
<td>has not been modified by lithic stone-working techniques.</td>
</tr>
</tbody>
</table>
Table 10. Comparison Cedar Mesa Artifact Classes with Thesis Classes

<table>
<thead>
<tr>
<th>Cedar Mesa Classes</th>
<th>Thesis Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1 (Unifacial Flake--steep angle edge)</td>
<td></td>
</tr>
<tr>
<td>Class 2 (Unifacial Flake--narrow angle edge)</td>
<td></td>
</tr>
<tr>
<td>Class 3 (Utilized Flake--steep angle)</td>
<td>SAME</td>
</tr>
<tr>
<td>Class 4 (Utilized Flake--narrow angle)</td>
<td></td>
</tr>
<tr>
<td>Resharpening or thinning flakes</td>
<td></td>
</tr>
<tr>
<td>Graver</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DENTICULATES</td>
</tr>
<tr>
<td>Snapped denticulates</td>
<td></td>
</tr>
<tr>
<td>Retouched denticulates</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SAME</td>
</tr>
<tr>
<td>Core Scrapers</td>
<td></td>
</tr>
<tr>
<td>Bifacially retouched or cutting flakes</td>
<td></td>
</tr>
<tr>
<td>Biface fragments</td>
<td></td>
</tr>
<tr>
<td>Large point fragments</td>
<td></td>
</tr>
<tr>
<td>Small point fragments</td>
<td></td>
</tr>
<tr>
<td>Jumbo side and corner notched points</td>
<td></td>
</tr>
<tr>
<td>Large corner notched-straight base points</td>
<td>BIFACES</td>
</tr>
<tr>
<td>Large corner notched-round base points</td>
<td></td>
</tr>
<tr>
<td>Large side notched points</td>
<td></td>
</tr>
<tr>
<td>Small corner notched-barbed points</td>
<td></td>
</tr>
<tr>
<td>Small corner notched-broad base points</td>
<td></td>
</tr>
<tr>
<td>Small triangular points</td>
<td></td>
</tr>
<tr>
<td>Desert Side notched points</td>
<td></td>
</tr>
<tr>
<td>Small shallow side notched or stemmed points</td>
<td></td>
</tr>
<tr>
<td>Large &quot;knives&quot; and fragments</td>
<td></td>
</tr>
<tr>
<td>Small &quot;knives&quot; and fragments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DRILLS</td>
</tr>
<tr>
<td>T or flanged drills</td>
<td></td>
</tr>
<tr>
<td>Other or plain shaft drills</td>
<td></td>
</tr>
<tr>
<td>Drill fragments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HAMMERSTONES</td>
</tr>
<tr>
<td>Irregular (spherical) hammerstone</td>
<td></td>
</tr>
<tr>
<td>Pebble hammerstone</td>
<td></td>
</tr>
<tr>
<td>Hammerstone fragments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SAME</td>
</tr>
<tr>
<td>Choppers</td>
<td></td>
</tr>
<tr>
<td>Cores</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MANOS</td>
</tr>
<tr>
<td>Two-hand manos</td>
<td></td>
</tr>
<tr>
<td>One-hand manos</td>
<td></td>
</tr>
<tr>
<td>Cedar Mesa Classes</td>
<td>Thesis Classes</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Milling stones or metates</td>
<td>SAME</td>
</tr>
<tr>
<td>Ground stone fragments</td>
<td></td>
</tr>
<tr>
<td>Gizzard Stones</td>
<td>MISCELLANEOUS</td>
</tr>
<tr>
<td>Other miscellaneous artifacts</td>
<td></td>
</tr>
<tr>
<td>Primary flakes</td>
<td></td>
</tr>
<tr>
<td>Secondary flakes</td>
<td>SAME</td>
</tr>
<tr>
<td>Tertiary flakes</td>
<td></td>
</tr>
<tr>
<td>Lithic debris (unidentifiable)</td>
<td></td>
</tr>
<tr>
<td>Unmodified raw material</td>
<td></td>
</tr>
<tr>
<td>Thesis Classes</td>
<td>Gross Lumps&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Cores</td>
<td>MANUFACTURING DEBITAGE</td>
</tr>
<tr>
<td>Primary flakes</td>
<td></td>
</tr>
<tr>
<td>Secondary flakes</td>
<td></td>
</tr>
<tr>
<td>Tertiary flakes</td>
<td></td>
</tr>
<tr>
<td>Unmodified raw materials</td>
<td></td>
</tr>
<tr>
<td>Class 1</td>
<td>RETOUCHED LITHICS</td>
</tr>
<tr>
<td>Class 2</td>
<td></td>
</tr>
<tr>
<td>Thinning flakes</td>
<td></td>
</tr>
<tr>
<td>Bifaces&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Class 3</td>
<td>UTILIZED OR EDGE-DAMAGED LITHICS</td>
</tr>
<tr>
<td>Class 4</td>
<td></td>
</tr>
<tr>
<td>Denticulates</td>
<td></td>
</tr>
<tr>
<td>Bifaces&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Gross lumps were only used where thesis classes comprising the groups showed exactly the same average pattern size. Many of the sites have not been characterized by the relative sizes of grossly lumped artifact categories.

<sup>b</sup>These obviously change groups dependent on individual attributes.
APPENDIX B

DIMENSIONAL ANALYSIS OF VARIANCE:
PROGRAM AND NOTES
Dimensional Analysis of Variance Program

by Tim Kohler

$JOB
C DIMENSIONAL ANALYSIS OF VARIANCE
C ITOT IS THE TOTAL NUMBER OF GRID UNITS
C NC IS THE TOTAL NUMBER OF ARTIFACT CLASSES
C K IS COMPUTED TO BE THE NUMBER OF AGGREGATIONS NECESSARY
C ON THE FIRST DATA CARD ENTER ITOT AND NC AS INTEGERS
C USING COLUMNS 1 - 3 AND 4 - 6, RESPECTIVELY, RIGHT-ADJUSTED.
C ON SUBSEQUENT DATA CARDS ENTER THE RAW FREQUENCIES FOR EACH
C ARTIFACT CLASS AS INTEGERS TWO COLUMNS WIDE
C USING (NC * 2) TOTAL COLUMNS ON EACH INPUT IMAGE.
C SEE WHALLON 1973 AND PIELOU 1969 FOR FURTHER DETAILS.
C
REAL SUMSQ, DJ
INTEGER C(7,64), ISUM, ISQ, ITOT, NC, K, NJ, N
READ(5,2) ITOT, NC
2 FORMAT(2I3)
K=1
NJ=ITOT
3 IF (NJ .LE. 1) GO TO 4
NJ=NJ/2
K=K+1
GO TO 3
4 CONTINUE
WRITE(6,1) ITOT, NC, K
1 FORMAT(/,' NUMBER OF GRID UNITS IN ANALYSIS = ',I3,' (ITOT)/
2 ' NUMBER OF ARTIFACT CATEGORIES IN ANALYSIS = ',I2,' (NC)/
3 ' ITERATIONS NECESSARY TO AGGREGATE ALL GRID UNITS = ',I3,' (K)/
4 ' THESE ARE THE DATA:,'
READ(5,9)
WRITE(6,10)
9 FORMAT(7I2)
10 FORMAT(7(1X,I2))
C
THAT ROUTINE DEFINED C AS AN INTEGER MATRIX WITH THE COUNT
C FOR EACH ARTIFACT CLASS STORED ALONG THE COLUMNS WHERE EACH
C NEW ROW REPRESENTS A PROVENIENCE UNIT, AND RETURNED THE DATA.
C IT IS VERY IMPORTANT TO ENTER THESE PROVENIENCE UNITS
C IN THE ORDER IN WHICH THEY ARE TO BE AGGREGATED; THUS,
C UNITS TO BE LUMPED TOGETHER IN THE FIRST AGGREGATION MUST BE
C ADJACENT; PAIRS WHICH WILL BE CONSIDERED TOGETHER
C IN THE SECOND AGGREGATION MUST BE ADJACENT, AND SO FORTH.
C
N=1
DO 100 KK=1,K
C OUTERMOST LOOP STEPS THROUGH ITERATIVE
C AGGREGATION OF GRID UNITS
C
WRITE(6,15) KK, ITOT/N
15 FORMAT(/,' ITERATION ',I3,' USING ',I3,' GRID UNITS.' )
NARTC=0
20 IF (NARTC .EQ. NC) GO TO 90
SECOND LOOP STEPS THROUGH ARTIFACT CLASSES
AT EACH LEVEL OF GRID UNIT AGGREGATION

NARTC=NARTC+1
WRITE(6,25)NARTC
25 FORMAT(5X,'ARTIFACT CLASS',I2,':')
ISUM=0
ISQ=0
ISUMSQ=0
II=ITOT/N
LL=0
DO 60 I=1,II

THIRD LOOP SUMS AND SQUARES
COUNTS FOR EACH ARTIFACT CLASS

DO 30 L=1,N

INNERMOST LOOP ADDS ARTIFACT COUNTS FROM
ADJACENT SQUARES TOGETHER AFTER THE FIRST
AGGREGATION OF GRID UNITS

LL=LL+1
ISUM=ISUM+C(NARTC,LL)
30 CONTINUE
ISQ=ISUM**2
ISUMSQ=ISUMSQ+ISQ
ISUM=0
60 CONTINUE
SUMSQ=FLOAT(ISUMSQ/N)
WRITE(6,55)N,SUMSQ,N,ITOT/N
55 FORMAT(10X,'S(',I3,') = ',F7.1,5X,'D(',I3,') = ',I3)
GO TO 20
90 CONTINUE
N=N*2
100 CONTINUE
STOP
END
$DATA
64 7
Notes on the Computer Program

Lines 2, 16, 17 must be modified for each site, when grid size or total number of artifact classes analysed varies. The program, as it appears here, does computations on 7 artifact classes in a grid of 64 units. When grids of more than 256 units are used and artifact classes have many members, all "format" statements need to be modified to allow for larger values of the degrees of freedom (D) and sum of squares (S).

The program produces only D and S. Variance, or mean-square, is derived by subtracting the S at the next larger block size from the S of interest, and dividing the difference by the degrees of freedom.

Since initial grid units, in this thesis, are 4 x 4 m, "iterations" indicate block sizes which are multiples of four (Table 12, Figure 10).

Table 12. Block Sizes Used in the Dimensional Analysis of Variance

<table>
<thead>
<tr>
<th>Iteration</th>
<th>Grid unit size (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4 x 4</td>
</tr>
<tr>
<td>2</td>
<td>4 x 8</td>
</tr>
<tr>
<td>3</td>
<td>8 x 8</td>
</tr>
<tr>
<td>4</td>
<td>8 x 16</td>
</tr>
<tr>
<td>5</td>
<td>16 x 16</td>
</tr>
<tr>
<td>6</td>
<td>16 x 32</td>
</tr>
<tr>
<td>7</td>
<td>32 x 32</td>
</tr>
<tr>
<td>8</td>
<td>32 x 64</td>
</tr>
<tr>
<td>9</td>
<td>64 x 64</td>
</tr>
</tbody>
</table>

Similarity Coefficient

Similarity is set equal to the number of matches in block size of artifact class distributions in the two sites of interest, divided by the number of artifact classes analysed for both sites.
**ENTRY ORDER**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>4</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>13</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>12</td>
<td>15</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

**RELATIVE BLOCK SIZES**

Figure 10. Plot showing manner in which grid units are grouped in dimensional analysis of variance. Upper plot shows entry order for grid of four units by four units. Lower plot (after Whallon 1973) shows relative block size. Only four iterations would be necessary to the plot shown with 16 grid units.
APPENDIX C

EXAMPLES OF PLOTS FROM SYNAGRAPHIC MAPPING SYSTEM
AND EXAMPLES OF MEAN-SQUARE TO BLOCK SIZE RATIOS FROM TWO STUDY SITES
Figure 11. Graphs of mean-square ratio to block size for WJ 19-4, north-south grid. (Two analyses run, grid for second analysis, "---", is shifted slightly from first analysis.)
Figure 12. Graphs of mean-square ratio to block size for WJ 19-4, east-west grid. (Two analyses run; grid for second analysis, "-.-", is shifted slightly from that of first analysis.)
Figure 13. WJ 19-4, plot of collection units.
Figure 14. WJ 19-4, plot of secondary flake distribution.
Figure 15. WJ 19-4, plot of tertiary flake distribution.
Figure 16. WJ 19-4, plot of total artifact distribution.
Figure 17. Graphs of mean-square ratio to block size for WJ 19-7, north-south grid. (Two analyses run; grid for second analysis, "--", is shifted slightly from that of first analysis.)
WEST JOHNS 19-7
D.A.V. SUMMARIES
GRID ORIENTED EAST-WEST

UTILIZED FLAKES

n=10

M-S RATIO

1.0

0.8

0.6

0.4

0.2

0.0

ITERATION

1 2 3 4 5 6 7 8

TOTALS

n=48

M-S RATIO

6.0

5.0

4.0

3.0

2.0

1.0

0.0

ITERATION

1 2 3 4 5 6 7 8

SECONDARY FLAKES

n=15

M-S RATIO

1.0

0.8

0.6

0.4

0.2

0.0

ITERATION

1 2 3 4 5 6 7 8

Figure 18. Graphs of mean-square ratio to block size for WJ 19-7, east-west grid. (Two analyses run; grid for second analysis, "--", is shifted slightly from that of first analysis.)
Figure 19. WJ 19-7, plot of collection units.
Figure 20. WJ 19-7, plot of secondary flake distribution.
Figure 21. WJ 19-7, plot of total artifact distribution.